P.V. NARSIMHA RAO TELANGANA VETERINARY UNIVERSITY

RAJENDRANAGAR, HYDERABAD - 500 030.

Manual On

Skill Development in Livestock Production

(Developed under ICAR-NASF Project -
"Development of e-Extension Modules for Capacity Building in Livestock Farming")



SURGERY AND RADIOLOGY

MEDICINE

GYNAECOLOGY

PATHOLOGY, PARASITOLOGY MICROBIOLOGY AND BIO-CHEMISTRY

GENETICS AND BREEDING

LIVESTOCK PRODUCTION AND MANAGEMENT

POULTRY

NUTRITION

FODDER DEVELOPMENT

LIVESTOCK PRODUCTS TECHNOLOGY

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FOREWORD



It gives me immense pleasure to introduce this timely and essential manual on "Skill Development in Livestock Production". In an era defined by the need for sustainable livestock development and nutritional security, the role of skilled veterinarians has never been more critical.

This University is firmly committed to advanced veterinary education and development of skilled veterinarians that directly addresses real-world challenges in livestock production. the manual will be a ready recknor for delivering effective services in livestock production. I covers important skills in breeding, animal health, nutrition and farm management necessary for enhanced livestock productivity.

I commend, Prof. Ch. Satyanarayana, Department of Veterinary & A.H. Extension Education for his meticulous effort in compiling this comprehensive resource. This work aligns perfectly with national objectives of empowering the small and marginal livestock farmers through skilled veterinarians which paves way for significant economic growth.

Confidence exists that this manual will serve as an invaluable gude for veterianarians, veterinary scholars, trainees and students, extension workers and saspiring livestock-preneurs, a enabling them to make a tangible impact on the sector.

Date: 06-12-2025

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PREFACE



The livestock sector is a mainstay of global agriculture, supporting livelihoods, ensuring food security, and driving economic growth, particularly in developing regions. Yet, the true potential of this industry is often constrained by a noticeable gap between existing practices and the rapidly evolving demands of modern and sustainable production systems. Efficiency, animal welfare, animal health care, environmental stewardship, and profitability all hinge upon the competency of the stakeholders who work within this value chain.

This manual is born from a recognition of that gap. It is not merely a collection of literature, but a blueprint for empowering the stakeholders who are the backbone of livestock production. Our objective is to provide essential knowledge and skills to standardize best practices across the entire ecosystem.

We acknowledge that a veterinarian, a smallholder farmer, a manager, and an extension officer each require a distinct, tailored skills set. Therefore, the chapters within have been meticulously compiled to address these varied needs. For the producers, we offer skills in fundamental animal husbandry, nutrition management, and basic health protocols designed to optimize yield and sustenance. For veterinarians, the focus shifts to advanced diagnostic methods, treatment strategies, advanced reproductive techniques, nutrition strategies etc.for skill development. For students and aspiring professionals, this serves as a foundational text, bridging academic theory with practical, field-ready application.

The comprehensive set of skills detailed herein covers critical areas: from foundational management to advance skill sets in diagnostic techniques, surgical methods, reproduction, feed formulation and value addition in livestock production. Each section emphasizes practical application, aiming to transform theoretical knowledge into tangible, on-the-ground competence.

Our hope is that this manual becomes a trusted companion for all who endeavor to improve the productivity and sustainability of livestock farming. By investing in skill development, we are not just improving animal output; we are investing in resilient communities, improved economies, and a more secure food future. The journey toward a more skilled and efficient livestock sector begins here.

My goal is to empower every user of this manual to enhance productivity, improve livelihoods, and ensure the ethical and sustainable future of livestock production. I trust this compilation will be an invaluable resource in your journey toward skill development and professional excellence.

I profusely thank Shri. Prof. M. Gnana Prakash, the Hon'ble Vice-Chancellor of PVNR Telangana Veterinary University and ADG of ICAR-NASF for providing resources and opportunity to bring out this usefulmanual under ICAR-NASF research project. I extend my special thanks to the Director of Research, PVNRTVU and the Associate Dean of CVSc., Hyderabad and the faculty of PVRNTVU for their direct and indirect contribution for this compilation.I hope this manual would fulfill what it is intended for.

Prof. (Dr) CH.Satyanarayana

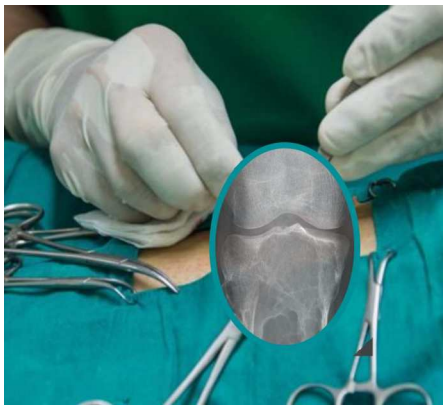
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WOUND MANAGEMENT WITH SUITABLE ANTISEPTIC SOLUTIONS AND OINTMENTS

ANTISEPTICS

1. Tr. Iodine

Action: Iodine diffuses in to the bacterial cell and interferes with vital metabolic reactions. It kills spores and vegetative forms. Spores are killed within 15 minutes when ethyl alcohol is used with iodide the antibacterial action of combination increases. Tincture iodine (2%) when applied on skin produces minimal irritation, spread evenly, dries slowly and within 3 minutes reduces the bacterial flora to 10%. strong tincture of iodine has greater antibacterial action.

Use: For application before surgical incision (or) hypodermic injection, for skin diseases treatment caused by fungi or ecto-parasites, sometimes used on wound. Strong tincture iodine is not used on skin, as it delays wound healing. This is powerful local irritant.

a)Weak solutions (usual strength is 2.5 %): sterilization of injection site and application in the field of operative site. It can be applied on the fresh wounds. Tr. Iodine is applied on the stump of the umbilical cord to prevent infection

b)Strong solution (usual strength is 5-7%): treatment of ring worm and demodectic mange.

Presentation: 500ml bottle , 50% v/v in alcohol

2.Povidone iodine as 5% & 10 % solution : local antiseptic for wound dressing, used as cleaning solution for wounds, teat tips and udder

3.Tincture benzoin:-It contains benzoin – 10 gm*;* storax - 7.5 % gm; balsum of tolee – 2.5 gm Aloes - 4.0 gm and alcohol - 90% added to 100 ml

Action: Benzoin and storax have antiseptic, disinfectant, parasiticidal, stimulant, haemostatic and expectorant action. Balsam of tolu has parasiticidal, stimulant, antiseptic and stomachic action. Aloe is used for stimulant, desiccant and purgative action

Use:- as antiseptic and stimulant on fresh and old wound, as hemostatic. It is excellent for minor bleeding cuts, abrasions, as parasiticidal in ringworm injection and as expectorant in catarrhal condition of respiratory tract

Presentation: - 500ml bottle, 70-77% v/v in alcohol

4.Glycerine: Glycerine is used as mouth wash with $MgSo_4$ as morison's paste.

Used for inflammation of mouth, in buccal cavity and in stomatitis.

Presentation: 50ml (gm) bottle

*Boroglycerin*e (boric acid 30 gm +glycerine 70 gm)

Ichthammolglycerine paste (ichthammol and glycerine) : It is applied as a pain reliever and counter irritant on rheumatic joints, sprains and other inflammatory swellings. Useful in various skin diseases like acne, eczema etc.

Magnesium sulphate + glycerine paste: widely used to treat oedematous conditions in animals. It absorbs water and thereby reducing the oedema

5.Turpentine oil : It has characteristic pungent smell.

Used as maggicidal in maggot wound. Due to pungent smell maggots will come out from wound. Used as oral drench to reduce surface tension in case of bloat / rumen tympany.

Presentation: in 500ml bottle

6.Rectified oil of turpentine used as carminative in cattle and horse @30- 60 ml; pig @ 4 - 8 ml; goat@ 4-10 ml and in dog @0.12 – 1.3 ml externally. It acts as a rubefacient, vesicant, local haemostatic, antiseptic, disinfectant and fly repellent. Internally it acts as an antiseptic, expectorant, sialogogue, gastric stimulant, antizymotic, carminative and intestinal haemostatic and rubefacient in treating sprains, strains, joint affections , neuralgia, myalgia and recent swelling.

Presentation: - in 500ml bottle

7.Liquid paraffin:- It is a soothening agent.

Use: as soothening agent to soothen the hand to pass in rectum etc., as in case of prolapse of uterus and vagina. To smoothen the stomach tube by applying on the surface of the stomach tube and in case of constipation it is used in dog and large animals.

Presentation: 500ml bottle

8. Savlon: It contains - chlorhexidinegluconate 0.3% w/v and Cetrimide - 0.6% w/v

Used as surface disinfectant

Action: Chlorhexidine is a cationic surfactant. It has better activity against gram positive bacteria than gram negative bacteria. It kills microorganisms by disrupting cell membrane and precipitates the cell content. It inhibits membrane bound at phase. It is active in blood and organic matter

Presentation: 1 lit bottle.

9.Formalin: A standard preparation contains not less than 37% and not more than 41% of formaldehyde)

Uses:

1. Orally as anti-zymotic in bloat condition
2. Formalin with $KMnO_4$ for fumigation
3. Antiseptic, disinfectant and deodorant
4. For irrigation of sinus and fistula@ 2%
5. For seborrhoea in horse – 1 in 500 solution
6. For sterilizing instrument @ 1-2%
7. For sterilization of dressing materials- 1 in 1000 / 1 in 2000 solution
8. 1 in 10% is used for foot bath

10.Lysol: Solution of cresol with soap (1-2%) used as antiseptic, disinfectant for instruments

11. Tincture turpentine: Used as counter irritant to musculo skeletal system externally

12. Acriflavin: Brownish smooth powder. Available as 20 gm bottle 1% solution in 70% alcohol for prolonged antiseptic action. Hygroscopic in nature

13. 70% alcohol: Surgical spirit: for drying the skin surface and surgeon's hand

14. Iodine ointment: Contains iodine 4 gm; potassium iodide 4 gm, glycerine 12 gm and lanoline 80 gm. It is mainly used as counter irritant for maturation of abscess. It can be utilized for treating

various conditions like oedema, rheumatism, arthritis, synovitis, lymphadenitis, bursal enlargement, mastitis, contusions, etc.

15. BIPP ointment: Contains bismuth sub nitrate 1 gm; iodoform 2 gm and liquid paraffin q.s. Used as topical dressing for the treatment of infected wound. It promotes granulation.

16. Silver nitrate (lunar caustic): Internally act as intestinal astringent and externally as caustic, astringent and antiseptic. Collyrium at 0.5 -1% strength is useful for conjunctivitis. It is applied to cauterize the bite wounds of rabid dog and snake. Applied on warts to destroy it's growth. Control of exuberant granulation in wounds. Formation of protective covering under which healing proceeds. Used in dehorning. Useful to cauterize the fistulous tract especially teat fistula.

17. Hydrogen peroxide solution (H_2O_2): Aqueous solution contains not less than 5% and not more than 7% of hydrogen peroxide. Used as non-irritating antiseptic and disinfectant. Usually applied in cavities and lesions which contain pus. It foams and effervesces in presence of pus. The solution in 1:3 ratio in water to be employed in septic wounds, abscess, fistulous tract and cavities. It is also applied on punctured wounds to prevent infection. It is used as mouthwash for tonsillitis, pharyngitis and stomatitis. Gauze soaked in H_2O_2 is an excellent dressing for wounds. Used in otorrhoea cases.

18. Carbolic acid/ phenol: available as liquefied phenol; glycerine of phenol; carbolic oil; carbolic ointment; corbolglycerine (ear drops) 1:30 gylcerine; carbolic liniment 5-10%; carbolic dusting powder 20-30 % and carbolic soap 10-20% when applied externally it act as a caustic, disinfectant antiseptic, local anaesthetic, parasiticide and deodorant.

19. Eupad: Contains bleaching powder 50 gm and boric acid 50 gm used as surface antiseptic for wound, ulcers and infected cavities (vaginal and nasal douche).

20. Eusol: Contains bleaching powder 12.5 gm; boric acid 12.5 gm and water 100 ml used as surface antiseptic for wound, ulcers and infected cavities (vaginal and nasal douche).

21. Triple sulphate powder: Contains zinc sulphate 30 gm; copper sulphate 30 gm and ferrous sulphate 30 gm used in thrush wounds of horses.

22. Hypertonic saline solutions: used for flushing the necrotic wound as 5% solution

23. Linimentum saponin: it is a liniment of soap and used for sprains

24. Liquor ferriperchloride: Strong solution used as local haemostatic (styptic)

25. Boric acid: It has many applications

Dusting powder : Contains boric acid 2 gm; iodoform 1 gm and zinc oxide 2 gm used as an antiseptic and as an excellent dressing powder for treating otorrhoea in the dogs.

Collyrium: Contains boric acid 0.5 gm; zinc sulphate 0.12 gm and distilled water 30 ml used in treating conjunctivitis especially useful in catarrhal and purulent conjunctivitis.

Ointment 10%: Contains boric acid 10 gm and white paraffin 90 gm useful in treating eczematous conditions of eyelids.

1% boric lotion: used in conjunctivitis, stomatitis, vaginitis, and cystitis.

26. Zinc oxide ointment: Contains zinc oxide 3.0 g and white soft paraffin 27.0 g. It is used as an external astringent and antiseptic, useful in eczema, act as protective ointment in healing wounds.

27. Sulphur ointment (sublimed sulphur 2.0 g; yellow/white soft paraffin 18.0 g.) Sulphur is converted to sulphide in skin . Used as fungicide, acaricide and effective against mange.

28. White lotion: Contains zinc sulphate 1.5 g lead acetate 2 g water 40 ml internally-astringent. Externally useful in conditions like sprains, contusions, bruises, seborrhea, fissured heals and wounds.

29. Calamine lotion: Contains calamine 15 gm; zinc oxide 15 gm; glycerine 5 gm and distilled water to 100 ml. Desiccant and astringent and mild antiseptic properties when applied externally. Useful in eczema, erythema and pruritis. Used as skin astringent and protectant.

30. Potasium permanganate ($KMnO_4$): It oxidize the protoplasm by liberating nascent O2 (O).

Uses:

1. Crystals are soluble in water to the extent of 1 gm in 15 ml.
2. The solutions are bacteriostatic, astringent, irritant and caustic depending on the concentration.
3. Used in concentration of 1 in 1000 (0.1%) on any tissue for deodorant and antiseptic activity and also to wash the exudate.

Action includes disinfectant, deodorant, antiseptic, oxidizing agent and antidote to alkaloidal poisons. It is a chemical antidote for opium, morphine and other alkaloidal poisons. It liberates oxygen on contact with organic matter. A 0.1% solution is used for removal of exudates from tissues. A 2% solution is employed in the treatment of snake bite as a local antidote. It is administered subcutaneously around the bite wound. Potassium permanganate crystals are directly applied as a caustic on ulcers.

Presentation: - Purple color crystals

31. Zinc sulphate powder: astringent action

Uses:

1. Silver nitrate + zinc sulphate is used as eye drops for the treatment of kerato conjunctivitis.
2. Component of haematomas mixture along with copper sulphate and ferrous sulphate.
3. Aqueous solution of $ZnSO_4$ 10% acts as astringent action.
4. It also has antipruritic action.
5. It is component of white lotion.

Presentation: White crystalline 400 gms powder.

32. Zinc oxide powder: Astringent action.

Uses:

1. Zinc oxide ointment 20% astringent on skin.
2. Component of calamine lotion.

Preparation: White powder with uniform texture 500gm powder

33. Red iodine of mercury: Antiseptic, parasiticidal, absorbent, rubifacient, desiccant of blister depend upon its concentration used

Uses:

1. In higher strength (1:4 to 1:8) as prepared above it has a postulant or desiccant action. It is applied to nature abscesses and to destroy the wall of fistula and sinuses
2. It is applied over basal enlargement, yoke tumours in cattle and capped elbow

Presentation: Orange colour powder

34. Copper sulphate: available as bluish crystalline powder or sticks and 20 % aqueous solution.

Used as

1. Devitalized tissue cauterization and initiation of granulation tissue.
2. A 20% aqueous solution of $CuSo_4$ is used as caustic.
3. Component of haematonic mixture.
4. Applied to destroy exuberant granulation (proud flush) and the walls of the sinus and fistulae.
5. A 1-3% solution : Urethritis, Vaginitis and Epidermophytosis.
6. A 0.5 % collyrium : for conjunctivitis.
7. A 1-2 % ointment follicular conjunctivitis.

35. Magnesium sulphate:

Used as

a. Laxative in case of constipation
b. As purgative
c. Used in euthanasia / mercy killing
d. Used in malison's paste preparation along with glycerin
e. 10% $MgSO_4$ and used as muscle relaxant
f. It is also used as bronchodilator by giving s/c route.

36. Acriflavine: 1 in 1000 solution or 1 in 2000 solution is used also used as ointment. It is a less irritant antiseptic solution used to treat wounds, ulcers, burns and inflammations of mucous membrane.

37. Bin iodide of mercury/ mercuric iodide ointment (red iodide of mercury 10 g. and white soft paraffin 90 g.): an ointment of 1 in 20 to 1 in 50 is used for the treatment of ringworm in horse and cattle. A 1 in 20 ointment is applied to stimulate the horny tissues. The effect of ointment is also utilized in ringbone, spavin, splints, inflammatory conditions such as elbow hygroma, yoke gall, etc.

38. ZAB solution: Contains zinc sulphate, alum , boric acid in 1:2:2 ratio respectively. Used for irrigation of eye.

39. Iodex ointment / black ointment: Iodex ointment contains iodine, potassium iodide and vaseline. Iodine has the property of absorption of fluid.

40. Potassium iodine: Crystalline powder. Component of lugol's iodine and iodine ointment.

41. Alum powder: White crystalline powder. Used as styptic available as 500 gm powder.

42. Sodium salicylate: White crystalline powder. Component of whit fields ointment used with benzoic acid used as surface applicant on dermatological wounds.

43. Sulphur Powder: Yellow in colour and a surface medicament

44. Liniment of turpentine: Contains soft soap 1.25 g; Camphor 2.5 g and turpentine oil 16.25 ml in 50 ml of distilled water (soft soap - 3.75 gm; Camphor - 2.5gm and turpentine oil – 32.5 ml in distilled water – 40 to 50 ml it is whitish solution . Turpentine liniment is used as counter-irritant.

Closed wounds

- Bruise: Blunt-force trauma that doesn't break the skin but causes damage to the skin and underlying tissue to a lesser degree.
- Contusion: Blunt-force trauma that doesn't break the skin but causes damage to the skin and underlying tissue to a greater degree.

Open wounds

- Abrasion: Skin damage with a loss of epidermis and a portion of the dermis.
- Avulsion: Tearing of tissue from its attachments.
- Incision: Wound created by a sharp tool, resulting in wound edges with minimal tissue trauma.
- Laceration: Irregular wound caused by tearing, which produces superficial and underlying tissue damage.
- Puncture: Penetrating wound caused by a sharp object; punctures cause minimal skin damage but underlying tissue damage may be severe, resulting in a higher risk of subsequent infection by contamination introduced at time.
- Duration refers to the length of time between the infliction of a wound and wound treatment. Duration and degree of contamination are divided into 3 classes. However, the degree of contamination is more important than the duration; a relatively new wound that has gross debris or devitalized tissue should be assigned a higher wound classification.

Class 1: Clean wound with minimal contamination and a 0 to 6 H duration.

Class 2: Wound with significant contamination or 6 to 12 H duration.

Class 3: Wound with gross contamination or > 12 H duration.

The initial treatment of a wound should include:

Clipping around the Wound: A water-soluble gel (ie, K-Y Jelly) is placed in the wound and a large area of skin around the wound is clipped. The gel clumps the clipped hair together and prevents further wound contamination during clipping.

Cleaning around the Wound: The gel is flushed from the wound with sterile saline and the skin around the wound is scrubbed with chlorhexidine until debris is removed. Care should be taken to avoid introducing the surgical scrub into the wound as this may cause tissue damage.

- Irrigating the wound with adequate volumes of a sterile, balanced electrolyte solution will help decrease bacteria and flush debris from the wound.
- The wound should be irrigated using a 20 ml syringe and an 18-gauge needle or catheter to provide the appropriate pressure.
- It is important to remember that higher-pressure irrigation can cause tissue trauma and seed bacteria into the wound.

Wound debridement: All dead and devitalized tissue should be surgically removed from the wound by debridement. This is best performed with a scalpel or sharp scissors under aseptic surgical conditions.

- The wound and surrounding surgical field is draped.
- Debridement is started superficially. While debridement of skin can be somewhat conservative, fat and muscle tissue that does not bleed should be removed.
- Once the entire wound has been debrided to healthy tissue, it is again irrigated under appropriate pressure.
- A decision on closing the wound is then made.
- Wounds that are deemed healthy and can be closed without tension indicate primary closure. One or more gravity or closed suction drains may be required to prevent fluid accumulation in wound dead space.
- If the wound is still considered contaminated or if, when closure is attempted, there is excessive tension on the wound edges, the wound should initially be left "open" and, ideally, bandaged.
- Once initial care is completed, the clinician determines the most appropriate type of bandage to apply.
- The most common types of bandages are the *modified Robert Jones bandage* and the *tie-over bandage*.
- Tie-over bandages can be used anywhere on the body and are convenient for wounds occurring in areas that would preclude the use of a modified Robert Jones bandage (ie, the head, flank, or inguinal region).

Tie over bandaging will have….

- A primary/contact layer of sterile gauze packed into and on the wound.
- A secondary layer of sterile laparotomy sponges.
- A tertiary layer of waterproof material, which can be a surgical drape or an absorbent pad cut to cover the other layers.
- Stay sutures are placed in a circular pattern around the wound and umbilical tape is tied over to secure all of the layers in place.

A. Layers

Primarycontact layer

- **Adherent bandages** include both dry-to-dry and wet-to-dry bandages; they are created with sterile gauze squares. It is important to remember that these sponges debride the wound and their removal may be painful to the patient.
- ***Dry-to-dry* bandages are used for wounds producing increased amounts of low-viscosity fluid/exudate and if foreign debris and necrotic tissue are present; for example, wounds that are producing a large volume of non-infected serum-like fluid.**
- ***Wet-to-dry* bandages are indicated for wounds producing higher viscosity fluid/exudate and if loose debris is present; for example, wounds that are still contaminated after debridement and producing purulent exudate. The gauze sponges are moistened with a sterile, balanced electrolyte solution.**
- **Non-adherent bandages**, such as Telfa pads (Kendall Brands), are used to cover a wound for protection but do not provide any additional benefits.

- **Non-adherent, semi-occlusive bandages** can be created using Vaseline-impregnated gauze, which is a material that allows fluid to absorb into the intermediate layer of the bandage. It keeps the wound moist and allows atraumatic removal of the dressing.

Secondary Layer

- Secondary layers are comprised of bandage materials that can absorb exudate, secure the contact layer, and provide some pressure to decrease dead space and/or prevent edema. Examples of materials commonly used to create this layer are cast padding and roll cotton.

Tertiary Layer

- The purpose of the tertiary layer is primarily to secure other parts of the bandage. Conforming, stretch-gauze bandage is used. An outer layer of either Vetrap or Elastikon is used to secure the 3 layers of the bandage.

C) Materials used for bandage

a) Dressing materials

Various types of dressing are available. These are applied in direct contact with the surface of the skin. Dry dressing absorbs pus or fluid from the wound. Impregnated gauze dressings may be applied to wounds that need to be kept moist. Eg. Burns and scalds. These dressings are petroleum or Vaseline based and may be impregnated with antibiotic, corticosteroid or chlorhexidine.

b) Padding materials

These provide the intermediate layer of many dressings. These cushion and support the wound and also provide protection to bony prominences and prevent excoriation. These may be made from natural or man made fibres, including

1. Cotton wool, a natural fibre which is cheap and has good absorptive properties.

2. Soffban, a soft, natural padding material available as rolls of varying width and thickness

3. Foam, a useful padding material also available as rolls.

c) Bandaging materials

These are applied to protect the wound and to hold dressings in place. These include

1. White open-weave, a natural bandage which is strong and firm, has the disadvantage of not conforming to the patient's body and a tendency for the cotton fibres to fray.

2. Conforming bandage, the bandage of choice for most dressings, provides a strong neat bandage that conforms to the shape of the patient's body.

3. Cohesive bandage, has self-adhering properties but does not stick to hair or skin . It is strong , flexible and conforming .

4. Tubular bandage, elasticated cotton or nylon bandage applied with the use of an applicator, is particularly useful for bandaging limbs or the tail.

5. Crepe bandage, not commonly used in veterinary practice, has the advantage of the being washable and therefore may be reused. It conforms the larger parts of the animal's body and is useful for head and thorax bandaging.

d) Covering materials

These form the outer layer of the dressing and provide support and protection

1. Zinc oxide tape, an adhesive, inelastic, relatively, non – conforming material with a tendency to fray. More commonly used as a traction tape.

2. Elastoplast, an adhesive, elastic material which provides a neat, conforming a protective layer.

3. Non adhesive tape, material that will adhere to itself but not to the patient.

e) Casting materials

1. Fiberglass cast, a rigid, lightweight material that provides a strong, fast setting cast.

2. Plaster of Paris, a roll of gauze impregnated with calcium sulphate dehydrate. It is applied by immersing the roll in water and winding the material around the affected part in the manner of a bandage. Once dried, it sets to a hard, supportive, conforming cast.

D) Bandaging techniques

a)Limb: Limbs are frequently bandaged in veterinary practice to provide protection and support for cuts, torn due claws, closed fractures and after surgical procedures. Various materials are utilized, including narrow open- weave bandage, conforming bandage, and elasticated tubular gauze.

Procedure

- The patient should be suitably restrained.
- In order to absorb sweat and prevent irritation, place cotton wool between the patient's toes, pads and dew claws.
- Apply a layer of cotton wool or around the foot.
- Apply the conforming the bandage longitudinally cranial and caudal surface of the limb and then turn it to wind around the limb in a figure of eight pattern.
- Ensure an even tension throughout the bandage.
- Anchor the bandage in hock or carpus.
- Apply an external layer of adhesive tape in the same manner.

b) Ear: One or both ears are often bandaged following trauma, bleeding from ulcerated ear tips, or surgical procedure such as aural haematoma or resection.

Procedure

- Place a pad of cotton on the top of patients head. Fold the ear back on to the pad.
- Apply a dry dressing and place a further pad of cotton wool over the ear.
- Apply conforming bandage and then under the chin anchor it on either side of the free ear.
- The bandage may be covered with adhesive tape.
- It is important that the ear bandage is not applied too tightly. The patient should be able to open its mouth normally and its respiration must not be obstructed.

c) Abdomen: The abdomen is routinely bandaged following trauma or surgery. Apply conforming bandage around the abdomen and secure it with adhesive tape or tubular gauze. The bandage may have to be extended forwards to axilla to stop it to bunching up latter. Care should be taken to prevent the bandage from rubbing on the exposed ventral surface of the abdomen. Use cotton wool padding or apply Vaseline.

d) Chest: The procedure for bandaging the abdomen also applies for the chest. The bandage may be anchored between the front legs in figure – of – eight fashions.

e) Tail: A light bandage may be required following trauma to the tail or amputation of vertebrae. This can be one of the most difficult areas for keeping a bandage in place.

E) Specialized bandaging techniques

a) Ehmer sling: It is applied to support the hind limb following reduction of hip luxation

b) Velpeau sling: It is applied to support the shoulder joint following luxation or surgery

c) Robert Jones bandage: It is applied to provide support and immobilization to fractured limbs in a first aid situation or following surgery.

F) Care of bandaging and dressing

Once the bandage has been applied, constant checks should be maintained until it is removed. Any evidence of odour, edema, discharge or skin irritation should be noticed every day. The bandage should be checked to ensure that it is not too tight or uncomfortable. It is important that the dressing does not become soiled or wet. This may be prevented by covering it with a plastic bag when the patient is taken out side. Constant chewing or licking at the bandage by the patent should be discouraged.

PREPARATION OF SURGICAL PACK

SURGICAL INSTRUMENTS

The exact instruments and materials included in pack will vary with the surgical procedure or with the surgeon's preference.

I. **Surgical pack preparation**: the general surgical pack consists of the following instruments and surgical apparel.

General instruments:

1.	Mayo's scissors 15 cm blunt end straight	- one
2.	Mayer's scissors 15 cm blunt end curved	- one
3.	BP handle no. 3 and 4	- each one
4.	Tissue forceps - plain / rat toothed	- each one
5.	Tissue forceps 15 cm	- six
6.	Haemostatic forceps curved and straight	- each two
6.	Mosquito haemostat 12 cm	- six
7.	Needle holder	- one
8.	Groove director	- one
9.	Suture needles, traumatic and atraumatic	- six
10.	Surgical gloves (as per size)	- 2 pairs
11.	Surgical gown, mask, cap	- two each
12.	Surgical drape with slit (75 x 105 cm)	- one
13.	Surgical drape without slit (17 x 12 cm slit)	- each one
14.	Surgical towels (20 x 30 cm)	- four
15.	Gauze sponges	- six
16.	Surgical pack wrapper (90 x 120 cm)	- one

17. Surgical blade to suit bp handles - 3 each
18. Suture materials, nylon, silk catgut etc. - Sufficient
19. Scalpel - one

Special instruments: Special instruments needed for any operation may be sterilized along with general surgical pack or sterilized separately depending upon the type of operation eg., a laryngoscope for endotracheal intubation. A rumenotomy set for rumenotomy in cattle, an intramedullary pin and a driller for a fracture repair in a dog.

Note: Surgical blades and cat gut should not be sterilized as they are available in presterilized form and ready to use.

Care and maintenance of instruments

Instruments must only be used for the purpose for which they are intended. Handle the instruments carefully, never throw or drop them. The instruments are thoroughly washed immediately after operation with soft brushes to remove blood clots, dirt and dusts. Use demineralized distilled water for rinsing and washing so as to avoid metal/mineral deposition, however mild cleaning solutions can also be added. Dry the instrument after washing. Check hinged instruments for mobility, so that all box joints should work smoothly. Instruments must be cleaned, lubricated before packing, use of mineral oils; grease for lubrication should be avoided. Place protective tips over sharp and delicate instruments when not in use. An ultrasonic cleaner may then be used if available (up to 90% of debris is removed after a 5 minutes cycle.

SURGICAL PACKS STERILIZATION PROCEDURES FOR SURGICAL INSTRUMENTS

Methods of sterilization

Heat

Is the oldest and most widely used and recognized process. Heat destroys bacteria by coagulating its proteins.

A) Moist heat:

Principle: Denaturation or destruction of cellular proteins by heat resulting in destruction of microbes. Moisture hastens the coagulation of cellular proteins as water catalyzes all chemical reactions. Unlike dry heat, which burns microbes after slow process of heat absorption, steam give up its heat by condensing back into the water form, which it comes. 121°C, 15 pound pressure, for 30 minutes.

Types of steam sterilizers/ autoclaves/pressure steam sterilizers

1. Gravity displacement or downward displacement sterilizer
2. Pre vaccum steam sterilizer
3. Steam pulsing system.

- Cleaning of surgical supplies – Clean and place them in surgical pack with hinges open.
- Preparation of surgical pack – Place all the cleaned instruments and drapes and towels folded in accordion folds in instrument drape. Then it is packed in table drape. A sterilization indicator tape is placed over it.

- Autoclave operation - 121°C, 15 pound pressure, for 30 minutes
- Sterile pack storage- Can be stored for a week in airtight containers.
- Indicators. Chemical: changes colour when certain temperature is reached

B) Boiling water: is not destructive to spores, however, addition of 2% sodium carbonate can kill spores within 5 min.

C) Dry heat sterilization (hot air oven) - Substances which cannot be steam sterilized e.g. oils, powder, glass wares, knife blades, needles, can be sterilized by dry heat sterilization.

160°C for 1 hour 180°C for 20-30 min Infrared oven: 180°C for 10min

D) Flame sterilization: wire loop, probes, teat dilators, teat cannula can be sterilized.

Chemical sterilization

Gaseous Ethylene Oxide

Principle: kills organisms by alkalization. Labile hydrogen is replaced by hydroxyethyle groups that block the reactive groups necessary for essential metabolic reactions. Destroys all known microbes e.g. bacteria, spores, fungi and virus. EO air mixture is explosive. Moisture is necessary for the entrance of gas into the cell. Conditions: 400-1500 mg/l gas conc., 21-60°C temp, >48 min, 3 3-40 RH.

Formalin:

- Paraformaldehyde tablets in airtight boxes by heating with electric element or spirit lamp for 30 min led to adequate sterilization. Betapropiolactone: Act faster than EO and formalin.
- Used to sterilize hospital rooms and animal houses. But is carcinogenic, toxic and damage painted and plastic surfaces.

Cold sterilization: Soaking instruments in disinfectant solution. Kills all bacteria except Tubercle bacillus. Spores and viruses are not sterilized. Should not be used for delicate instruments.

1. Alcohols

E.g. ethyl alcohol (70%) and isopropyl alcohol (99%) Principle: coagulation of proteins, Cannot kill viruses and spores.

- Aldehyde: e.g. Formaldehyde and Glutaraldehyde. Formaldehyde (37%) kills all microbes and spores. Is irritant to skin and mucous membranes.
- Chlorhexidine (savlon): have residual effect, effectiveness increases after repeated use.
- Chloroxylenol (dettol): 5% solution for 30min.
- Iodines: can be available as inorganic iodides or Iodophors (iodine complexed with organic molecules e.g. detergents).
- Coal tar derivatives: e.g. Phenol/ carbolic acid, Cresol, bisphenol. They are not affected by the presence of organic matter.
- **Principle:** kills microbes by coagulation of cell proteins or protein denaturation.
- Quaternary ammonium compounds: Benzalkonium chloride, Zephiran chloride. Surface active agents that dissolve lipids in bacterial cell walls and membranes. Cannot kill spores and viruses.

- Detergents: soaps, cetrimide (2%), chlorhexidine (1%).
- Mercurialse.g. bichloride of mercury (1:1000or 1:2000).
- Oxidizing agents: e.g. H_2O_2 or $KMnO_4$, kills microbes by producing nascent oxygen.

Irradiation

1. Ultraviolet rays (300-400nm wavelength) produced by mercury vapor lamps. Principle: absorbed by nucleic acid leading to death of the cell. Eyes should be protected against UV rays.
2. X rays, γ, β rays: shorter wavelength, have deeper penetration.

Mechanical sterilization:

1. Seitz filter of asbestos and berkfeld filter.
2. Ultrasonic waves.

Operation theatre Sterilization:

- Mop theatre furniture lamps, sitting tables, trolley tops, operation tables, procedure tables, boyle'sapparatus). Need not use chemicals/disinfectants unless contaminated with blood or body fluids between the procedures.
- Clean operation tables or contaminated surfaces with disinfectant solutions. In case of spillages of blood/ body fluids decontaminate with bleaching solution/ chlorine solution (10% available chlorine).
- Discard all the waste in plastic bags (do not accumulate around surgical sites).
- Do not discard soiled linen and gowns in the operation theatre floor.
- Clean all the table tops, sinks, door handles with detergent followed by low level disinfectant.
- Clean the floors with detergents mixed with warm water.
- Finally mop with disinfectant like phenol in the concentration of 1 in 10 (low concentrations of phenol will not serve the purpose).
- Keep the operation theatre dry for the next day's work Fumigation.
- Seal the room with adhesive tapes round the edges of the doors/windows and ventilators and apertures.
- For each 1000 cu.ft of space place 500 ml formaldehyde (40% solution) and 1000 ml of water in an electric boiler. Switch on the boiler, leave the room and seal the door.
- Seal the room for 24 hrs.
- Then open the door and neutralize any residual formaldehyde with ammonia by exposing 250 ml of s.g 880 ammonia/ 1lt of formaldehyde used. Ultra violet radiation: UV lights are fixed in the theatre.
- Daily UV radiation should be applied for 12-16 hours.
- UV radiation should be switched off before 2 hours of operation exercise.

ANAESTHETIC TECHNIQUES AND PROTOCOL AND SUTURING TECHNIQUES WITH SUITABLE MATERIAL

ANAESTHESIA

Cattle and sheep

- In general, cattle and sheep are unsuitable subjects for inhalation anaesthesia unless endotracheal intubation is practiced, and for work in the field, light general anaesthesia by intravenous injection without abolition of the swallowing and belching reflexes gives satisfactory results, especially if combined with some form of local analgesia. It is in these species of animal that regional analgesia has attained its greatest development. For major abdominal operations, paravertebral or lumbar epidural injections are most satisfactory; for obstetrics caudal epidural block is extensively employed, while for cornual and digital surgery perineural block is suitable.

The pig

- The continuous squealing and struggling which restraint provokes in the pig makes most veterinarians disposed to adopt general anaesthesia in the adult animal for all but the most rapidly performed operations. Fortunately the pig is a good subject for general anaesthesia provided its airway can be kept patent by maintaining its head normally flexed on the neck with the lower jaw pushed forward. Where this is not possible endotracheal intubation is mandatory and the pig is probably the most difficult of the domestic animals to intubate. In the little pig most operations can be satisfactorily carried out under local infiltration analgesia.

SEDATION

- **Siquil – in cattle and buffaloes IM, IV.**
- **Chlorpromazine HCl @ 1 mg per Kg body weight in pigs.**
- **Xylazine- in cattle and buffaloes, dogs and cats IM, IV.**
- **Diazepam- sheep, goats, dogs and cats IV.**

CLASSIFICATION OF ANAESTHESIA

A) General Anesthesia (GA): Usually used in small animal surgery

- Injectable GA
- Inhalation GA

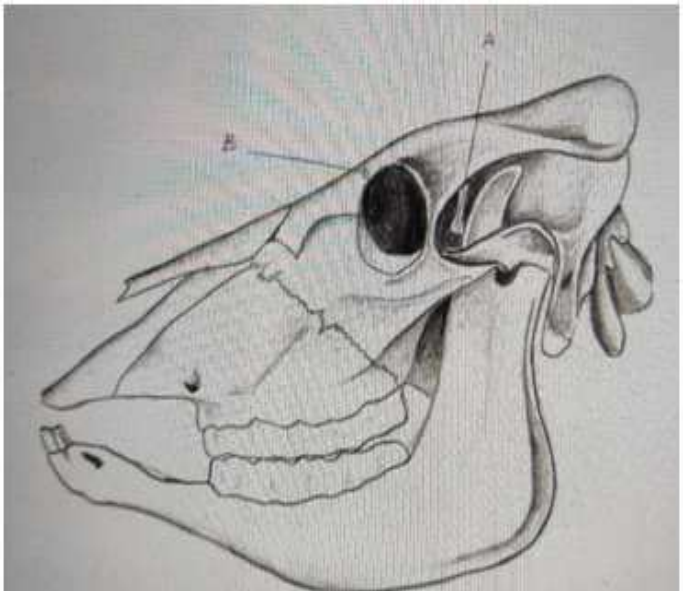
B) Local Anesthesia: Used mainly in large and small ruminant surgery and also in small animal surgery if necessary- Lignocaine HCl 2%

- Topical – oral, skin and other mucous membranes.
- Linear infiltration- local anesthetic injected on the line of incision.
- Field Block- rumenotomy and cystotomy (inverted L block),
- Regional Nerve Block- rumenotomy, cystotomy, caesarean section (Cornual nerve block, Peterson's eye block, Retrobulbar and Auriculopalpebral nerve block, Paravertebral and Epidural nerve block)

- Epidural (epidural or subarachnoid space) – to control maternal straining in dystocia, tail and perineal surgeries.
- Regional Intravenous – in limb surgeries

Cornual Nerve Block:

- Nerves Affected: Ophthalmic division of trigeminal nerve (corneal branch of lacrimal nerve or zygomaticotemporal nerve) in cattle and cornual branch of lacrymal nerve and corneal branches of the infratrochlear nerve in goats.
- Landmarks: Point of injection in cattle is midway between lateral canthus of the eye and the base of the horn along the zygomatic process on the upper third of the temporal ridge, about 2.5 cm below the base of the horn. In cattle with well-developed horns, additional infiltration along the caudal aspect of the horn can be used in a partial ring block fashion to affect subcutaneous branches of second cervical nerve. Additionally for goats, the second point of injection is a line block midway between medial canthus of the eye and the medial horn base.

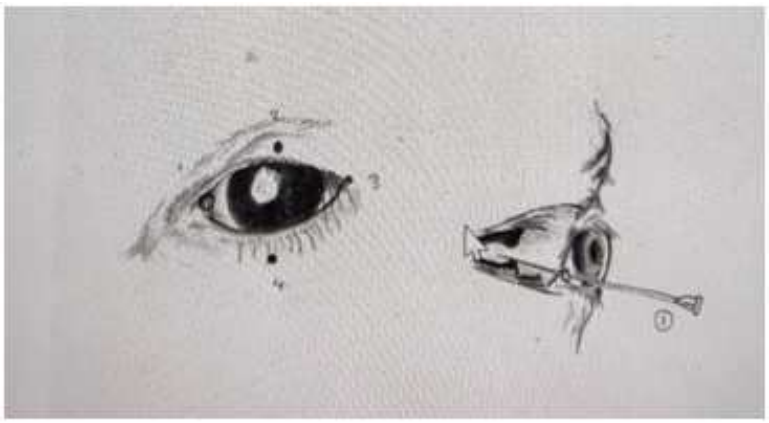


A) Cornual nerve block B) Site of Infratrochlear nerve block in goats

- Procedure: In cattle, 5-10 ml of local anesthetic is administered subcutaneously and relatively superficially, approximately 0.7-1 cm deep. Onset of anesthesia is within 10 minutes and duration is approximately 1 hour. The same method can be applied to goats using 3-5 ml of local anesthetic but is contraindicated in kids because of the tendency for a total overdose due to their small size.

Retrobulbar Eye Block:

- Nerves Affected: Sensory and Motor to oculomotor, trochlear, abducens, and three branches of the trigeminal nerve branches (ophthalmic, maxillary, and mandibular).
- Landmarks: Point of injections are medial and lateral canthus of the eye or the upper and lower eyelids at the orbital rim.
- Procedure: An 18-gauge, 15 cm needle is bent slightly in order to facilitate passage around the globe and introduced through the eyelid or canthus at the orbital rim, making sure to deflect the globe with a finger to protect it from the needle. While advancing the needle slowly toward the back of the orbit, 15 ml of local anesthetic is introduced in small increments. Care should be taken to avoid penetration of the globe, orbital hemorrhage, damage to the optic nerve and injection of local anesthetic into the optic nerve meninges.



Retrobulbar eye block

Peterson Eye Block:

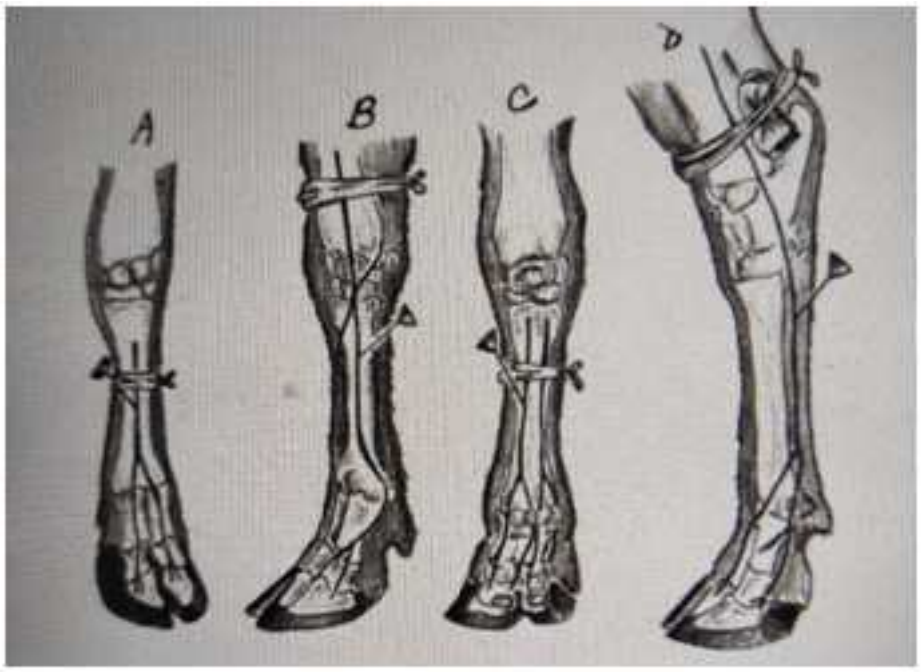
- **Nerves Affected:** Sensory and Motor to oculomotor, trochlear, abducens, and three branches of the trigeminal nerve branches (ophthalmic, maxillary, and mandibular).
- Landmarks: Point of injection is the notch formed by the supraorbital process cranially, zygomatic arch ventrally, and the coronoid process of the mandible caudally. Figure 1: Depicts the injection sites for the Retrobulbar nerve block. (Illustration by Kim Crosslin.)
- Procedure: Inject 5 ml of local anesthetic subcutaneously at this site using a 22-gauge, 2.5 cm needle. A 14-gauge, 2.5 cm needle serves as a cannula and is placed through the anesthetized area as far anterior and ventral as possible in the notch. A straight 18-gauge, 10 to 12 cm needle is inserted into the cannula and directed horizontally and slightly caudally until it comes into contact with the coronoid process of the mandible at approximately 2.5 cm below the skin. The needle is then gently manipulated rostrally until its point passes medially around the coronoid process. It is then advanced to the pterygopalatine fossa rostral to the solid bony plate that is in close proximity to the orbital foramen at a depth of 7.5–10 cm. Penetration of the nasopharynx and turbinates should be avoided. Aspirate to ensure that the ventral maxillary artery has not been penetrated. Approximately 15 ml of local anesthetic is then injected. Both the retrobulbar block and the Peterson eye block prevent blinking for several hours. The cornea must be kept moist if these blocks are used for procedures other than enucleation.



E) Shows injection site for peterson eye block

Bier Block:

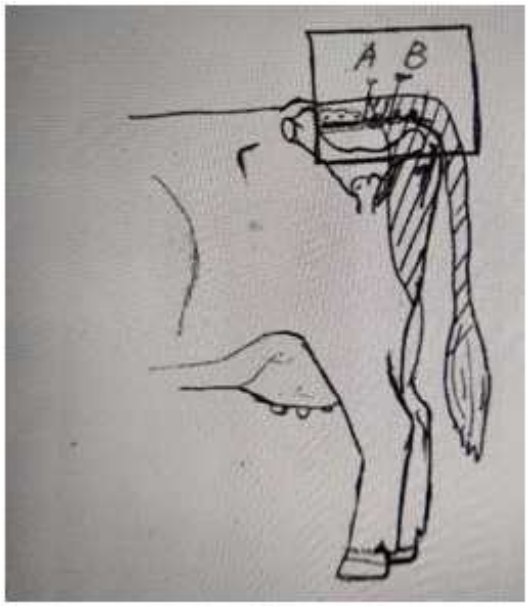
- **Region affected:** Distal limbs below the placement of the tourniquet.
- **Landmarks:** A tourniquet is placed proximal to the fetlock. In the thoracic limb, the dorsal metacarpal vein, plantar metacarpal vein, and radial vein can be used for injection. In the pelvic limb, the lateral saphenous vein or lateral plantar digital vein may be used. It is only necessary to inject anesthetic into one vein for effective anesthesia to the entire area below the tourniquet. In small ruminants, it may be difficult to use the dorsal digital vein or the palmar (plantar) digital veins; as a result, the tourniquet can be placed above the elbow in the forelimb or below the tarsus in the hind limb to allow use of the larger cephalic and recurrent tarsal veins.
- **Procedure:** For intravenous regional anesthesia, 20 ml of local anesthetic is injected intravenously as close to the surgical site as possible. The use of a 20-gauge, 3.3 cm needle or a 21-gauge butterfly catheter may be used. Anesthesia occurs within 10 minutes and the area is anesthetized until the tourniquet is removed. The tourniquet can remain safely on for 1-1.5 hours in order to provide hemostasis during the procedure. In small goats where the placement of the tourniquet is altered as previously stated, 3-4 ml of 2% lidocaine hydrochloride is adequate to produce limb anesthesia while the tourniquet is in place. Some problems can arise due to inadequate or prolonged tourniquet time, causing failure to take effect or long term damage.



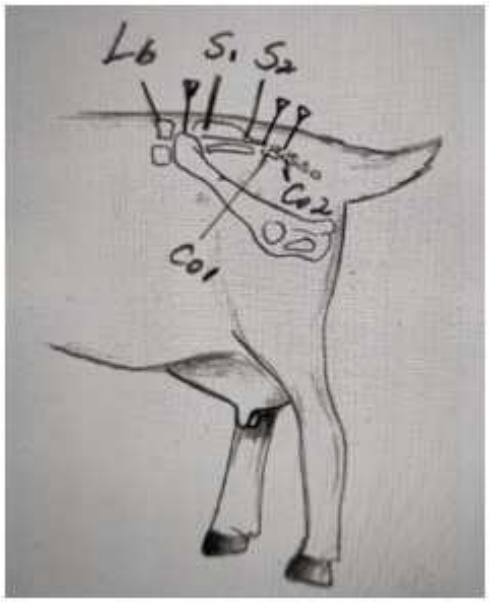
(A) Injection sites for regional intravenous anesthesia (Bier nerve block) common dorsal metacarpal vein of the forelimb, (B) lateral palmar digital vein, (C) lateral palmar metacarpal vein, and (D) lateral saphenous vein of the hind limb. (Illustration by Kim Crosslin.)

High Volume epidural: (Caudal epidural and Continuous caudal epidural anesthesia)

- **Nerves affected:** Sacral nerves S2, S3, S4, and S5 for a high caudal epidural at sacrococcygeal space. Sacral nerves S3, S4, and S5 for a low caudal epidural at the first coccygeal space.
- **Landmarks:** Point of insertion is the fossa between the last sacral vertebra and the first coccygeal vertebra or between the first and second coccygeal vertebrae for high and low versions, respectively.
- **Procedure:** The tail should be moved up and down to locate the fossa. An 18-gauge, 3.8 cm needle without the syringe attached should be directed perpendicular to the skin surface. After penetrating the skin, a drop of local anesthetic is placed in the hub of the needle, then the needle should be advanced slowly until the drop is drawn into the epidural space by negative pressure. The syringe can be attached to the needle and the solution can be slowly injected with no resistance. The dose for cattle is 0.5 ml per 45 kg of body weight. In the case where a continuous administration of anesthetic is needed, a catheter can be placed into the epidural space for intermittent administration of local anesthetic. If providing continuous epidural anesthesia, an 18-gauge, 5 cm spinal needle with a stylet is inserted into the epidural space at the first coccygeal space with the bevel directed cranially. To determine if the needle is in the epidural space the stylet can be removed and 2 ml of local anesthetic added. Once in the epidural space, a catheter is introduced into the needle and advanced cranially for 2-4 cm beyond the needle tip. The needle is then withdrawn and the catheter remains in place. An adapter is placed on the end of the catheter and the catheter is secured on the skin of the dorsum. Local anesthetic can then be administered as needed.



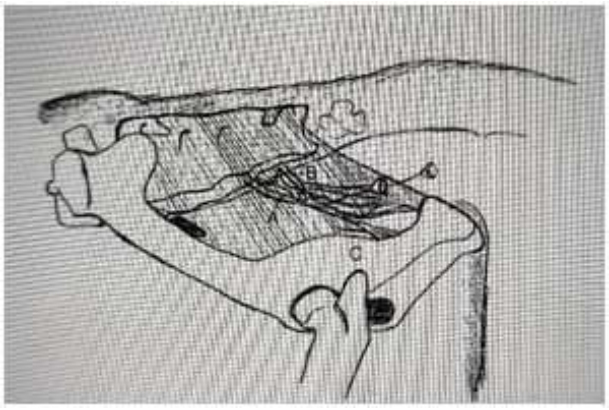
Caudal epidural nerve block in cattle. (A) Intersacrococcygeal space S4 and Co 1, (B) intersacrococcygeal space Co1 and Co2. (Illustration by Kim Crosslin.)



Caudal epidural and lumbosacral nerve blocks in goats. (Illustration by Kim Crosslin.)

Pudendal Nerve Block:

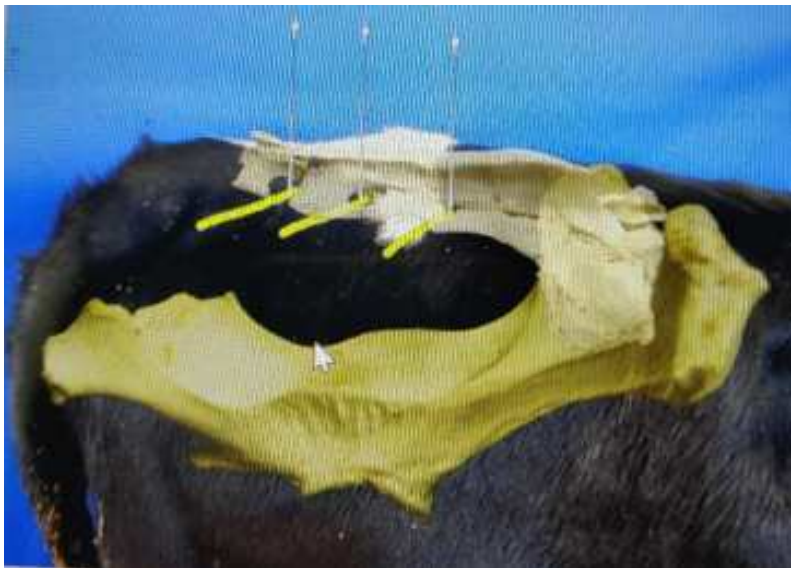
- **Nerves affected:** Internal pudendal nerve (fibers from ventral branches of third and fourth sacral nerves and the pelvic splanchnic nerves) and the anastomotic branch of the middle hemorrhoidal nerve.
- **Landmarks:** An ischiorectal approach is used, approaching from the ischiorectal fossa to the pudendal nerve. Placing the left hand into the rectum to the level of the wrist and directing fingers laterally and ventrally will identify the lesser sacrosciatic foramen as a soft depression in the sacrosciatic ligament. The internal pudendal nerve lies on the ligament directly cranial and dorsal to the foramen and approximately one finger's width dorsal to the pudendal artery passing through the foramen. This pudendal artery can be palpated a finger's width ventral to the nerve.
- Procedure: The skin at the ischiorectal fossa on both sides is clipped, disinfected, and anesthetized using 2 ml of local anesthetic. A 14-gauge, 1.25 cm needle is inserted into this area at the ischiorectal fossa to act as a cannula. With your right hand, an 18-gauge, 10-15 cm spinal needle is directed through the cannula and directed medial to the sacrosciatic ligament and directed cranioventrally. Once the needle has been introduced roughly 5-7 cm it can be felt via rectal palpation and repositioned onto the pudendal nerve. Once at the nerve 20 ml of local anesthetic is deposited at the nerve. Withdrawing the needle partially and redirecting 2-3 cm more caudodorsally, an additional 10 ml of local anesthetic is deposited at the cranial aspect of the foramen in order to desensitize the muscular branches and the middle hemorrhoidal nerve. Once the needle is removed, the area is massaged to help disperse the anesthetic. This procedure is then repeated on the opposite side. Full effect of relaxation of the penis may take approximately 30-40 minutes and last 2-4 hours. Assessing the effectiveness of the block may be tested by firmly squeezing the tail of the epididymis of each testicle, where failure to retract the testicle signals adequate anesthesia.



Internal pudendal nerve on left side of pelvis of cattle. (A) internalpudendal nerve, (B) pelvic splanchnic nerve, and (C) pudendal artery. (Illustration by Kim Crosslin.)

Sacral paravertebral Nerve Block:

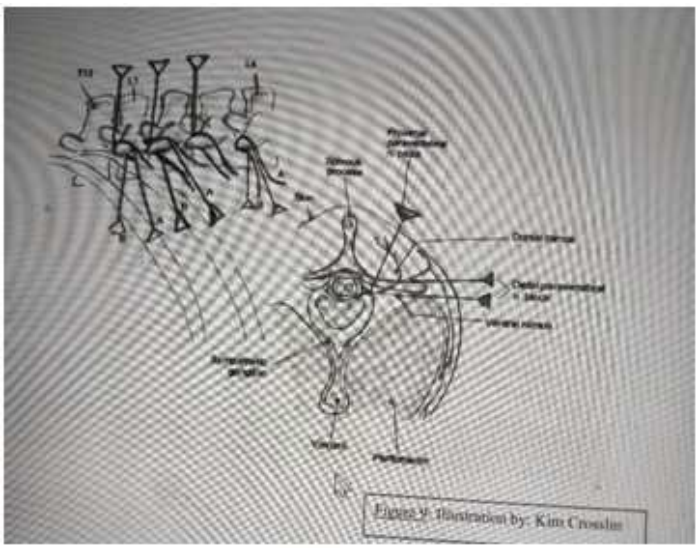
- **Nerves affected:** Pudendal nerve (pudic nerve), medial hemorrhagic nerve (pelvic splanchnic nerve), and caudal hemorrhagic nerve (caudal rectal nerve).
- **Landmarks:** Anesthesia is produced by blocking the 3rd, 4th, and 5th sacral nerves as they branch off of the spinal cord. The paired S5 foramina are 1-2 cm lateral to the sacral coccygeal joint. The S4 foramina are approximately 3-4 cm cranial and more lateral to the S5 foramina. The S3 foramina are an additional 3-4 cm cranial to the S4 foramina. The foramina can be palpated rectally with a finger placed in or over the osseous ring.
- **Procedure:** The skin over the dorsal sacrum is clipped of hair and surgically prepped. A stab incision is made dorsal to each foramen to help introduce a 5-7 cm 18-gauge needle.



Proximal and Distal Paravertebral Nerve Blocks:

- **Nerves affected:** The proximal paravertebral nerve block affects the dorsal and ventral nerve roots of the last thoracic and first and second lumbar spinal nerves (T13, L1, L2). The distal paravertebral nerve block affects the dorsal and ventral rami of spinal nerves T13, L1, and L2 at the distal ends of transverse process of L1, L2, and L4 respectively.
- Landmarks: For a proximal paravertebral block, to desensitize T13, cannula needle is placed at the anterior edge of the transverse process of L1 approximately 4-5cm lateral to the dorsal midline. In order to desensitize L1 and L2 the cannula needle is placed just caudal to the transverse processes of L1 and L2. For a distal paravertebral nerve block, point of insertion is ventral and dorsal to the transverse process.
- **Procedure:** For proximal paravertebral block, the skin at the cranial edges of the transverse processes of L1, L2, and L3 and a point 2.5-5 cm off the dorsal midline is desensitized using 2-3 ml of local anesthetic with an 18-gauge, 2.5 cm needle. To minimize skin resistance during insertion of an 18-gauge, a 10-15 cm spinal needle, a 14-gauge, 2.5 cm needle can be used as a cannula or guide needle. 5 ml of local anesthetic can be placed through the cannula

to anesthetize the needle tract. To desensitize T13, the spinal needle is passed ventrally until it contacts the transverse process of L1. The needle is then walked off of the cranial edge of transverse process of L1 and advanced 1cm to pass ventral to the process and into intertransverse ligament. A 6-8 ml total of local anesthetic is injected with little resistance to desensitize the ventral branch of T13. The needle is withdrawn 1-2.5 cm above the fascia or just dorsal to the transverse process and 6-8 ml of local anesthetic is infused to desensitize the dorsal branch of T13. To desensitize L1 and L2, the spinal needle is walked off of the caudal edges of the transverse processes of L1 and L2 at a similar depth to T13's injection site and the needle is advanced roughly 1 cm to pass slightly ventral to the process and into the intertransverse ligament. A 6-8 ml total of local anesthetic is injected with little resistance to desensitize the ventral branches of the respective nerve. The needle is withdrawn 1-2.5 cm above the fascia or just dorsal to the transverse process and 6-8ml of local anesthetic is infused to desensitize the dorsal branch of the respective nerve. For distal paravertebral nerve block, an 18-gauge, 3.5-5.5 cm needle is inserted ventral to the transverse process and 10 ml of local anesthetic is infused in a fan shaped pattern. The needle can be completely removed and reinserted or just redirected dorsal to the transverse process in a caudal direction where an additional 10 ml of local anesthetic is infused in a fan shaped pattern. This pattern is repeated for the transverse processes of the second and fourth lumbar vertebrae. The proximal paravertebral nerve block has the advantage of requiring small doses of anesthetic while providing a wide and uniform area of analgesia and muscle relaxation, decreased intraabdominal pressure, and absence of local anesthetic at margins of surgical site. Some disadvantages include more skill required for consistent results, difficulty identifying landmarks in those obese or heavily muscled animals, and scoliosis of the spine which can make closure of the incision more difficult. Advantages of distal paravertebral nerve block include a lack of scoliosis seen with proximal method, more consistent results produced, and it is an easier method to perform. The disadvantages of the distal paravertebral block include the need for larger doses of local anesthetic required and variations in efficiency due to variations in anatomical pathways of the nerves.



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3. Grimm K. Veterinary anesthesia and analgesia. 5 ed. K Grimm LL, W Tranquilli, S Greene, editor. Ames Iowa: John Wiley & Sons; 2015.
4. Edmondson M. Farm Animal Anesthesia. 1 ed. H Lin P Walz, editor: John Wiley & Sons; 2014. 20 p.
5. Grady Cofield L. A Review of Local Anesthesia Techniques and Applications in Food Animal Practice Department of Clinical Sciences, 1500 Wire Rd, College of Veterinary Medicine, Auburn University, AL 36849-5522 USA; email: lgc0004@auburn.edu; cell: 270-350-0335.

SUTURE MATERIALS AND SUTURE PATTERNS

Ideal Suture Material

- Easy to handle.
- Reacts minimally in tissue.
- Inhibits bacterial growth.
- Holds securely when knotted.
- Resists shrinking in tissue.
- Non-capillary, non-allergenic, non-carcinogenic.
- Absorbs with minimal reaction after the tissue has healed.
- Unfortunately the so-called ideal suture does not exist although nowadays some of the sutures available in the veterinary market are very close to ideal.

Classification of suture material

Suture materials may be classified according to their

- Behavior in tissue (absorbable or non-absorbable),
- Their structure (monofilament, multifilament) or their origin (synthetic, organic or metallic).
- Sutures of biologic origin such as surgical **catgut** (not widely used recently due to availability of strong monofilament synthetic absorbable suture materials) are gradually digested by tissue enzymes and phagocytized,
- Whereas sutures manufactured from synthetic polymers (mostly used nowadays) are broken down by hydrolysis. Non-absorbable sutures are ultimately encapsulated or walled off by fibroblasts.
- Monofilament sutures are made of a single strand of material.
- They have less tissue drag than multifilament sutures and do not have interstices that may harbor bacteria.
- They should also be handled with care because nicking or damaging them with needle holders or forceps weakens them and predisposes them to breakage.
- Multifilament sutures generally consist of several strands of suture that are twisted or braided together.
- Generally they are more pliable and flexible than monofilament sutures.

- They may be coated to reduce tissue drag and enhance handling characteristics.
- Synthetic absorbable sutures loose most of their tensile strength within 60 days and eventually disappear from the tissues because they have been hydrolyzed.
- The time to loss of strength and for complete absorption varies among suture materials.

In the recent years most commonly **synthetic absorbable sutures** used in veterinary practices are:

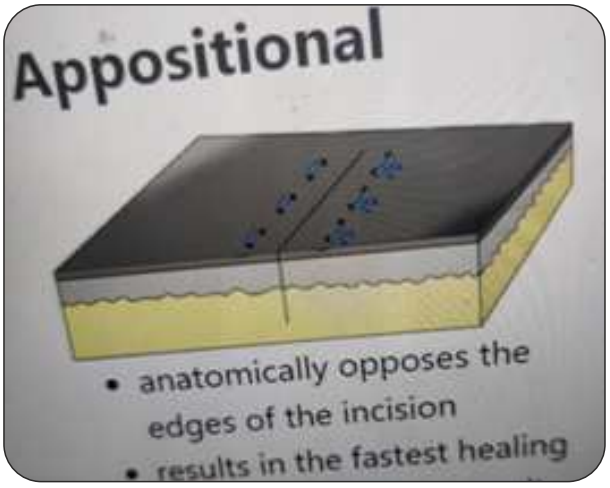
- Vicyl (Polyglactin 910), Polydiaxonone

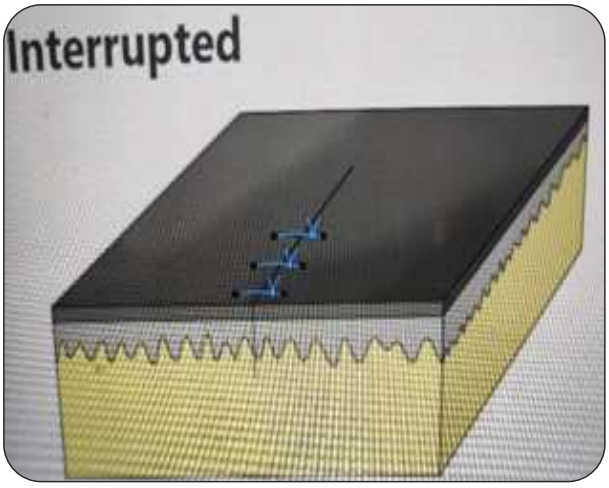
Non-absorbable suture material

- Non-absorbable sutures are marketed as braided multifilament or monofilaments.
- They are typically strong and induce minimal tissue reaction.
- Non-absorbable sutures, which consist of an inner core and an outer sheath (e.g. Supramid) should not be buried in tissue because they may predispose to infection and fistulation.
- The outer sheath is frequently broken thus allowing bacteria to reside under it.
- Nowadays most commonly non-absorbable sutures used in veterinary practices are……
- Nylon, silk, Synthetic polyamide

Suture Patterns

- **Apposing**: To bring the wound edges closure(exact approximation of cutaneous edges of a wound)

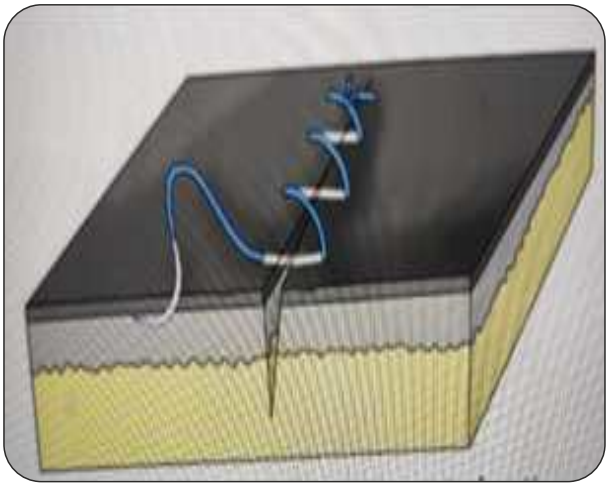






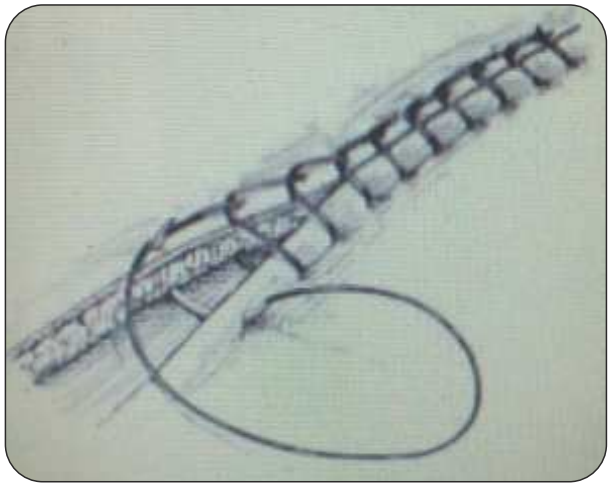


Simple interrupted suture



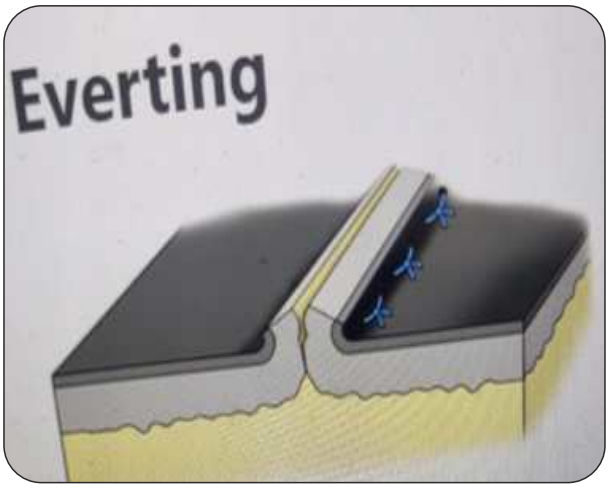


Simple continuous suture



Continuous interlock suture

- **Everting**: Slight eversion is useful in skin closure.

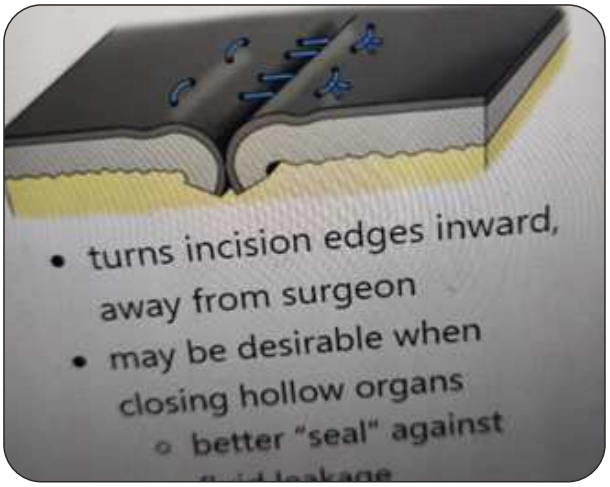


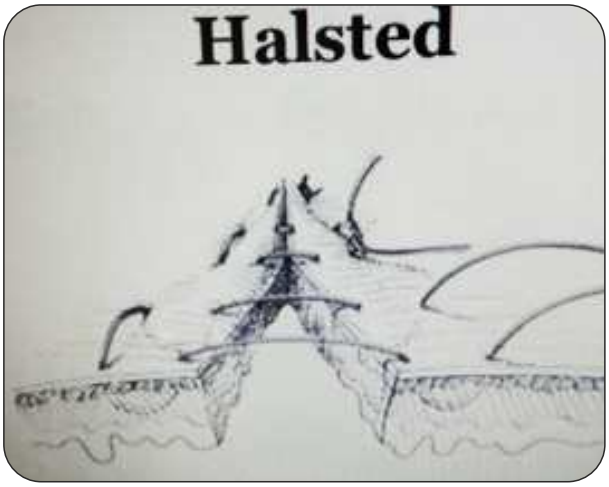


Horizontal mattress suture

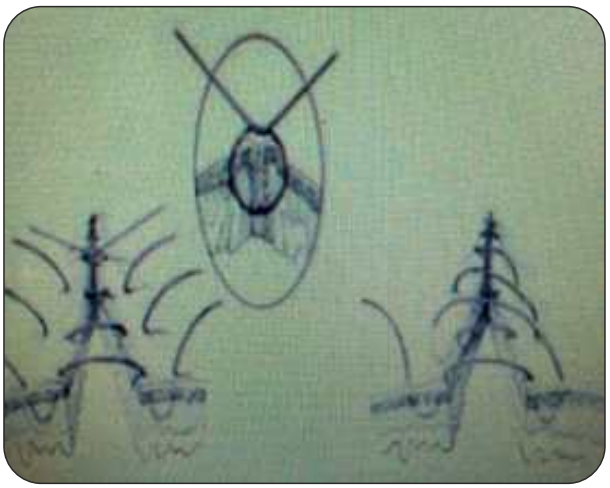
- **Inverting:** Used in closure of hollow viscera, however excessive inversion may decrease lumen diameter, Rumen, Reticulum, Omasum, Abomasum, stomach, urinary bladder etc. Gastrointestinal: enterotomy Intestine: resection and anastomosis.

  Eg. Cushing, Lembert and halstead.

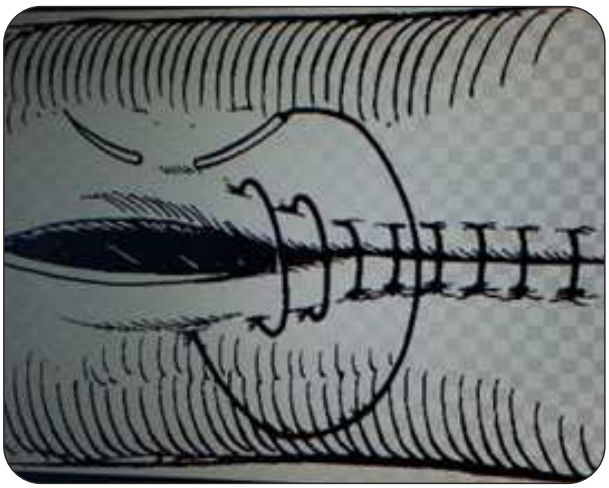




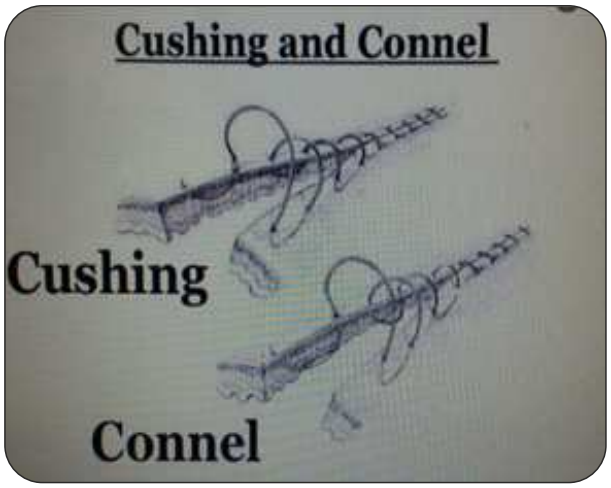
Halstead suture (Penetrates up to submucosa)



Lembert suture



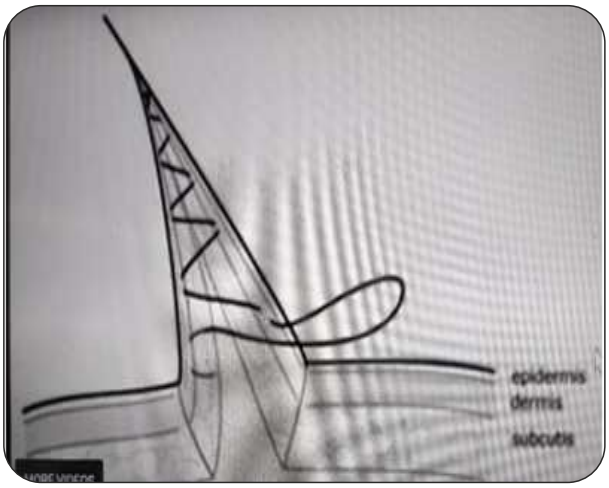
Cushing suture



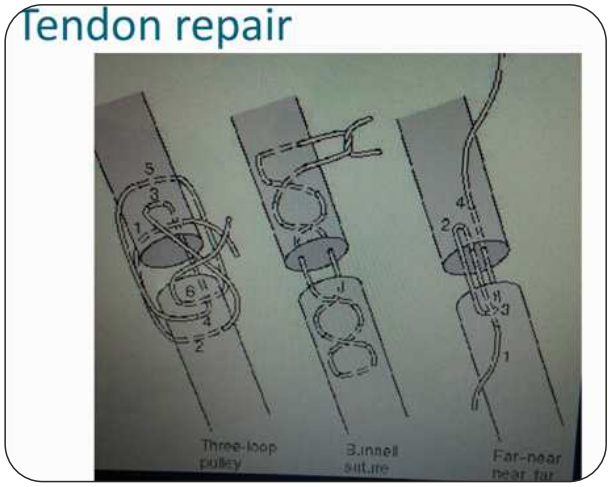
Cushing, lembert and halstead sutures will penetrate up to submucosa only, Where as connel suture penetrates mucosa also and enters the lumen of hollow organs.



Appearance of inversion suture



Subcuticular suture



Three loop pully, Bunnel suture and Far-near near -far sutures

Wounds

- Wounds should be sutured with just enough tension to bring the edges into light apposition

Types of tension sutures:

- Interrupted vertical mattress
- Horizontal mattress
- Walking sutures
- Quilled sutures
- Stent sutures

Simple interrupted suture pattern

Most widely used including:

- Skin.
- Subcutis.
- Fascia.
- Blood vessels.

- Nerves.
- Gastrointestinal tract. – esophagus, intestines etc.

Advantages

- Secure closure with precise application of tension possible.
- Simple and quick to perform.

Disadvantages

- Excessive tension → inversion.

Inversion sutures are used to close holo organs- Rumen, Reticulum, Omasum, Abomasum, Stomach, Urinary Bladder etc.

1. Lembert.
2. Cushing.

DIFFERENT SURGICAL CONDITIONS AND MANAGEMENT
COMMON SURGERIES IN LARGE AND SMALL RUMINANTS AND PIGS

I. RUMENOTOMY IN A COW

Indications

1. Persistent rumen impaction.
2. Frothy bloat.
3. Traumatic reticulitis.
4. Repair of reticular hernia.
5. Hair balls and other foreign bodies in rumen and reticulum.

Site of operation: Left mid flank.

Anesthesia: Inverted L block- 1 to 2 inches away from Parallel to the last rib and lumbar transverse process.

Control: In standing position.



Left flank is aseptically prepared for the surgery



The operation site is draped and given inverted L block with2% lignocaineHCl



Skin incision on the site of operation



Muscles are incised in line with the skin incision



Peritoneum incised and entered the abdominal cavity



Rumen is fixed to the weingarthsrumenotomy set and rumen is incised



Rumen is explored for the presence of any foreign bodies



The ruminal contents are examined for foreign bodies. If at all the contents are removed only 2/3 rd quantity has to be removed and 1/3rd has to be left in the rumen. After transplantation of fresh rumen liquor from other animal the ruminal incision has to be closed.



After exploration and removal of foreign bodies the rumen is closed with a double row of lembert or cushing followed by lembert suture pattern using No.1 chromic catgut



After completion of closure of the ruminal incision the blood clots on the rumen are cleared with normal saline and the rumen is left in to the abdominal cavity



The abdominal muscles and subcutis are closed with No. 2 chromic catgut using simple continuous and subcuticular suture patterns respectively.



The skin incision is closed using nylon or silk

II. UPWARD FIXATION OF PATELLA IN CATTLE AND BUFFALOES - MEDIAL PATELLAR DESMOTOMY

STEP 1. Upward fixation of patella is a non-inflammatory functional disorder of the femoropatellar joint in cattle and buffaloes **characterized by jerky movement of the hind limbs during walking to complete immobilization of the stifle joint.** This condition causes economic loss to the farmer.

STEP 2. This condition is more common in young and debilitated animals with a steep angle between femur and tibia. Breed, genetics, nutrition and over exploitation will predispose the animal for this condition. This may occur due to the strain brought about by heavy work on tendon and immature ligaments of the femoropatellar articulation. These things predispose the animal to upward fixation of patella. The relaxed ligaments allow the patella to glide freely on the articular surface of trochlea. If the limb is over extended or due to a confirmatory defect, the patellar apex

may get trapped over the medial trochlear ridge. This results in complete extension of the limb with flexion of the fetlock joint in cattle and buffaloes.

STEP 3. Symptoms are pronounced when animal moves after prolonged rest. It struggles hard to walk because of difficulty in flexion of the affected stifle joint. This may cause accidental fall and fracture of bones and lack of sufficient nutrition as movement is difficult. These symptoms are more pronounced during pregnancy.



Upward fixation of patella

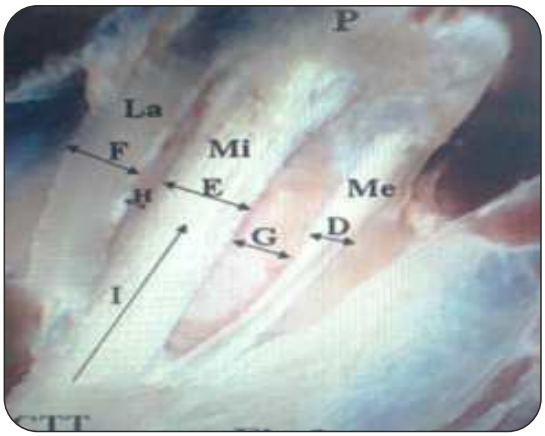


Dragging of affected limb in a buffalo

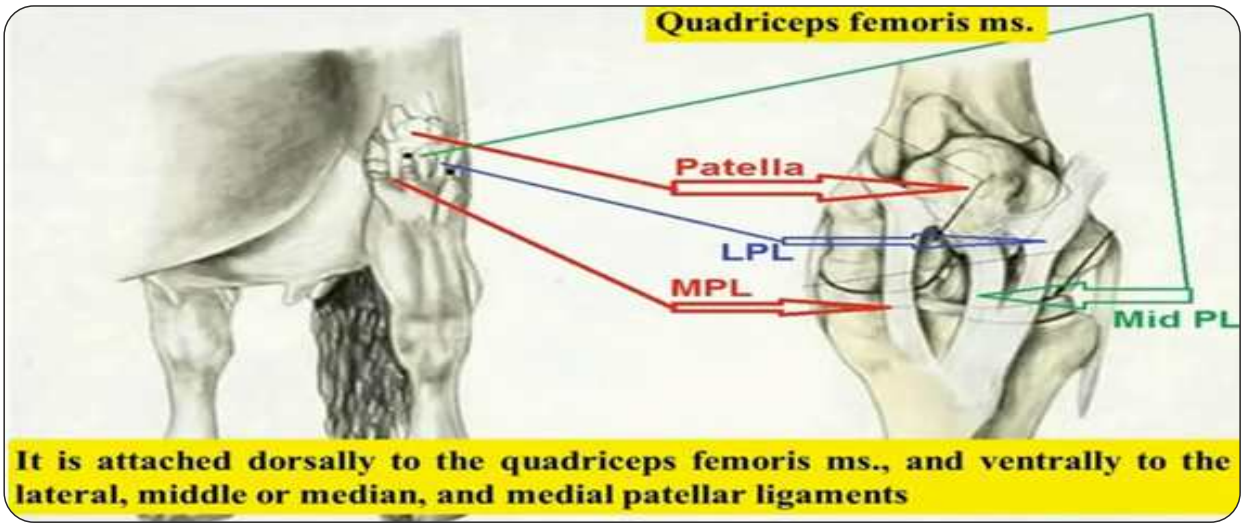


Dragging of affected limb with flexion of fetlock joint in a cow

STEP 4. Once the diagnosis is made the treatment is medial patellar desmotomy (severing of medial patellar ligament) which will cure the disease permanently. To do the medial patellar desmotomy (MPD) the knowledge of surgical anatomy is essential. The three patellar ligaments are the continuation of fibrous bands of quadriceps muscle and have the insertion at the cranial tibial tuberosity.



Me- Medial patellar ligament, MI- Middle patellar ligament and La- Lateral patellar ligament.CTT- Cranial tibial tuberosity, P – Patella





Cutting of the medial patellar ligament in a cadaver stifle joint (Left to right- medial patellar ligament, middle patellar ligament and lateral patellar ligament)

STEP 5. For performing MPD the animal should be casted on the lateral recumbency with the affected limb down so that the medial side of the hind limb faces the surgeon or it can be performed when the animal is standing with proper restraint. If the animal is casted in lateral recumbency the limb is tied at the fetlock joint and drawn backwards till the stifle joint is exposed and the ligaments are held in taut by tying the fetlock to a poll. The site (1 and 1/2 inch above the cranial tibial tuberosity and infront of the medial condyle of the tibia) is prepared aseptically and surgical spirit or betadine is applied liberally. A few ml of lignocaine HCl, injected at the site to prevent pain and accidental movement during the operation. The middle patellar ligament is thick and strong as compared to the other two ligaments. Palpate this ligament and keep the ligament between your thumb and index finger. The posterior border of this ligament is the starting or cranial border of the medial patellar ligament. With the help of number 11 blade on number 3 BP handle give a stab incision in the groove between the middle and medial patellar ligament and draw the blade posteriorly towards the skin. Thus the medial patellar ligament is cut and there will be protrusion of the adipose tissue. This indicates the successful severing of the medial patellar ligament. 10 ml of tincture iodine or betadine is injected in the gap created by the severing of the ligament. Performing MPD is same in both cattle and buffaloes.

STEP 6. The medial patellar desmotomy dramatically improves the mobility of the affected hind limb. The animal shows immediate relief from the dragging of the limb and walks away simply.

MPD IN STANDING POSITION IN CATTLE AND BUFFALO



Application of betadine



Injection of lignocaine HCl



Locating the medial patellar ligament in a buffalo in standing position



Severing of medial patellar ligament in a buffalo in standing position

MPD IN LATERAL RECUMBENCY



The animal is casted in lateral recumbency with the affected limb down and the fetlock joint is tied to a poll after drawing the limb caudally to make the medial patellar ligament taut.



Location of site of operation



Severing of medial patellar ligament in lateral recumbency

III. HORN AMPUTATION IN A BUFFALO

In cases of broken horn and horn cancer the horn amputation is performed.

Special equipment needed: Surgical saw or embryotomy wire saw, bone hammer and chisel.

Anaesthesia: Cornual nerve block or infiltration of anaesthetic (Lignocaine HCl 2%) around the base of the horn.

Control: In standing position.

Procedure: The site of operation is prepared aseptically. An elliptical incision is given around the base of the horn and the flaps are everted to expose base of the horn core. With the help of wire saw the horn is cut.



Broken horn in a buffalo



The flaps are everted to expose the base of the horn core, The horn is cut and removed. The flaps are sutured. The bleeding is controlled by ligating the vessels, application of Tr. Benzoin or liquid nitrogen.

IV. AMPUTATION OF TAIL

Indications: 1. Tail gangrene.

2. Injury or neoplasm of the tail.

Site of operation: Above the affected area of the tail.

Anaesthesia: Epidural anaesthesia.

Control: In standing position.

Procedure: Prepare the site of operation aseptically. Apply tourniquet at the base of the tail. V shaped incisions are made on dorsal and ventral aspect of the tail below the intervertebral space above the affected area. The flaps are everted by undermining the skin incisions. The vessels are ligated and the tail is cut at the intervertebral space and removes the affected portion of the tail. The skin flaps are opposed with horizontal mattress sutures with either nylon or silk.



Suturing the stump of the tail after the removal of the affected tail

AURAL HAEMATOMA IN DOG

- Aural haematoma occur frequently in dogs with pendulous ears and occasionaly in dogs with erect ears and cats.
- Haematomas are most apparent in the concave surface of the ear.
- The etiology is not clear but the most accepted theory is that the lesion is self inflicted from head shaking, scratcing and rubbing the ear.
- The auricular cartilage is pierced by many foramina, a configuration that permits the passage of numerous vessels from the great auricular artery.
- Shearing forces from trauma are believed to tear some of the vessels.
- Blood accumulates between the skin and the layers of cartilage of the pinna. Bleeding contiues until the internal pressure equals the pressure of the feeder arteries.



- Hematomas should be treated immediately after diagnosis.
- Untreated haematomas usually cause various cosmetic alterations resulting from fibrous contracture.
- Some ears have cauliflower like appearance, which is permanent alteration.
- Identification and treatment of the underlying cause are critical to longterm management of patients with aural haematoma.

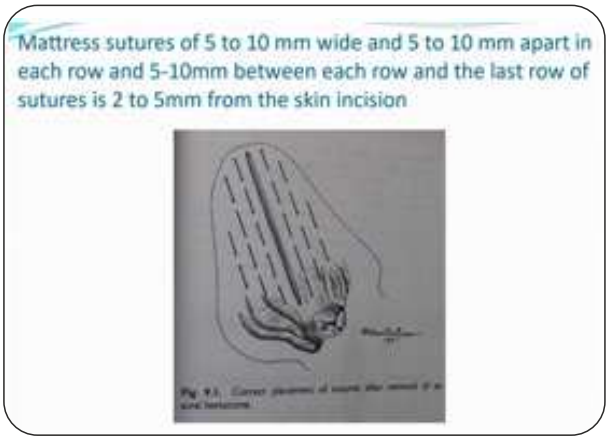


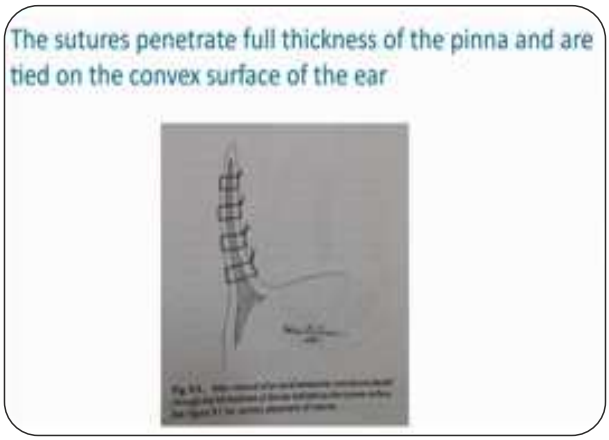
Surgical treatment of aural haematoma











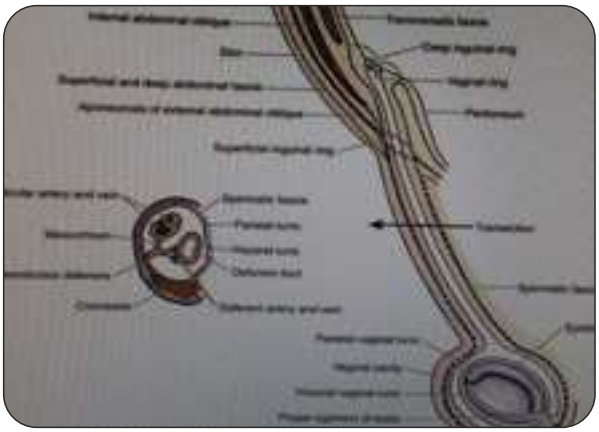
CASTRATION IN DOGS

Castration or neutering of male dogs is surgical removal of the testicles (orchiectomy). The procedure involves general anesthesia. An incision is made just in front of the scrotal sac and both testicles are removed, leaving the sac intact.

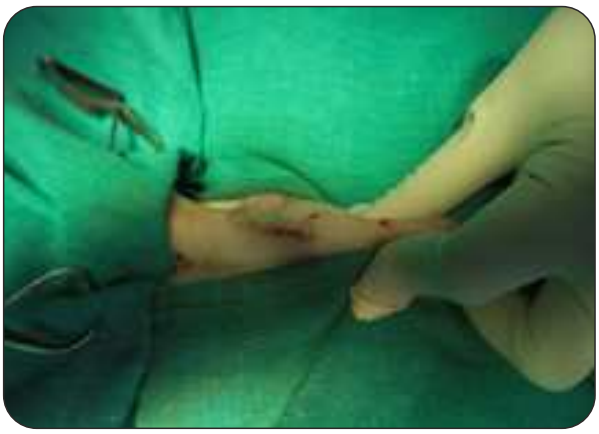
Indications

- This is a common practice to prevent breeding and unacceptable sexual behavior,
- Reduce aggressiveness and prevent accidental or indiscriminate breeding.
- To control perineal hernia and perianal tumors.

Anatomy of the canine testis





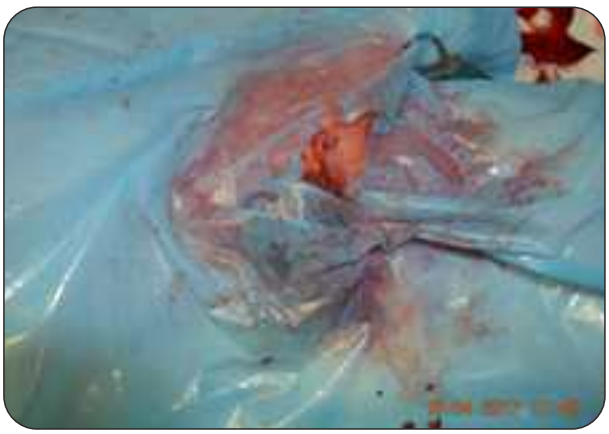












OVARIOHYSTERECTOMY IN A DOG

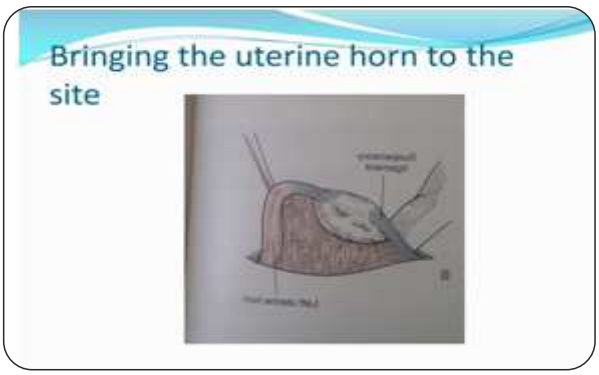
- It is also called as spaying or panhysterectomy, means entire removal of uterus along with ovaries.
- Indications: Sterilization.
- In ovarian and uterine tumours, pyometra and cysts of uterus and ovaries.
- Hyperplasia and neoplasia of mammary glands.
- Whenever the uterus is ruptured and irreparable damage has occurred to the uterus.





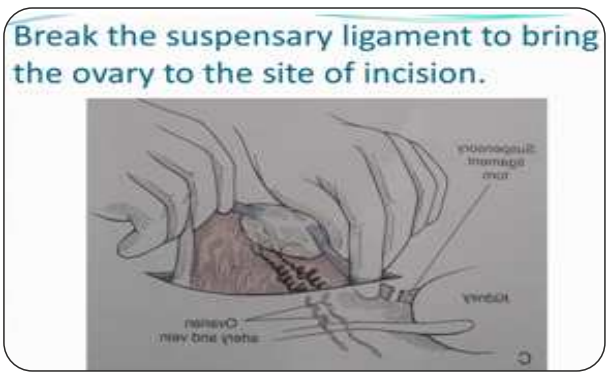


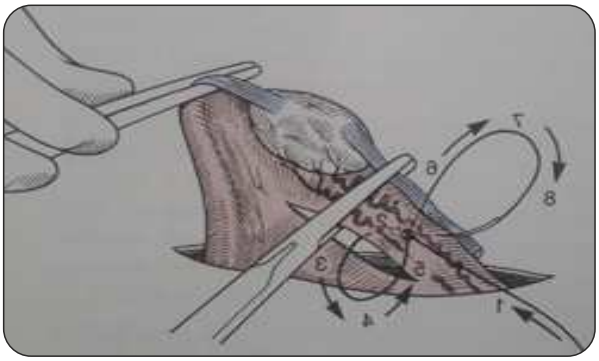






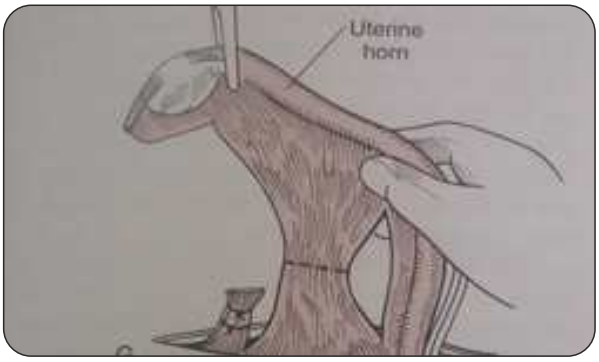






Apply ligatures by making a window in the broad ligament and encircle the anterior part of the ovarian pedicle and trans fix the ligatured tissue to the suspensary ligament by applyng another ligature.





And free the uterine horn and make sure that the ovarion pedicle has ovary or not.



Now expose the uterine body.



This is how the ligatures applied to the uterine body and two artery forceps are applied to the uterine body anterior to the ligature and the uterus is cut in between.



The excised uterus



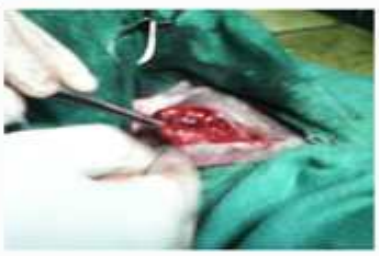
Before leaving the uterine stump in to the abdomen check for the bleeding and leave.



Then the abdominal wall is sutered with either simple interrupted or simple continuous sutere pattern with No.1 /0 chromic catgut



Then the subcuticular sutures are applied.





Mammary Tumours

- Mammary tumors are more **common in female dogs that are either not spayed or were spayed after 2 years of age.**
- The **risk** of a dog developing a mammary tumor is 0.5% if spayed before their first heat (approximately 6 months of age), 8% after their first heat, and 26% after their second heat.
- Cats spayed before 6 months of age have a 7-times reduced risk of developing mammary cancer and **spaying at any age reduces the risk of mammary tumors** by 40% to 60% in cats.
- More than 25% of unspayed female dogs will develop a mammary tumor during their lifetime.
- The risk is much lower for spayed female dogs, male dogs, and cats of either gender.
- In female dogs, 50% of mammary tumors are benign and 50% are malignant. However, **few of the malignant mammary tumors are fatal.**
- In contrast, over 85% of mammary tumors in cats are malignant and most of these have an aggressive biologic behavior (i.e., mammary tumors in cats tend to be locally invasive and spread elsewhere in the body).
- Surgical removal of mammary tumor is recommended for most mammary tumors. Chemotherapy may be required following surgery in some cases.
- The prognosis is good following surgical resection for most mammary tumors in female dogs, but the prognosis is worse for certain types of tumors in dogs and all mammary tumors in cats.
- Of dogs, poodles, dachshunds, and spaniels are most affected. In cats, Siamese or other Oriental breeds and domestic short hairs are most often affected. **In dogs, obesity at a young age is a risk factor.**

Symptoms:

- A palpable mass underneath the skin of the abdomen is the most common findings in dogs and cats with mammary tumors. However, other signs and symptoms include discharge from a mammary gland, ulceration of the skin over a gland, painful, swollen breasts, loss of appetite, weight loss, and generalized weaknes.



Diagnosis

- A good general physical examination is needed to find the location, size, and character of all the mammary masses and assess local lymph node enlargement.
- **Other procedures** are performed to stage the cancer (determine what type it is and where it is located in the body):
- **Bloodwork:** blood count, chemistry, urinalysis, and clotting profile
- **Abdominal ultrasound**, **chest x-rays and sometimes CT scan**: used to check for cancer that has spread to other parts of the body
- **Aspiration** (aka Fine Needle Aspirate): a needle is used to sample the mammary mass to help distinguish it from other skin tumors. Lymph nodes may also be assessed to look for a spread of cancer cells. This is more reliable in dogs than cats to confirm a diagnosis (FNAC).
- A **biopsy** may be indicated to rule out a certain kind of tumor called inflammatory mammary carcinoma, as surgery is generally not recommended for this tumor type.

Treatment

- The type of surgery depends on the size, location, and number of mammary tumors and species of the animal.
- In general, surgery is more conservative for dogs with mammary tumors and involves removal of either the mass alone or the affected mammary gland.
- However, in cats, more aggressive surgery is recommended with removal of one or preferably both sets of mammary glands. Surgery to remove both sets of mammary glands from a cat is often done in two surgical procedures 2–3 weeks apart.
- The local lymph node should also be removed in cats, if possible, to assess for evidence of spread of the cancer.
- The role of spaying female dogs with mammary tumors is controversial. Most studies have shown no beneficial effect of spaying at the time of tumor removal in preventing the development of new mammary tumors or influencing the aggressiveness or metastatic potential of existing mammary tumors.
- However spaying at the time of mammary tumor resection may be recommended because recent studies have shown a beneficial effect in dogs with mammary tumors and it can prevent unrelated diseases, such as pyometra (uterine infection).

- The role of chemotherapy in cats and dogs with malignant mammary tumors has not been clearly defined for all tumor types but oncologist consultation after surgery is often recommended.
- For most mammary tumors in cats and dogs, hormonal therapy, immunotherapy, and radiation therapy have either not been investigated or are not beneficial.
- **Surgery is not recommended for dogs with inflammatory mammary carcinoma** because it does not improve survival rate. Unfortunately, an effective treatment has not been discovered.
- Radiation therapy in combination with a non-steroidal anti-inflammatory drug has been shown to provide the most effective pain relief in dogs, but the prognosis remains poor.
- **Mastectomy procedures** are performed similarly in both dogs and cats although the laxity of feline skin generally makes the surgery easier in cats.
- 1. Lumpectomy-Skin incision made directly over the tumor
- 2. Partial mammectomy-Elliptic incision involving tumor and normal mammary tissue
- 3. Simple mastectomy- Elliptic incision is made to encompass the gland
- 4. Regional mastectomy- The cranial 3 gland are removed enbloc or the caudal 2 glands are removed enblocwith the lymph gland draining them.
- 5. Complete unilateral mastectomy- The skin incision encompasses all epsilateral mammary glands.



Figure 1: Lumpectomy- A small skin incision is made over the nodule.



Figure 2: The nodule is grasped with forceps and freed from surrounding tissues.

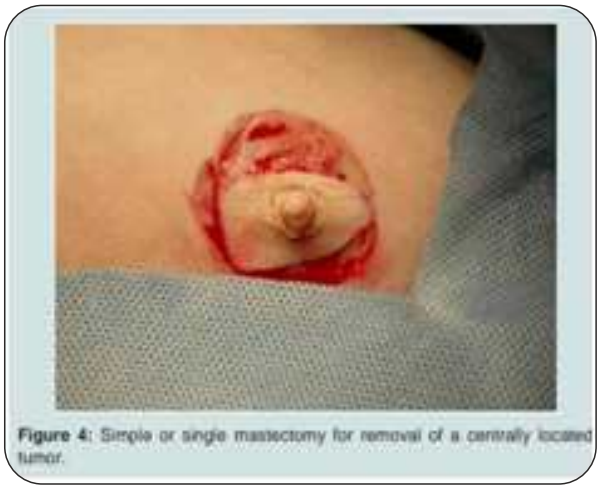


Figure 4: Simple or single mastectomy for removal of a centrally located tumor.



Figure 5: Skin deficit following simple mastectomy of Figure 4.







Simple Mastectomy Procedure

- The surgical procedure should be performed under GA.
- An elliptical incision of skin and subcutis is taken around the affected mammary gland enclosing the entire gland with 1-2 cm margins of healthy tissue.
- The mammary gland containing the tumor should be bluntly seperated from the abdominal wall.
- The cranial and caudal superficial epigastric vessels should be properly ligated and the mammary gland is removed. The bleeding vessels should be ligated.
- Subcuticular suture should be applied to avoid tension in skin closure.
- The skin incision is closed with horizontal mattress sutures.





Blunt dissection to separate the tumor from abdominal wall



Ligation of bleeding vessels during surgery



Blunt dissection to excise the tumor



The removed mammary tumor mass



Ligation of bleeding vessels



Subcuticular suture



Skin sutures



Application of antiseptic dressing



Postoperative Care

- **Restrictions following surgery usually are:**
- Elizabethan collar for 10–14 days after surgery to prevent the natural tendency of pets to lick and chew at a wound.
- Limited and restricted activity is indicated for about 2 weeks to allow recovery and incision healing.
- Bandage care may also be required if one is applied.
- Kitty litter made from newspaper may be recommended rather than clay litter.
- If the mammary tumor is malignant, the surgical site and regional lymph nodes should be checked for local tumor recurrence and metastasis, respectively, every 3 months for the first 12 months after surgery and then every 6 months thereafter.
- **Abdominal ultrasound and chest radiographs are also recommended every 3 - 6 months** to assess for evidence of metastatic disease.

Complications

- Complications following mastectmy may include seroma formation, infection, dehescence of incision, ischemic necrosis, self mutilation, haemorrhage, hindlimb edema and tumor recurrence.

SKIN GRAFTING

Nongrafting Options for Wound Reconstruction:

Such as wounds that lack available adjacent skin and do not allow for primary closure, tension-relieving techniques, or simple local skin flap reconstruction are not suitable then skin grafts are usually considered. For example, axial pattern skin flaps are rarely able to extend beyond the more proximal regions of the extremities, particularly on the forelimb. Therefore, skin grafts are often chosen for sizable wounds on the distal extremities. Unlike skin flaps, which include a vascular connection to the body, free skin grafts are portions of skin that are completely isolated from one area of the patient's body and used to resurface a remote full-thickness skin defect.

Skin graft healing:

Free grafts initially lack a vascular attachment when transferred to the recipient wound bed. These ischemic skin segments must survive the initial 36 to 48 hours after transplantation by absorbing liberated tissue fluid (mostly plasma) from the recipient bed via capillary action, similar to a sponge. During this period of plasmatic imbibition, the graft appears slightly cyanotic until capillaries from the recipient bed unite and sprout within exposed vessels on the deep surface of the graft to reestablish circulation in a process called inosculation.

In the ensuing several days, as undisturbed capillaries sprout and remodel, the surface color of the graft begins to turn from slightly purplish to more pink. At the same time, fibroblasts proliferate and begin to actively migrate from the recipient bed through a relatively weak fibrin layer "scaffold" toward the graft. Eventually, they produce a collagen bridge between the 2 surfaces, holding the viable graft securely in place. When successful, this process is known as a graft take.

Factors in success of grafting

Ensuring ideal conditions at the recipient bed and strict adherence to bandaging and aftercare are just as important to eventual graft success as the actual grafting technique followed. Therefore, the surgeon's first priority is to carefully consider if and when the wound bed is suitable for grafting.

Ideal qualities of a graft receiving bed

- Bed is free of foreign material
- Bed is free of epithelium and devitalized tissue
- Bed has a smooth surface
- Bed has a uniform healthy, red, vascularized surface
- Bed is free of hemorrhage, inflammation, and pus

Although free skin grafts require a well-vascularized recipient bed for survival, granulation tissue formation is not an absolute necessity. Immediate grafting of a fresh skin defect may be considered, but only when the bed is clearly suitable for free grafting, such as over a healthy muscle or periosteal surface with minimal evidence of surgical trauma, inflammation, or bleeding. However, a healthy, pink, smooth, non-exudative granulation bed is the ideal substrate for a skin graft take, and most successful surgeons prefer to wait until this has formed (FIGURE 1). Chronic granulation beds are pale and have a relatively poor vascular supply, so they are not considered good recipient beds for free grafting; they must be excised and allowed to re-form a suitable well-vascularized bed first.









Fluid (e.g., blood, pus, or serum) accumulation under the graft can separate the graft from the bed and prevent or delay revascularization, which often results in graft death. Recipient beds that have undulating surfaces create poor contact between the graft and bed and can result in inconsistent inosculation. Likewise, islands of epithelium remaining on the recipient bed block capillary ingrowth to the graft directly above them. Infection of the bed can cause fibrinolysis and break down the early fibrin scaffold that temporarily fastens the graft to the bed. Absence of this scaffold effect prevents fibroblast migration, ultimately leading to a lack of strong collagen fixation between the graft and bed.

In the early stages of graft healing, before a firm collagen bond has formed, any motion between the graft and recipient bed "shears off" fragile capillaries attempting to revascularize the graft, greatly increasing the risk of graft necrosis. Proper bandaging and care and limited patient activity are essential to prevent this risk. Owners must be aware of these priorities before surgery.

Types of skin grafts

Free grafts can be applied as a sheet over an entire recipient surface area, or they can be applied to a bed as multiple smaller grafts in a variety of shapes and sizes, sometimes called partial coverage grafts.[1] Depending on the surgeon's resources and training, skin grafts may be harvested as split-thickness or full-thickness grafts.

Split vs Full thickness grafts

Split-thickness skin grafts include epidermis and a variable amount of underlying dermal tissue. These thin grafts lack durability and hair growth and are more susceptible to contraction, but they generally take readily without significant risk of graft necrosis. An advantage of split-thickness sheet grafting is that even expansive harvested donor beds rapidly heal by adnexal reepithelialization, often without the need for surgical reconstruction. Split-thickness sheet grafts, however, require expensive specialized equipment and training for effective harvesting.

Full-thickness skin grafting does not require extensive experience or training and can be performed with readily available instruments from a standard general surgery pack. A full-thickness skin graft includes the entire dermis as well as the epidermis. Due to their greater depth, full-thickness grafts rely on plasmatic imbibition to a greater extent early in the process of healing, and sprouting capillaries take longer to fully spread and nourish the dermis. For this reason, full-thickness grafts may not take as consistently as split-thickness grafts.[1,4] Also, unlike split-thickness donor beds, most full-thickness donor bed defects require surgical closure.

Full-thickness skin grafts are preferred by many small animal surgeons because they are much more durable and cosmetic (they contain variable amounts of hair follicles and glands). In addition, when harvested as a sheet, they are less susceptible to secondary graft contraction, which is particularly important when grafting in the region of a joint to preserve mobility. In the author's experience, properly executed full-thickness skin grafts can achieve take rates comparable to those published regarding split-thickness grafts in small animals, particularly cats.

Sheet Versus Partial Coverage Grafts

Sheet grafts are usually "meshed" (multiple full-thickness incisions through the graft) to allow for drainage and help the graft contour to the defect surface. If needed, meshing can also help expand the graft somewhat to cover more expansive defects (FIGURE 1). In such cases, mesh incisions created by a scalpel blade are oriented perpendicular to the direction needed for graft expansion.

Punch, pinch, strip, and stamp grafts are used to partially cover a recipient bed. These smaller grafts can be spread out over the bed to increase the total surface area a small harvested graft can cover. Open spaces between these smaller graft "islands" allow for drainage until the granulation bed is covered by migrating epithelial cells originating from the graft boundaries. When these grafts are nestled within the granulation bed (e.g., punch grafts), they can survive under less-than-ideal recipient bed conditions (FIGURE 2).





(A) Severe calcinosiscutis affecting the lumbosacral region in a beagle with Cushing's disease.

(B) Dermal necrosis and infection of the affected region necessitated extensive full-thickness skin debridement and open wound management. The looped sutures were used for tie-over bandages in this challenging region to dress.





(C) Following successful open wound management, the wound bed is covered with granulation tissue. Expanding islands of white epithelialized tissue can be seen within portions of the bed.



(D) Small punch grafts can be seen evenly interspersed within a portion of the granulation bed 5 days after implantation.

(E) Healed punch-grafted area at 5 weeks. Note there has been significant contraction of the original wounds, and the surface, while epithelialized, has sparse hair cover and is somewhat disfigured.

Smaller partial coverage grafts conform to irregular recipient beds and are relatively easy to place. The goal of these widely spaced graft segments is to rapidly epithelialize the wound defect. Unfortunately, the result is less than cosmetic and is much less durable when compared with full-thickness sheet grafts, so these grafts should not be considered for weight-bearing areas such as the paw or elbow. Partial coverage grafting techniques are described in more detail elsewhere.

Pre-operative Antibiotics

All granulation beds are contaminated with bacteria to some extent. Some surgeons routinely culture the wound bed before grafting to ensure the most appropriate antibiotic is chosen during the grafting procedure. The author does not routinely culture the bed provided it is fully covered with healthy granulation tissue and is non-exudative. The author prefers to apply a liberal amount of silver sulfadiazine cream over the area for 1 to 2 days before the proposed grafting procedure (bandages are changed daily). First-generation cephalosporin antibiotics are then given intravenously at anesthetic induction and repeated every 90 minutes until the procedure is completed so that high tissue levels are achieved during graft harvesting and application. Generally, post-operative systemic antibiotics are not considered essential, but if they are elected, they should not be continued for longer than 5 to 7 days after surgery.

Skin Graft Donor Site Choice

For sheet grafts, choose a donor site with ample surrounding loose skin to allow primary closure of the site without tension. The donor site should be in a location that allows access to both donor and recipient sites without having to alter the animal's position and should appear healthy with no evidence of trauma, inflammation, or infection. The author often prefers the lateroventral trunk region for a sheet graft donor site because the skin is of uniform thickness, there is usually plenty of surrounding skin, it does not contain a subdermal panniculus muscle layer, and achieving hemostasis is generally not an issue. However, nearly any region of the body with ample healthy, redundant skin can be used.

Surgical Preparation of Donor and Recipient Beds

On the day of surgery, the donor area is routinely aseptically prepared. Before liberally clipping hair from the region of the recipient site, coat the bed with sterile lubricating gel and then cover it with sterile gauze sponges. After clipping, the defect is cleansed and gently scrubbed with sponges soaked with a stock solution of 2% chlorhexidinegluconate diluted with saline (1:40) to create a 0.05% solution. Aseptically prepare the remaining skin surrounding the defect in a routine fashion.

Intraoperative Considerations

The procedure must be conducted under strict aseptic technique. The harvested graft and recipient bed must not be allowed to dry out at any time. While the recipient site is being prepared, the author wraps the graft in a moistened gauze pad that is secured with forceps to the cover drape so it is not accidentally discarded. Alternatively, the surgeon can prepare the recipient bed first and cover it with moistened gauze before graft collection. For efficiency, an assistant can close the donor site while the surgeon prepares and applies the harvested graft to the moistened recipient bed. When using sheet grafts, any islands of epithelialization in the wound bed should be sharply excised. In addition, any hemorrhage from the wound bed should be fully controlled and any debris removed before grafting.

Skin Graft Techniques

A full-thickness sheet graft is most often used in small animals because of its inherent durability and hair growth. Punch grafts are sometimes chosen when durable or cosmetic repair of a skin defect is unnecessary and the surgeon desires to hasten epithelialization of the wound bed. Punch grafts are easy to harvest, but the procedure is tedious when employed in larger defects.

Meshed Sheet Graft

Outlines the key technical points of a successful sheet grafting procedure.

- Keep the graft moist throughout the procedure.
- Remove slightly more skin than the actual size of the recipient bed
- Ensure that the graft has no attached subdermal tissue (i.e., is properly defatted).
- Bathe the graft periodically with cool saline.
- Cut staggered rows of full-thickness mesh holes in the graft.
- Ensure that the graft is not applied too tightly or too loosely.
- Ensure uniform contact between the graft and the bed.
- Overlap the edge of the graft with the defect margin and secure it with fine sutures around the periphery.

Design the Graft Template

After the recipient bed region and donor areas are widely clipped and aseptically prepared, design the sheet graft to completely cover the recipient bed with a uniform layer of skin.

First, wipe the skin around the recipient site free of moisture. Using sterile paper such as a surgical glove paper wrap or four-quadrant draping material, create a template of the recipient bed by pressing the paper onto the moistened, raw wound surface and lifting to retain a moist impression of the defect. Cut out the template along the boundary of the impression area with scissors, and use a marking pen to indicate the direction of the desired hair growth in the recipient site.

Place the template over the selected donor skin site, orienting it such that the hair growth in the donor area is in the same direction as that marked on the template. Mark the donor site about 1 cm outside the border of the template to ensure adequate coverage since the graft, when harvested, can be expected to shrink somewhat. Redundant skin, if any, can be excised during graft placement.

Remove the Sheet Graft

Incise the proposed graft margins with a clean scalpel blade and sharply remove the graft at a level between the dermis and hypodermis. Avoid trauma and excess handling of the skin graft with thumb forceps during skin undermining; use skin hooks or stay sutures if needed. Control hemorrhage and cover the donor area with moistened sponges. Ideally, the donor site should be cosmetically closed *after* the graft is prepared and placed on the defect. If graft placement is delayed, store the graft in a moistened sponge that is secured to the cover drape with forceps.

Prepare the Graft for Placement

All subcutaneous tissue must be meticulously and fully removed from the deep surface of the graft (i.e., defatting). Fat removal can be achieved by anchoring the margins of the graft to a sterile piece of corrugated cardboard with the deep surface showing. Smaller grafts can be draped over a sterile 4-inch roll of Vetrap (3M) or the like. Stretch the graft on the chosen surface and secure it with stay sutures or skin staples placed evenly around the perimeter of the graft edge. The graft surface must be kept moist during the defatting process.

Either sharp Metzenbaum scissors or a #10 BP scalpel blade (preferred by the author) can be used to remove any remaining fat. The defatted cut surface of the graft should have a cobblestone or "stippled" appearance, and the graft should appear opaque when held up to a bright light.

Immerse the graft in a saline bowl to spot any remaining strands of fat that should be excised. All subdermal fat must be removed from the graft before its final placement in the bed. Some dermal adnexa will also be removed during the defatting process, and the amount of hair growth on the healed grafted area may appear accordingly sparse.

Place and Anchor the Graft

Place the graft with the epidermal layer surface up and create small (less than 1 cm), staggered, uniformly oriented, parallel, full-thickness scalpel incisions (preferably perpendicular to the desired direction for graft expansion if needed) throughout the graft to allow drainage of fluid collecting between the graft and bed. Ideally, the sheet graft should slightly overlap the edges of the bed to be sure all wound edges are covered. Fix the graft to the wound edges with 4-0 monofilament non-absorbable sutures, allowing this overlap to remain. Sutures are not typically placed between the graft and the wound bed, although some surgeons do this in an attempt to limit any shifting within the central aspect of the graft.

Key Point

After suturing, sheet grafts must maintain even contact with the underlying recipient bed to help ensure effective revascularization. The sutured graft must not be under significant tension, which might inadvertently lift it off the bed, particularly on concave defects. The graft should shift along the bed surface just slightly when touched with a finger.

Punch Graft

This partial coverage grafting technique is best used when there is a thick granulation bed in the defect in which the grafts can be firmly seated (Figure 2). Because these grafts are nestled within a pocket and surrounded by vascular tissue, the author often chooses this method when the recipient granulation bed is less than ideal or the patient has a systemic disease that increases the risk of infection or poor healing. Punch grafts are easy and inexpensive to perform, and are considered "forgiving" due to the fact that if a number of grafts dislodge or do not survive, they can simply be replaced. The goal is to cover the defect with skin graft plugs staggered and spaced evenly throughout the defect, about 1 to 1.5 cm apart.

Harvest the Grafts

Generally, a 6-mm Baker's punch is used to harvest the plugs of skin, generally from the shoulder or trunk area. Try to punch the skin on an angle parallel to the local hair shafts so any hair regrowth will lie down against the skin surface. If possible, note hair growth direction during harvesting so that when the plugs are implanted and properly oriented, hair growth will be in a uniform direction similar to surrounding skin.

Prepare the Grafts for Placement

Metzenbaum or iris scissors can be used to lift and cut each plug from its subcutaneous fatty attachments. Trim any remaining fat from the plug so that the dermis is fully exposed at the depth of the plug. This is highly important because fat left on the dermis will block inosculation and increase the chance of graft failure. Store the harvested skin plugs in moistened saline-soaked sponges, and close the small donor defects with individual sutures.

Place the Grafts

Use a 4-mm Baker's punch to core circular holes into the granulation bed. The smaller hole compensates for graft contraction after harvesting so that the grafts fit snugly. Sever the cored granulation plugs at the base using iris scissors or a #15 blade. If active bleeding is observed from the holes or pockets, plug them individually with sterilized cotton swabs for at least 4 to 5 minutes before applying the grafts. Otherwise, active bleeding tends to push the grafts from their foundation.

Insert each harvested skin graft into the granulation bed, ideally such that the epidermal layer is level with the granulation surface. When using this technique in thinner granulation beds, either cut the harvested skin plugs thinner to sit flat with the surface of the bed or insert them into angled pockets (instead of cores) made with a #15 blade. Some surgeons choose to fix each skin plug to the granulation bed with a single fine absorbable suture.

Bandaging

After surgery using either technique, the site should be carefully bandaged so the graft remains immobilized. Most sheet skin grafts are applied to mid- to distal extremities, and bandages in these areas have a natural tendency to migrate distally. Bandages must not be allowed to shift distally at any time. Proper choice and application of the 3 layers of the bandage are essential to ensure graft survival.

First, liberally and uniformly apply a triple antibiotic ointment (oil base) to a nonadherent or low-adherence dressing. Ointments are chosen because they protect the graft from desiccation, and the antibiotic reduces bacterial proliferation. The author prefers a petroleum-impregnated fine-weave material for the low-adherence contact layer (e.g., Adaptic). Skin staples or tacking sutures can be used to secure the overlapping contact layer to the skin outside the grafted area to avoid shifting.

Next, apply unfolded 4 × 4 gauze sponges (4 × 8 lengths) in a spiral fashion around the contact layer in 2 layers and use sterile, self-adherent rolled gauze (e.g., Kerlix) to secure the pads around the extremity or area that was grafted. Layer non-sterile cast padding on top, moving from the toes proximally, until a thick, firm secondary absorptive layer is created. Depending on the graft region, the bandage is generally extended above the adjacent joint in the process of application. Use an additional layer of gauze to create a firm, cohesive secondary contact layer.

Finally, apply an outer tertiary layer of elastic wrap (e.g., Elastikon, Johnson & Johnson) to cover and protect the underlying bandage layers. Adhesive tape or elastic wrap can be used to secure the bandage to the fur or skin to prevent slippage. White adhesive tape is often applied on the distal aspect of the limb and used as "stirrups" to additionally secure the bandage.

Additional measures (e.g., slings, meta-splints, reinforcement rods) to immobilize the graft and limb are applied as indicated based on the location of the graft area if additional rigidity and support are necessary. Tie-over dressings are quite effective at immobilizing grafts in difficult areas such as the thigh, sacral, or perineal regions. If the surgeon is familiar with negative-pressure wound management, this technique can be highly effective at firmly immobilizing the graft to the bed, particularly in areas where bandaging can be difficult.

After care

Avoid excessive or unnecessary bandage changes in the early postoperative period. Generally, the bandage is changed after surgery if there is strikethrough or if the bandage becomes soiled or wet or migrates. Otherwise, without these conditions, the author prefers to wait 3 to 5 days for the first bandage change to avoid disrupting the critical early healing phases of the graft.

Sedation or anesthesia is recommended for bandage changes to avoid traumatizing or shifting the fragile graft during bandage removal and reapplication. Take special care to avoid lifting or shifting the graft from the underlying bed, particularly when changing the contact layer. If the bandage layers are stuck together during the bandage change, soften them first by soaking them in warm, sterile saline, then peel the separate layers off slowly.

Carefully inspect the graft and irrigate it with sterile saline before applying a new bandage, following the description above. Viable grafts appear pink to lavender in color. Dead grafts have a black or off-white appearance and are generally not firmly adhered to the bed. However, during the first bandage change, do not become overly concerned if the graft is somewhat discolored or pale. Discolored graft skin should not be removed prematurely, since underlying hair follicles and deeper skin adnexa often survive and serve as islands for epithelialization.

After the initial critical bandage change, if healing appears to be proceeding appropriately, subsequent changes can be planned every 3 to 5 days. Bandages are kept clean and dry throughout the postoperative period. A plastic IV bag can be placed over the distal bandage when exposure to wet surfaces is expected but should not be left for more than several hours at a time.

Sedation of hyperactive patients may be warranted during the healing period. Any motion of the affected limb can cause the inner bandage layers to rub against the graft, which can be catastrophic; therefore, physical activity should be kept to an absolute minimum, especially for the first 5 days. The author usually hospitalizes patients until the first bandage change has taken place. After the first change, dogs are confined to a cage at home and leash-walked when taken outdoors to void only. Cats should be confined to a cage or carrier if possible. Generally, healing is complete at 2 weeks after grafting, at which point the graft can be either left uncovered or bandaged with a light padded wrap if the patient is active or a known "chewer."

SURGICAL EMERGENCIES

EMERGENCIES AND FIRST AID

- The immediate care we give to an injured animal or to an animal, suddenly fallen ill.
- The most important things one has to observe are…
- **A**ir way.
- **B**reathing and bleeding
- **C**ardiovascular (it includes heart function, pulse and capillary refill time).

AVULSION OF HORN

- Separation of horn sheath from the corium is called avulsion of horn.
- There will be severe bleeding from the horn corium.
- The horn is cleaned with KMnO4 and several layers of gauze applied to the corium and Tr. Benzoin is liberally applied. It acts as a styptic and as well as healing agent.

PROPTOSIS

- Protrusion of eye from the orbit due to severe trauma during road accidents or fighting with other animals.
- The prolapsed eye ball should be cleaned with either Normal Saline (NS) or 2% Boric acid lotion.
- Apply Chloromycetin Eye Applicaps around and on the eye ball. This acts as a lubricant with antibiotic activity. Then carefully the eye balls isreposited in to the orbit and apply stay sutures to the eye lids.

SUBLINGUAL SALIVARY CYST

- Sublingual Salivary Cyst is a common condition that affects large animals and dogs.
- It may interfere with mastication and respiration also causing respiratory emergency (Dyspnea).
- The cyst should be incised and a portion of the layer of the cyst is excised to drain the accumulated saliva and prevention of recurrence of the same.

FOREIGN BODIES IN ORAL CAVITY AND UP TO THE PHARYNX CAUSING DYSPNEA

- The foreign bodies may get stuck in the vestibule and interdental spaces and some may cause obstruction at the level of oropharynx and pharynx.
- Careful examination of oral cavity and pharyngeal area and removal of the foreign body with a long artery forceps or dressing forceps to be performed.

BLOAT

- Free gas bloat in ruminants causes severe distension of the abdominal cavity and causes life threatening dysponea.
- Immediate ruminocentesis should be performed to relive excess gases from the rumen with the help of trocar and cannula.
- Administration of antizymotics (Bloatosil/Tymponil) or ground nut oil 500ml to 1lit orally to prevent further accumulation of gases.

BLEEDING

- Bleeding may happen with injuries. The bleeder is located the vessel has to be ligated to control bleeding.
- If there is oozing of blood from the wound then clean it with antiseptic solutions and apply pressure bandage.
- Internal bleeding may be diagnosed by observing MM and CRT.
- Further bleeding can be controlled by giving Inj. Ethamsylate etc. and Tab. Styplon or Tab. Ayapon.

POISONIONG

- Different animal species are susceptible to different plants and poisons. Young animals are generally more susceptible to poisoning than adult animals.
- General principles of first aid in case of poisoning include immediate attention to the affected animal.
- If the route of poisoning is through ingestion then purgatives are given to the affected animals.
- Under field conditions, the poisoned animal is fed with crushed coal because charcoal acts as an antidote for poisoning.
- If the animal is suspected of poisoning through skin, then the skin of the animal is washed thoroughly with soap and water.

FRACTURE OF BONES

- Fracture is break in the continuity of the bone. There will be painful swelling and one can feel the crepitation of the fracured fragments.

- The fractured limb should be kept in alignment as far as possible and apply Robert jones bandage till the orthopaediccunsultation.

PROLAPSE OF RECTUM

- Prolapse of rectum may happen in pups with severe diarrhoea.
- The prolapsed mass should be cleaned with cool normal saline, lubricated with lignocain jelly, carefully reposited back and apply Purse string suture loosely.

PROLAPSE OF UTERUS

- Prolapse of uterus happens postpartum commonly in ruminants.
- The mass should be washed with cool water and lubricated with liquid paraffin and identify the cervix and the uterus has to be properly reposited back through the cervix and ensure proper positioning of the entire mass with pervaginal examination.
- Stay sutures are applied to the vulva to prevent recurrence.

SHOCK

- Shock is a result of a collapsed circulatory system and can occur due to stress, blood loss, fluid loss, low blood pressure and a damaged heart.
- Many animals which are badly injured show signs of shock.
- Signs of shock include rapid pulse or breathing, hypothermia (eg. mammals may shiver and birds fluff their feathers) and pale/white gums.
- The signs of shock are not always obvious and can develop over time. An animal in shock is usually still, quiet and cold.
- Treatment for shock should first aim at reducing stress (e.g. covering the animal's eyes), stopping any visible signs of bleeding and then making sure the animal is kept warm and quiet.
- Oral fluids should not be given to animals in shock (Morgan, 2008). Once the animal has been warmed up, warm fluids can be given.

HYPOTHERMIA

- Hypothermia is caused by a lowering of the body temperature. Signs of hypothermia include cold skin, lethargy, bradycardia (slow heart rate).
- The animal needs to be gradually warmed with a constant artificial heat source such as body contact in a handling bag (if no other heat source available), heat lamp or a hot water bottle. It is preferable that the heat source comes from outside of the holding container and directed at one end so the animal can move closer to or away from the heat source.
- If the heat source is inside the holding container is must be padded or shielded to avoid the animal burning itself. Care must be taken not to have any electrical connections or wiring within reach of the animal.
- Heat can be lethal so place a small dish of water (that cannot be tipped over by the animal) near the heat source (Choy, 2006). Always keep a very close watch as overheating is a danger.
- Once the animal has been warmed to its normal body temperature, high energy fluids can be offered.

BREATHLESSNESS

- Check to see if your pet is unconscious.
- Open your pet's airway by gently grasping its tongue and pulling it forward (out of the mouth) until it is flat. Check the animal's throat to see if there are any foreign objects blocking the airway (see the section above on Choking).
- Perform rescue breathing by closing your pet's *mouth* (hold it closed with your hand) and breathing with your mouth directly into its *nose* until you see the animal's chest expand. Once the chest expands, continue the rescue breathing once every 4 or 5 seconds.

RESUSCITATION

- Gently lay your pet on its right side on a firm surface. The heart is located in the lower half of the chest on the left side, just behind the elbow of the front left leg. Place one hand underneath the pet's chest for support and place the other hand over the heart.
- For dogs, press down gently on your pet's heart about one inch for medium-sized dogs; press harder for larger animals and with less force for smaller animals.
- To massage the hearts of cats and other tiny pets, cradle your hand around the animal's chest so your thumb is on the left side of the chest and your fingers are on the right side of the chest, and compress the chest by squeezing it between your thumb and fingers.
- Press down 80-120 times per minute for larger animals and 100-150 times per minute for smaller ones.
- Don't perform rescue breathing and chest compressions at the same exact time; alternate the chest compressions with the rescue breaths, or work as a team with another person so one person performs chest compressions for 4-5 seconds and stops long enough to allow the other person to give one rescue breath.
- Continue until you can hear a heartbeat and your pet is breathing regularly, or you have arrived at the veterinary clinic and they can take over the resuscitation attempts.

MOVING AN INJURED ANIMAL

- When moving or transporting an injured animal, minimize motion of its head, neck, and spine. A flat, firm surface of wood, cardboard, or thick fabric can be used to provide support. If the animal acts confused or disoriented after trauma, keep the head level or slightly elevated during transport. Avoid any jerking or thrashing motions, and prevent anything from pushing on the neck or jugular veins. Placing cats in boxes can minimize stress during transport. The box should have holes large enough so that you can see the cat.

FLUID THERAPY AND BLOOD TRANSFUSION

FLUID THERAPY

Choice of fluid

- A multi electrolyte, sodium containing crystalloid replacement solutions is usually the choice of fluid and whole blood have obvious advantage.

Types of IV fluids:

- Crystalloid- Normal saline containing 5% to 25% of glucose, Lactated ringers (containing NaCl, KCl, Calcium Chloride and sodium bicarbonate in distilled water)
- Lock's solution: Containing NaCl, KCl, Calcium Chloride and sodium bicarbonate anddextrse in distilled water.

- An easily available and effective crystalloid solution for treatment of shock is 5% glucose in normal saline with 90 milli equivalents of sodium bicarbonate added to each liter adjust the P^H of the solution to 7.4.
- Colloids-albumin, plasma protein and dextran.
- Blood and blood products- blood 5.5 cc per kg body weight. Plasma can be given 10 cc per kg body weight.
- Administration of quantity of the solution depends on quantity of whole blood or plasma lost from circulation. Usually administration is continued until pulse returns to normal.
- The quantity given may be calculated at the rate of 4.4 to 8 cc per kg body weight.
- Half of this calculated dose is administered intravenously and remaining dose subcutaneously.
- When large quantities are required to be administered (more than 5. cc per kg body weight), the additional fluid should consist of colloids in the form of fresh frozen plasma, albumin or whole blood.
- 25 to 50 gm of albumin may be added per liter of normal saline.

Blood transfusion

- Direct method of transfusion: the quantity of blood infused cannot be measured.
- Indirect method of transfusion: Blood is collected and coagulation is prevented by using sodium citrate or by defibrination and transfused to recipient animal.
- The quantity of sodium citrate added to blood is at the rate of 1 g of sodium citrate to 1 ounce of water of 9 ounces of blood.
- If defibrination technique is employed, coagulation of blood may be prevented by agitating the drawn blood beyond the clotting time for the species(for cattle-10 min and for horses, 15 min).

Plasma transfusion

- Plasma collected from same species (homogenous plasma) or from other species (heterogenous plasma) may be used to counter the loss of blood volume.
- The plasma can be collected and stored as follows..
- Sodium citrate can be added to the blood to prevent coagulation.
- Storing in the refrigerator for three to eight days separates plasma from dogs blood. But centrifuging is necessary to separate bovine plasma.
- If suitable broad spectrum antibiotic is added to the plasma then the plasma can be stored in refrigerator up to three months.
- Plasma can be given @ 10 cc per kg body weight.

Water requirement = 35,25+1.58 x DM intake

- +0.9 x milk yield (Pounds/day)
- +0.11 x sodium intake (gm/day)
- +2.65 x weekly mean minimum temp (F/1.8-17.78)

FLUID THERAPY IN CATTLE

1. Fluid distribution.
2. Calculation of fluid deficit and choice of fluids.
3. Acid-base imbalances and rehydration management.
4. Heat stress

Total deficit = TD

- ECF = TD x 1/3
- Plasma = ECF x 1/4
- OR = (TD x 1/3) x 1/4
- TD = TD x 1/12

ASSESSMENT OF DEHYDRATION

- <5% - NOT DETECTABLE
- 5-6% - Subtle loss of skin elasticity
- 6-8% - Marked loss of elasticity (2-4%)
- CRT (2-3”), Pink hardy sticky mm
- 8-10% - Tented skin stands in place (5”)
- CRT (4-5%), Enopthalmos, dry mm
- 10 -12% - Low skin elasticity (6-10%)
- CRT – (6-8%, Marked enopthalmos and dry mm)
- 12 – 15% - Low skin elasticity (20”) CRT (<8%)
- Enopthalmos, dry mm (white or blue), early shock and moribund and death imminent.

In calves

% dehydration	Eye ball status	Skin tent (in seconds)	mm
	None	<1	Moist
1-5-	None to slight	1 - 4	Moist
6-8 -	Slight separation	5 – 10	Tcky
9-10 -	<5 mm gap	11-15	Tacky to dry
11-12-	5 -n10 mm gap	16 - 45	Dry

- Dehydration = Degree of eye recession in to the orbit in mm x 1.6

Laboratory analysis

	PCV	TS	pH
Normal	30 -40	6 – 7.5	7.35 -7.45
Need FT	50 -60	8 – 10	7.20 – 7.30
Unfavorable	>60	>12	7.0 – 7.10

Requirement

- Maintenance requirement = 50 ml/kg/day
- Fluid requirement in litres = Surface area x 2 lit/sq. m
- Calculation of fluid requirement for a 450 kg cow?

Kg	SA (sq.m)	Total fluid requirements
1	0.10	0.20
5	0.29	0.58
10	0.46	0.91
20	0.72	1.44
50	1.32	2.64
100	2.10	4.20
250	3.83	7.65
450	5.64	11.28
500	6.04	12.10
800	8.24	16.50
1000	9.55	10.10

In conditions like D- lactic acidosis, urinary tract diseases, SI strangulation/ obstruction, choke metabolic acidosis, low bicarbonate and severe dehydration. Choice of fluid is NaHCO3 initially followed by electrolytes.

LATEST DIAGNOSTIC TECHNIQUES- USG, X-RAY, ENDOSCOPY, LAPROSCOPY

A number of imaging procedures have been developed to help diagnose diseases in humans, and many of these have been adapted for use in animals. Most imaging methods provide a lot of information by non-invasive and economical means and, at the same time, do not change the disease process or cause unacceptable discomfort to the pet. However, because of the complexity and expense of the equipment and instruments, some of these procedures are carried out in facilities designed especially for their use.

X-RAY IMAGING/RADIOGRAPHY

X-rays have been in use for many decades to create images called radiographs (black, white, and gray images). Radiography is the most common imaging procedure used in veterinary practices. The x-ray images (radiographs) are produced with the same processes used in human medicine except that the equipment is sized for use with dogs, cats, and other small animals. Portable equipment may be used in a large animal clinic that treats horses and other large animals. Although the procedure is painless, in some cases pets are sedated to reduce the anxiety and stress associated with the procedure, to position the animal, and to help the animal stay still while the images are taken.

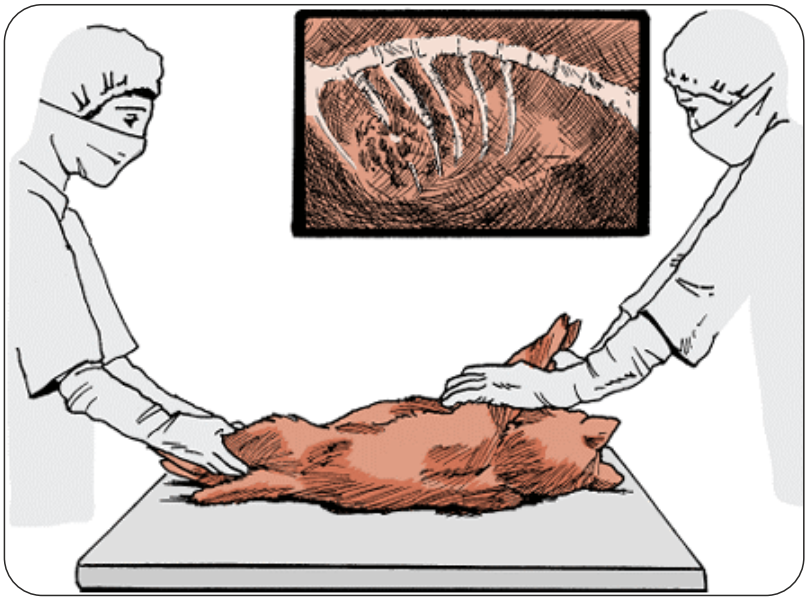
X-rays work well for creating images of bones, foreign objects, and large body cavities. They are often used to help detect fractures, tumours, injuries, infections, and deformities. Although radiographs may not give enough information to determine the exact cause of your pet's problem, they can help your veterinarian determine which other tests may be needed to make a diagnosis.

The body's soft tissues do not absorb X-rays well and can be difficult to see using this technology alone. Specialized X-ray techniques, called contrast procedures, are used to help provide more detailed images of body organs. In these procedures the animal is given a dye that will block X-rays. This can be given intravenously to examine organs like the kidneys or heart, or by mouth to examine the digestive tract. A series of X-rays is taken after the dye is given, which will outline the organs where the dye collects. This makes it easier to spot any abnormalities.

The X-ray machine is positioned so that X-rays are focused on the area to be examined. Exposure to X-rays lasts only a fraction of a second. However, the greater the exposure, the greater the risk that radiation may damage cells. For this reason, a very low dose is used, and lead shields may be used to protect areas that are not being x-rayed and the people taking the radiograph.

Traditionally, radiographs were captured on film. However, recent advances in technology have made it possible for these images to be stored digitally on computers.

There are many advantages to storing radiographs on computers. One of the most important is the ability to rapidly and economically transmit copies of the images to specialists or other clinics. Specialists (board-certified radiologists or surgeons) or individuals at other clinics can study the images of your pet and help your veterinarian accurately diagnose and treat your pet's condition.



ULTRASONOGRAPHY

Ultrasonography (commonly called ultrasound) is the second most commonly used imaging procedure in veterinary practices. It uses sound waves to create images of body structures based on the pattern of echoes reflected from the tissues and organs. Ultrasound is much better than X-rays at showing the soft tissues within the body.

The veterinarian or technician usually performs an ultrasound scan by pressing a small probe against the animal's body, most frequently the abdominal wall. The sound waves are directed to various parts of the abdomen by moving the probe. Echoes occur as the sound beam changes velocity while passing through tissues of varying density. The echoes are converted into electrical impulses that are then converted into an image that represents the appearance of the tissues. In modern scanning systems, the sound beam is swept through the body many times per second, producing a dynamic, real-time image that changes as the probe moves across the body.

An ultrasound scan can show the size and shape of many organs and can also show abnormalities within them. An ultrasound scan is both painless and non-invasive, and poses no risk of complications. This is the same diagnostic tool used in many medical facilities to check the condition of a human foetus in the womb.

Although ultrasound can be used to evaluate most soft tissues, the heart and abdominal organs are the most frequently scanned in veterinary clinics. Ultrasonic imaging of the heart is termed echocardiography. The structure and function of the heart and its valves can be evaluated by this procedure. There are limitations to ultrasonography, because it cannot be used to scan gas-filled (lungs, intestine) or bony tissues.

COMPUTED TOMOGRAPHY

In this procedure, the animal is placed on a motorized bed inside a CT scanner, which takes a series of X-rays from different angles. When one series, or scan, is completed, the bed is moved forward, and another scan is taken. CT scans differ from ordinary X-rays because they show different levels of tissue density and produce more detailed images. From these scans, a computer creates cross-sectional images of the body part under investigation and displays the images on a monitor. A dye that can be seen on X-rays may be injected intravenously to make it easier to see abnormalities in the images. By sequentially scanning a body area, an entire organ or other structure can be imaged without interference from neighbouring or overlying structures. These scans can be used by the veterinarian to detect structural changes deep within the body, including tumours, abscesses, changes in blood vessels, and fractures.

Because of the need to remain still for a relatively long time while scanning is completed, animals undergoing a CT scan are anesthetized.

MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging (MRI) is another form of imaging in use today. It is an alternative to computed tomography. With this procedure, a very powerful magnetic field generates detailed anatomic images. No X-rays are involved and it is extremely safe.

For the procedure, the animal is placed in a tubular electromagnetic chamber and pulsed with radio waves, causing tissues in the body to emit radio frequency waves that can be detected. Many repetitions of these pulses and subsequent emissions are required. The emitted waves are then converted into images that are displayed on a computer screen. The images can also be saved for additional study. Sequential examination of slices through the body is done in the same way as for computed tomography. Because the procedure is rather lengthy and the animal must not move throughout the procedure, general anaesthesia is used in most cases.

NUCLEAR MEDICINE IMAGING

Nuclear medicine imaging, also known as radionuclide imaging or scintigraphy, involves dosing the animal with an element that emits a type of radiation known as gamma rays. This element is then detected within the body by means of a special camera attached to a computer, which generates the image. The element is attached to a molecule that has an affinity for the organ or tissue of interest. If the molecule is metabolized by the organ or tissue or stays in the tissue for only a short time, consecutive camera images can be used to evaluate the function of the organ or tissue. Veterinarians most frequently use nuclear medicine imaging to analyze the lungs, kidneys, liver, thyroid, and heart, although other portions of a pet's body may also be studied with this technique.

PHYSIOTHERAPY

Physiotherapy deals with treatment of diseases by physical methods. It aims at correcting deformities, making the joint movements more supple and preventing deforming tendencies, developing paralyzed muscles, healing faster and restoring the functional ability.

Choice of the physiotherapeutic modality shall depend upon a variety of considerations, like species, age, sex, stage and type of illness, therapeutic means available, their indications and contraindications. Usually a combination if physiotherapeutic means / modalities are required to be applied.

Principles of physical therapy

- Decrease pain and facilitate healing of inflamed and injured neurological and musculoskeletal tissues
- Maintain normal range of motion in affected joints, i.e. hind limb, fore limb.
- Prevent soft tissue contracture and fibrosis in weak or paralyzed limbs.
- Prevent further disuse atrophy of affected musculature of hindlimb/forelimb during the healing process of neurological and musculoskeletal tissues.
- Improve strength and function of weak or paralyzed limbs.
- Maximize post-surgical recovery and function of the patient. Provide positive psychological effects for the patient and owner.

Classification

The commonly employed physiotherapeutic means are

1. Cold therapy
2. Hydrotherapy
3. Massage
4. Exercise (active and passive)
5. Heat application.
6. Use of infrared and ultraviolet rays
7. Diathermy (short wave and microwave) 8. Ultrasonic therapy
9. Electricity
10. Cryotherapy
11. Acupuncture
12. Laser therapy
13. Electrostimulation
14. Pulsing electromagnetic field
15. Magnetic therapy.

The scope of physiotherapy is tremendous, practically from womb to tomb. The concept of physiotherapy is age old but its application on scientific lines by veterinarians is still in its infancy and not much in vogue.

Limitations:

There are multiple problems in the Institution of physiotherapy in veterinary practice. Veterinarians are faced with the management of animals of all sorts, small to large, light to heavy, docile to vicious, various species and breeds. Heavy body weight, prostration, pressure sores, pre and post-operative recumbency, muscular atrophy, inability to get up etc. are some common problems, especially in large animals.

Electrical stimulation

Electrical stimulation is useful physical therapy modality to

1. Increase muscle strength.
2. Improve muscle tone.
3. Increase range of motion.
4. Relief of pain
5. Reduce muscle spasms.

A pair or more electrodes is connected to the patient to deliver muscle stimulation in pulsed format. AC current is commonly used.

Electrical stimulations for diagnosis (Electro Diagnosis)

- Electricity may be employed (continuous and reduce currents) to reveal information on the degree of contractibility of muscles The integrity or alterations of motor nerves Ascertain the degree of contractibility of muscles

Technique: The positive electrode is usually placed at the level of spinal cord in the anterior part of the dorsal vertebrae and in the lumbar region for the examination of the muscles of the forelimb and hind limbs respectively. The other electrode is placed on the muscles or motor nerves to be examined.

- Diagnosis is made on the basis of hyper excitability or hypo excitability. A contraction produced with both faradic (AC) and Galvanic (DC) currents or by DC or only by AC indicates the variability of the muscle function. Any difference in the contractions (excitability) is noticed by stimulation with Galvanic current after inter change of the electrode also to be noted to understand the functionality.

Electrical stimulations for therapy (electro therapy)

Electrotherapy is mainly useful to treat paralysis and muscular atrophy.

Continuous currents (DC) Galvanization

Induced currents (AC) Faradisation

High frequent currents- Dorsogavalisation .

Technique : A feeble current that does not cause pain is used. The electrodes are placed so that the current travels the brain or cord longitudinally from the forehead or from pole towards the lumbar region or transversely from one temple to the other, or perpendicularly from the dorsolumbar region towards the sternum or abdomen.

Ionophorosis

- Electricity used to enhance absorption of medicaments through the tissues.
- By the action of current, the drug molecules in agent are decomposed or some chargepositively descends the current and other charge negatively ascends the current.

Agents: Sodium chloride, Salicylate of Soda, iodide of potassium, Quinine, Zinc and lithium.

Technique: The solution must be prepared with distilled water and galvanic current is employed. The electrode positive or negative according to the active ion of the medicament should be covered with a thick layer of cotton wool saturated with solution. This should be placed on the affected region and fixed by an elastic bandage to ensure close contact with the skin. The other electrode is placed at a point so that the current travels in the region involved. The intensity of current gradually increased to a tolerated degree for 10-13 minutes on every alternative day.

II. FULGURATION refers to employment of electrical sparks or splashes in the treatment. It is affected by means of high frequency currents brought to an electrode which is placed at a certain distance from the tumor projects, on to it a series of long flashes. Strong splashes of 8-10 cm long are projected on to the wound for effect. Ten -30 times are required upon the type of tumor.

Ultrasound therapy

Therapeutic heating agents are of two types.

1. Superficial tissue heating agents produce temperature changes in the skin and subcutaneous tissue to a depth of approximately 10 mm. e.g. Hot packs and warm water baths.

Deeper tissue heating agents

They cause temperature elevations in tissues to depths of 3 cm or more, without over heating the superficial tissues. e.g. ultrasound short wave and microwave diathermy Ultrasound can be used for scanning of internal structures (diagnostic ultrasound) and for therapy, treating certain discases (therapeutic ultrasound). Therapeutic Ultrasound is used for tissue destruction surgery for tumour irradiation, lithotripsy and physical therapy to promote deep tissue healing and restores function. The various properties of ultrasounds are listed below.

Physical properties

- Therapeutic frequencies of 1 MHz penetrate as deep as 4-6 cm into the tissues. Tissues with a high fluid content, such as blood and muscle, will absorb sound waves better than less hydrated tissues.
- Nerve tissue has a high coefficient of ultrasound absorption. Thus, use of ultrasound in treating peripheral nervous systems is encouraging.

2. Thermal effects

- Skin and subcutaneous fat can not absorb ultrasound well, absorption takes place onthe molecular level and protein molecules are the major absorbers. So the skin surfaces may remain cool while underlying structures are heated.
- This unique characteristic of ultrasound made an ideal therapeutic option for treating sports insures, that occur at the nerves, ligaments, tendons, joint capsules, muscles and all tissues with a high protein component and high coefficients of ultrasound absorption.
- Blood vessels in the path of the interacting waves could also suffer thermal damage. When periosteum is overheated, pain results.
- Thermal damage can be avoided by using low intensities and by steadily moving the sound head over an area close to the skin surface.

1. Chemical effects

- Ultrasound waves result alternating cycles of compression and rarefaction in the area through which it passes.
- Rarefaction (areas of decreased density and pressure) forms air bubbles in the blood or tissues fluids and expand because of the decrease in pressure. During expansion, gas enters into the bubble.
- In compression phase (increased density and pressure), gas is flown out of the bubbles.
- Rarefaction and compression phase results in the gaseous exchange, which exerts mechanical stress on the surrounding called cavitations.

Ultrasound therapy with the therapeutic range produces stable cavitations. Stable cavitations have multifactorial benefits:

i. It increases cell permeability

ii. It has electrolytic effect

iii. Useful in the breaking up of calcified deposits

- Increasing in the extensibility of fibrous capsule.
- Ultrasound of higher frequencies produces unstable cavitations, which causes collapse of bubbles under the influence of changing pressures. Thus, high temperature and pressure is created which can damage the cell and produce free radicals.
- Acoustic streaming/ micro streaming/ micro massage: Another important mechanism of ultrasound which is therapeutically valuable. Ultrasound when passes through, liquid flow along the cell membranes pushed by the pressures of the sound wave. Thus, diffusion of ions and metabolites across the membrane improves. Change in membrane permeability to sodium ions could be involved in the altered electrical activity in nerves, resulting in pain relief. Exchange of sodium and calcium probably helps in reduction of muscle spasm.

4. Indications

- Ultrasound is very useful to get rid of stiffness and a decrease in flexibility of skeletal muscle.
- It improves range of motion of the joint- ultrasound has more affinity towards collagen tissues. Joint capsule is rich in collagen. Because ultrasound selectively heats this type of tissue, it is the ideal modality for pre-stretch heating. Ultrasound also improves circulation to the scar tissue as it is rich in collagen
- Ultrasound therapy decreases pain and muscle spasm. It is reported that ultrasound therapy can be used successfully on painful neuromas, in back pain and herniated intervertebral disc syndrome.
- Ultrasound therapy stimulates the resorption of calcium deposits (e.g. splints,spondylosis).
- Ultrasound stimulates tissue repair by acoustic streaming and promoting the healing of pressure sores by increasing the rate of protein synthesis by fibroblasts and increased lysosomal activity.

Technique: The area to be treated should be clipped/shaved and cleaned. Ultrasound gels (coupling agents) are applied liberally and sound head is placed over the skin. After setting required frequency and time, sound head must keep on moving slowly over the target area.

Cold Therapy

Mechanism:

Cold therapy decreases local circulation, pain, and tissue extensibility. Initially local cold application results in constriction of blood vessels. Vasoconstriction is mediated by local reflexes and central nervous system responses. Reduced blood flow may help to reduce oedema, haemorrhage and extravasations of inflammatory cells. Reduced tissue metabolism may inhibit the effect of inflammatory mediators and enzyme systems.

- Because of these effects, cold therapy is often indicated during the first 48 hours of injury. Cyclical rebound vasodilatation, often referred to as "the hunting response", is another response of cold therapy. Following a minimum of 15 minutes of cold therapy that results in tissue temperatures from 10-15 °C, cycles of vasoconstriction and vasodilatation occur.
- Methods of application Cold may be applied by ice water immersion, application of ice packs or coldand Freon or ice water-charged circulation bandages or boots.
- Therapeutic effects of cold occur at tissue temperatures between 15 and 19 °C, packs, (59-66°F). Tissue temperatures of 10°C and less may causes cold thermal damage
- Average time of cold application is 15 to 20 minutes.
- Treatments are best repeated every 2-4 hours during the fist 24-48 hours of injury if the goal is to reduce tissue inflammation and oedema. Cold therapy should be used with caution in animal with peripheral sensory deficits or impaired circulation. If duration of cold therapy is more, excessive reboundvasodilatation and dependent oedema may result.
- The most effective method of cold therapy is to application of ice water directly with the skin. Buckets or turbulator boots may be used depending on the site. Indications
- Cold therapy is indicated in acute musculoskeletal injuries, particularly effective during the first 24 to 48 hours after injury. Distal limb injuries in horses and small animals can be effectively treated by this method.

Heat Therapy

Mechanism

Heat therapy increase local circulation, decrease pain, reduce muscle spasm and increase tissue extensibility.

Local heat applications dilate blood vessels and stimulate local circulation. Increased local blood flow help to mobilize tissue metabolites, increase tissue oxygenation and increase metabolic rate of cells and enzyme systems. As a rule, metabolic rate increases 2-3 times for an increase in tissue temperature of 10°C. These factors are especially beneficial for wound healing or other soft tissue injuries.

Increased local blood flow may be initiated by three mechanisms.

(a) The axonal reflex is a direct response of the blood vessels to local increases in tissue temperature.

(b) Local inflammatory mediators such as histamine, prostaglandins (such as PGF2 and prostacyclin), and bradykinin may also initiate vasodilatation and increase capillary permeability.

(c) Local spinal reflexes stimulated by afferent impulses from the thermoreceptors at the site of heating and result in decreased postganglionic sympathetic adrenergic nerve activity, which decreases smooth muscle tone of vessels, allowing them to dilate.

- Increased blood flow and vascular permeability may promote resorption of oedema.
- Heat application is recognized to decrease pain.

Theories that explain pain relief by thermal agents include: 1) In the gate-control theory of pain stimulus from heat receptors "closes the neural gate" which blocks afferent stimuli from peripheral pain receptors, and 2) Heat may act as a counter-stimulus to pain, making the afferent impulses of pain less noticeable.

Methods of application

- Superficial heat may be applied with hot packs, hydrotherapy, paraffin baths or moist air. These modalities provide heat penetration to approximately 1 cm deep to the skin, which is often sufficient for many veterinary applications on distal limbs because of the lack of an insulating fatty subcutaneous tissue layer in most species.
- Deep heat may be applied using radiant heat ("heat lamp") microwave or shortwave diathermy and therapeutic ultrasound.
- Warm water is probably the most accessible method of heat therapy. Methods of application may be from a hose or with wet towels, or water immersion in a bucket therapy tub, or turbulator boot.

Indications

- Heat is best applied after acute inflammation has subsided. It is useful for reducing muscle spasm and pain due to musculoskeletal injuries. Heat therapy can be used to increase joint and tendon mobility, particularly by heating before active stretching. Heat may be beneficial to accelerating the healing response of localized soft tissue injuries.

Contraindications

- Heat therapy should be used with caution in animals with peripheral sensory deficits. Local infection and tumors may conceivably be spread by use of heat therapy and local inflammation may be exacerbated.

Massage

- Massage may be defined as manipulation of soft tissues with hand and fingers. Mechanism: Massage improves circulation, nutrition supply, removes waste products, reduces indurations, looses contracted tendons, ligaments and muscles.

  Methods of applications Message comprises a series of maneuvers including.

  1. Slight friction: Fingers of the hand is used in centripetal direction. It gives feeing 109 of warmth and has a numbing effect.

  2. Methodical pressure: It is applied by firm pressure on to tissue with the pulp of the thumb or with fingers or the hell of the palm or with closed fist so as to act on 12 deep seated structures.

  3. Individual compression of muscles: Here, a portion of the muscle is hold between the fingers and thumb and uniform pressure is applied from its insertion towards its origin.

  4. Percussion: Consists of superficial or deep percussion of the tissue by striking the part perpendicularly with the fingers or closed hand. Indications: Exercise can be combined with the use of liniments in sub-acute, chronic inflammatory conditions.

Contraindications

- Acute inflammatory conditions with a threat of pretend haemorrhage
- Presence of foreign bodies
- Existence of neoplasm

Effects

1. Sensory nerve endings may be stimulated, assists in local and general relaxation.
2. Exercise leads to stimulation of sensory nerve endings, liberation of histamine substances, with local hyperemia results in dilatation of blood vessels.
3. Improves venous and lymphatic return by mechanical assistances due to alternative pressure and relaxation.
4. Mechanical movement causes stretching and softening of fibrous connective tissue. Lubricants: Olive, mustard or coconut oil or fine talcum powder can be used to reduce friction that softens the skin.

Precautions

1. Massage should be done in the direction of the venous and lymphatic flow.
2. Smear the part with Vaseline or mild Liniment.
3. Massage should be continued for 5-10 min at a time.
4. In case of joints, massage should be associated with passive movement and exercise.
5. Massage should be done in the direction of muscle fibres / across the fibres.
6. While massaging extremity make use of gravity as assist venous return.
7. During massage the motion should be rhythmic and pressure moderate.
8. Apply compression bandage to the part after massage If necessary.

Exercise

Exercise constitutes active and passive movement of a part or whole body to strengthen or maintain vitality of musculoskeletal system. Exercise plays a great role in rehabilitation especially following injuries and disorders of locomotor system and muscular weakness.

Indications

- Joint stiffness
- Abnormal posture
- Spastic Paralysis
- Orthopaedic problems
- Mechanical movement of joint and muscles improves venous and lymphatic return.
- Sensory stimulation by keeping cortical pathways open
- Mobility and range of movement of joints can be increased
- Passive movements can stretch so that softening of the fibrous tissues
- Balance and coordination can be improved Improve cardiovascular and respiratory capabilities

Method

I. Passive Exercise: In the method, the affected joint is grasped and its flexion and extension is done for 10-15 times.

II. Active Exercise: This includes walking, grazing and slow running up and on a slope. Active exercise is coupled with passive exercise and message can help in improving blood circulation, joint mobility, muscle power and coordination. However, the animal should not tire and exercise should be stopped if there is any increase in oedema and pain or decreased mobility of the joint.

Hydrotherapy: Hydrotherapy is the treatment of disease with water. This is a form of rehabilitation therapy particularly appropriate for dogs and horses recovering from a range of conditions especially those involving problems with limbs. Water absorbs more best per unit of weight than any other substance. The solvent properties of water help checking infection and accelerate wound healing by removing dirt and necrosed tissue. A treatment time of 10-30 min. is sufficient for this effect.

Buoyancy of Water: These can be used to relieve pressure on effected parts. The method is used in the form of an aqua lift system to treat downers cow syndrome if muscles damage has not occurred.

Whirlpool Hydrotherapy: It is essentially a water bath in which an extremity or the entire body is submerged in either warm or cold swirling water. The water is kept in constant agitation and mixed with air by the action of turbine thus producing a gentle massaging effect.

Irrigation: Irrigating the affected part with a stream of water through a house pipe is a simple and cheap method. This is often used for necrotic ponds, like those following sub cutaneous infiltration of urine in cattle, as a adjacent to the main therapy.

Swimming is another method of hydrotherapy in veterinary practice.

Precautions

- Animal with recent skin grafts
- Acute edema
- Fever
- Marked circulatory disturbances

Application of cold water: This type of treatment is used during the first 24 - 48 hrs after trauma has occurred.

Indications

- Acute congestion
- Recent acute inflammation
- Septic lesions in which there is no danger of death of the tissues from diminished blood supply.

Effects: Hypothermia of tissues induces vasoconstriction and decreases extra vasations of blood so probability of blood and fluid accumulation is restricted. Pain, muscle spasms and tissue metabolism are also reduced.

Methods of Application: Each application of cold water (46.5-59^0 F) should last 10-30 min with an interval of at least one hour in between the applications. For deep-seated lesions like sprains, water at a lower temperature may be applied, but if it is very cold, it should only be used intermittently. In veterinary practices, the water is usually applied directly to the part instead of being allowing to flow through a coil of rubber or metal tubing laid on the part.

Hot Water Application

Indications

- Sub acute and chronic inflammations
- Recent inflammation after the acute stage has passed
- Septic lesions in which the vitality of tissues lowered and they are threatened with deaths.

Effects

- Analgesia by softening and relaxing the tissues.
- Hyperemia results leucocytosis and phagocytosis in septic wound
- Reabsorption of exudates.

Methods

Hot water application is done to increase the temperature gradually to 113^0 F or even 122^0 F without scalding. Generally, resistance of tissue is diminished at temperature 113^0 F with moist heats. Intermittent application is warranted. Temperature of the water can be maintained by adding hot water. Even then, it is impossible to maintain a local superficial temperature equal to that of the blood. Hydro-thermoregulator may be used, which consists of a reservoir in which the water is pumped by an electric motor into a system of small very flexible tubes placed in variable fashion over the affected region. By this means a temperature of 107 - 113^0 F may be maintained for 12 - 24 hours with excellent effect.

Swimming

Mechanism

- Swimming helps to improve general fitness and stamina, improves muscle tone and is helpful in recovering from injury or operation.
- Since cold-water causes constriction of the superficial blood vessels muscles, it is better to swim dogs in heated water. Horses are usually swum in cold water to dissipate the enormous amounts of heat they generate under exertion with a less efficient cooling system.
- Swimming is an excellent form of exercise because most of the muscles normally used in movement are involved - without the stresses caused by running on hard ground. Swimming results increased resistance to movement, thus the muscles have to work harder than they would do on land. Swimming strengthens the muscles while avoiding this potentially damaging concussion. Cardiovascular workout: During swimming chest remains under pressure from the water thus every breath requires more effort - the muscles used

  Lungs: Under water, the chest is under pressure from the weight of the water squeezing inwards. This means that every breath requires more effort - the muscles used, particularly in breathing in, have to work harder (try breathing while someone sits on your chest). As any muscle strengthens with exercise, this improves the whole respiratory system.

  Heart: The heart has to work harder in order to meet the increased demand for nutrients by all the muscles which are being worked

Infrared therapy

Infrared rays are electromagnetic waves (radiant energy) of 770 to 1,00,000 mu. Sun light is most important natural source. The heat energy obtained from the rays is used to relieve pain. It is useful to treat muscle strain and pain.

Classifications: Infrared rays are of two types:

Long wave infrared (1500 to 12,000 mu) are emitted by all heated bodies and exclusively by low temperature bodies such as hot water bottles, electric heating pads etc. These rays can not penetrate to deeper those 2mm of the skin.

Short wave infrared (770- 1500 mu) are emitted by all incandescent bodies such as sun, electric incandescent lamps and specially designed high temperature infraradiators. Short wave infrared penetrate 5 to 10 mm of skin tissues so they influence blood vessels, lymph vessels, nerve endings and other subcutaneous structures directly. The employment of special red glass filter restricts these sources. Sources

(a) Natural: Sunlights is most important natural source of infrared radiation and comprises over 60% in an average sunlight.

(b) Artificial: The artificial sources are

1. Low temperature/Non-luminous/IR radial: A bare wire or carbon held in a suitable non-conducting material is used. It emits red glow and a quantity of radiation.

2. High temperature/Luminous/Heat lamps : Incandescent filament radiators consists of tungsten filament are principal sources of luminous heat radiation enclosed in a glass bulb mounted at the centre with a concave reflector.

Technique: The patients are placed in a comfortable, relaxed position and the radiation from the generator is directed over the part to be treated from a distance of 2 to 3 feet according to the sensitivity of the parts. Duration of exposure is 10 to 15 minutes.

Effects of infrared radiation

- Infrared therapy exerts local as well as central effects.
- Local effects: Infrared wave when hits the superficial tissues it causes

  (a) The stimulation of local circulation. Radiant heating the skin causes vasoconstriction of the capillaries and subsequent release of vasodilator substance which again absorbed locally thus more capillaries become active. In this way, blood circulation is increased

  (b) The stimulation of the nerve endings of the skin. Infrared exposure for a short time cause mild heating, results in relief of pain while strong heat stimulates counter irritation.

Clinical uses

- Sub acute and chronic traumatic and inflammatory conditions in locations accessible to external heating contusions and muscle strains
- Traumatic synovitis, tenosynovitis and sprains. Various forms of arthritis and rheumatic conditions, neuralgia
- Acute, sub acute and chronic catarrhal conditions of the mucous membranes in accessible location, sinusitis
- Circulatory disturbance of the extremities
- Infections of the skin, folliculate, furunculous and even extended abscess formation in the skin. As preliminary heating to other physical measures, like massage, voluntary and passive exercise.

Contraindications

- Infrared therapy is contraindicated to use in following condition
- Defective blood supply to the area
- Any blood loss
- Defective skin sensation (nerve damage)

Complications

Infrared rays may induce following complications:

1. Erythemal response
2. Hypersensitivity followed by erythema, wheel formation, local edema and eventually blistering.
3. Electric Shock
4. Faintness
5. Injury to eyes

Ultraviolet therapy

Ultraviolet rays are of 390 to 180 mu wave length. The chief natural source of ultra violet radiation is the Sun. The artificial sources of UV radiation are:

1. Mercury Vapour lamp: Mercury when vaporized in a quartz container by intense heat emits a spectrum rich in UV light. Quartz of silicone dioxide gas is extremely heat resistant and freely transmits UV radiation.
2. The Fluorescent sun lamp: The 20W lamp will produce minimal erythema at a distance of 2 feet in 20 minutes with bare lamp and in 7 minutes with a reflector. Those lamps may be used without a reflector.
3. R. S. type suit lamp: mercury arc tube enclosed in a special glass bulb emits short wave length ultra violet light.

General information

- UV rays can penetrate to a very limited extent through body surface.
- UV rays cause erythemal production, pigmentation and bactericidal effects. Spectral Band at 265.2 mu produces maximum bactericidal effects.
- Ultraviolet rays also produce erythemal of the skin within 2 to 8 hrs Ultraviolet rays produce local/regional analgesia when it hits nerve endings.
- Ultraviolet rays can be absorbed by blood cells and consequently bactericidal
- Activity potentiates. Calcium, Phosphorus, Iron and Iodine contents are also increased. Repeated irradiation with erythema doses between 280 to 300 mu results pigmentation
- With deposition of granules of melanin in the basal cells of the epidermis.

Technique: For general irradiation, entire affected body should the exposed; the genitalia should be covered by a cloth; the centre of the part should be in direct line of irradiation. A timer should be used to measure the time of exposure.

Dosage: The erythemal response of the individual patient serves as a guide for dosage for general irradiation. Distance of lamp and duration of exposure are important for dosage calculation.

Duration of exposure: To control local infection 3 to 5 minutes for 5 days is sufficient. Usually 20 exposures are required for complete cure.

Indications:

- General tonic effect
- Tuberculosis
- Chronic Ulcers
- Skin conditions a) Psoriasis b) Acne
- For diagnosis infection. - In dermatological cases with the aid of words lamp to detect fungal.



DEPARTMENT OF VETERINARY MEDICINE

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I. IDENTIFICATION OF SPECIFIC DISEASES

1. HISTORY/ ANAMNESIS

- History collection is an important key for diagnosis.
- Successful history taking involves vet–client relationships
- History includes patient data, disease history and General management history

A. Patient data: The relevant data includes

- Owner's name and initials,
- Postal address and telephone number,
- Signalment of the animal - Description for identification purposes and includes breed, sex, age, identification number (tattoo, ear tag etc.,) colour markings

B. Disease History

Immediate History

- This relates to the sequence of events associated with the period of time that the animal has been ill.
- It is important to determine the chronological order in which the more important changes in behaviour and in physiological functions were observed.
- Specific questions should therefore be centred on such aspects as appetite for food or drink, defaecation, urination, respiration, sweating, physical activity, milk production, growth, gait, posture, voice, odour, etc.

Past History

- Information should be obtained related to any previous illness which had affected the individual animal or group.
- Details regarding clinical features, diagnosis, treatments, morbidity and mortality rates, post mortem observations, etc., should be obtained.

Morbidity, Case fatality and Mortality rates:

- The morbidity rate is the percentage of animals that are clinically affected compared to the total number exposed to the same risks.
- The case fatality rate is the percentage of affected animals that die. The population mortality rate is the percentage of all exposed animals that die.
- Population mortality rate is the percentage of all exposed animals that die.

Prior treatment:

- Information on all prior treatments is desirable.

Details are required for

- Eliminating or considering some diagnostic possibilities.
- Assessing the probable efficiency of the treatment.
- Assessing the significance of laboratory tests.
- Prescribing additional treatment.

Preventive measures adopted:

- These include deworming, vaccination, disinfection methods, isolation procedures, type of protective clothing being worn by the handlers.

Previous exposure:

- When examining a group of animals it is important to know when particular animals were added to the group and when the animals got exposed to any previous illness.

Transportation and mixing of animals:

- Prolonged and continuous transportation can be a risk factor for diseases such as pneumonia in cattle and horses.
- Mixing of animals from different origins followed by transportation to a feedlot is a potential risk factor for certain diseases, such as shipping fever, pneumonia.

Recent travel to other geographical regions:

- Animals that have recently been to other geographical regions in which certain infectious diseases are endemic may become infected and return to their current home
- Ruminants and swine may have been taken to livestock shows and become infected with certain diseases that become clinical after their return to the home farm.

Culling rate:

- The reasons for the previous culling of the animals from the herd may provide clues about the diagnosis.

C. GENERAL MANAGEMENT HISTORY

The examination of an animal must be accompanied by a consideration of its surroundings and circumstances.

- This is more necessary in case of animals in groups than for individual animals, although even in the case of domestic pets the environmental aspects should not be completely overlooked.
- It include an enquiry into such aspects of animal husbandry as nutrition, breeding policy, housing, etc., which might reveal information of diagnostic significance. In relation to diet, any recent change in character or constitution should be ascertained.
- Knowledge of the local topography is of value in relation to vector-borne diseases including louping-ill, babesiasis, anaplasmosis, trypanosomiasis, African horse sickness, Rift Valley fever and blue tongue, etc., and a number of other diseases such as fascioliasis, hypocuprosis, cobalt deficiency, etc.
- Nutritional diseases are, in most instances, group problems, so that a number of animals are more or less simultaneously affected.
- Domestic pets, however, are still occasionally found to be suffering from serious nutritional deficiency syndromes.
- Feeding methods should also be investigated because they may contribute to low productivity or disease.
- Inadequate trough space for pigs and calves and for older cattle in yards leads to overeating on the part of the vigorous animals and partial starvation in the smaller, weaker ones.

- The design or fittings of a box, stall, pen or kennel may suggest the possibility of certain kinds of injury, or of exposure to draughts or sudden changes in environmental temperature.
- The state of the bedding may reveal whether the animal has been restless, either moving about aimlessly or circling clockwise or anticlockwise.

2. PRELIMINARY EXAMINATION – GENERAL INSPECTION

GENERAL INSPECTION (OR) DISTANT EXAMINATION:

- It is the general impression of the health of an animal obtained by an examination from a distance

1. PHYSICAL CONDITION

- It is usually easy to assess the bodily condition of the animal by simple inspection.
- Physical condition may be classified as being normal, obese, thin or emaciated.
- In normal, well-conditioned animals, all parts of the skeleton are covered with flesh, giving the body a rounded appearance.
- In those in poor (thin) condition, various parts of the skeleton are prominent (e.g. ribs and pelvis) and the supra-orbital fossae are deepened.

2. VOICE: The abnormalities of voice includes

- Hoarse – Rabies
- Weak – Gut edema
- Continuous lowing- Nervous acetonemia
- Persistent bellowing - Acute pain
- Soundless bellowing & yawning - Rabid cattle
- Yawning — Hepatic insufficiency.

3. APPETITE & EATING:

- Appetite in animals is generally assessed by reference to food consumption in healthy individual animals in identical circumstances.
- Variations in appetite include increase, decrease, or abnormality (depravity).
- Partial reduction in appetite (inappetence) is associated with many types of gastric disease
- In the more acute forms of these conditions, appetite is completely absent (anorexia).
- Increased appetite (hyperorexia) manifested by increased food consumption (polyphagia) observed in pancreatic deficiency, chronic gastritis, certain forms of intestinal parasitism, functional diarrhoea, certain metabolic diseases, such as diabetes mellitus,

4. GENERAL DEMEANOUR / BEHAVIOUR

- The Behaviour and Demeanour are reflections of the animal's health and its response to other animals or observers.
- **Bright and Alert**: If the animal responds normally to the external stimuli such as sound and movement, then the animal is said to be bright and alert.
- Various abnormalities of behaviour may be exhibited

Diminished behaviour

- Dullness or apathy: which state is appreciated by the reactions to normal stimuli being sluggish or retarded, or even somewhat suppressed.
- 'Dummy' state: is an advanced degree of failure to respond to external stimuli although the animal remains standing and is capable of movement.
- Coma: in which the animal is unconscious and fails to respond to painful stimuli, as in the cow in the advanced stages of parturient hypocalcaemia.

Excited Behaviour

- Mild: anxious, or apprehensive, the animal appears alert, looks about constantly, but exhibits normal movements.
- Restlessness is a more severe state in which movement is almost constant, consisting of lying down, rolling, getting up again, looking at the flanks, kicking at the belly and groaning or bellowing.
- Mania: behaviour aberrations appear to be compulsive and include vigorous licking of some specific part of the body surface (ketosis, pseudorabies), pressing forwards with the head (meningitis) or licking or chewing inanimate objects.
- Frenzy: the animal's actions are uncontrolled as in acute lead poisoning, hypomagnesaemictetany and rabies.

5. POSTURE:

- It is anatomical configuration of an animal in standing position.
- When approached in the lying position, most normal animals will get up.
- Various abnormalities of posture may be shown by animals, some of which do not indicate disease, but if they occur in association with other clinical signs then a disease process should be suspected.
- Changes in posture take the form of curvature of the spine, high or oblique carriage of the head and neck, unusual position of the limbs.

6. GAIT

- Locomotor disturbances are seen when the animal moves about voluntarily, or is led or driven at various paces past, towards or away from the clinician.
- Limb movements can be assessed by reference to their rate, range, force and direction.
- Abnormal movements include lameness, stiffness, shortened stride, stilted gait, exaggerated flexion abduction of one or more limbs, stumbling, staggering, and swaying of the hindquarters, forced movements, and so on.

7. BODY CONFORMATION:

- The assessment of conformation or shape based on the symmetry and the shape and size of different body regions relative to other regions.

8. SKIN:

- Abnormalities of skin can be seen from a distance.
- They include changes in the hair, wool abnormal sweating, discrete or diffuse lesions, and evidence of soiling by discharged and of itching.
- Normal lustre of the coat must be absent.

9. EXCRETION:

- Act of defecations may be accompanied by much straining or tenesmus.
- Constipation: Rectal paralysis, stenosis.
- Involuntary defecation: Diarrhoea, paralysis of anal sphincter

10. URINATION:

- Cystitis & urethritis: Increased frequency with passage of small amounts
- Incontinence with constant dribbling of urine is due to partial obstruction of the urethra or incompetence of its sphincter.

3. CLINICAL EXAMINATION

TEMPERATURE:

- The internal temperature of the body, as measured by the clinical thermometer, reflects the steady state existing between heat production and heat loss. In farm animals, rectal temperatures' are recorded.
- A short blunt bulb clinical thermometer with range of 36 °C (97 °F) to 42.5°C (108° F) is used.

Procedure:

- The procedure for taking the temperature of an animal is to first shake the mercury column in the thermometer down below the lowest point likely to be recorded.
- The bulb end of the thermometer should then be lubricated with soap or petroleum jelly prior to being gently inserted with a rotatory action through the anal sphincter into the rectum.
- Care should be taken to ensure that the bulb of the thermometer is inserted to the same depth in each particular species of animal and also that it makes contact with the mucous membrane of the rectum.
- In order to obtain an accurate determination of the body temperature, the thermometer should be left in situ for about two minutes.
- Whenever there is atony of anal sphincter or the presence of large masses of feces in paralysis of the rectum, in female animals, temperature can be recorded at vagina, where it is approximately 0.5 °C (1.0 °F) higher than in the rectum.
- When the temperature has been taken the thermometer should be wiped clean with a piece of cotton wool and then placed in a beaker containing disinfectant fluid.

PULSE:

- Expansion and elongation of arterial wall imparted by the column of arterial blood due to contraction of left ventricle.

Procedure:

- The technique of taking the pulse consists of placing the ball part of one or more fingers on the skin over the coccygeal artery/facial artery at a point where it overlies bone and applying gentle pressure until the pulse wave can be detected.

- Where the artery is large and tends to roll away from beneath the finger tips, it may be helpful to place the tips of two or even three adjacent fingers on the artery parallel to its long axis. In the examination of the pulse, rate, rhythm and quality should be considered.

RESPIRATION:

- The physical actions by means of which air is brought into and is expelled from the lungs, is termed as respiration.

Procedure:

- The clinician should stand behind and to one side of the animal, so that both the thoracic and abdominal areas of the body are in view.
- It is advisable to observe the animal from both sides, in order to determine whether the respiratory movements are bilaterally similar or divergent.
- In quiet animals, determining the frequency and rhythm of the respiration facilitated by placing one hand on the lower part of the coastal arch region.
- The rate of respiration may also be determined by observing nostril movements.
- The rate or frequency (number/minute), type, rhythm (regularity) and quality (amplitude or depth of the respiratory movements) should be considered

4. PHYSICAL EXAMINATION

PALPATION (TOUCHING)

- This includes direct palpation which consists of handling the tissues by means of the fingers, for which one or both hands may be employed, and indirect palpation with a probe.
- The objective of palpation is to detect variation in size, shape, consistency and the presence of pain in a tissue by noting increased sensitivity.
- The conditions identified by palpation may be defined by terms such as the following:
- **Resilient**: when a structure quickly resumes its normal shape after the application of pressure has ceased.
- **Doughy**: when pressure causes pitting as in oedema.
- **Firm:** when the resistance to pressure is similar to that of the normal liver.
- **Hard:** when the structure possesses bone-like consistency.
- **Fluctuating**: when a wave-like movement is produced in a structure by the application of alternate pressure.
- **Emphysematous:** when the structure is swollen and yields on pressure with the production of a crepitating or crackling sound.

AUSCULTATION (LISTENING)

- Auscultation means listening to the sounds produced by the functional activity of an organ located within a part of the body, in order to assess its condition.
- The method is used chiefly in the examination of the lungs, trachea, heart and certain parts of the alimentary tract.

- Changes in the frequency, rhythm and intensity of normal sounds can be detected. Abnormal sounds can be identified. Stethoscopes are often used to increase the acuity.

PERCUSSION (TAPPING):

- This is a physical method of examination in which, by means of striking a part of the body, it is possible to obtain information about the condition of the surrounding tissues and, more particularly, the deeper lying parts.
- The sound produced provides information regarding the shape, size and density of the object.

Resonant sound or Ringing sounds:

- Indicates the presence of large volume of air or gas beneath the site of percussion. Normal sound produced by a normal lung.

Ringing sound:

- When there is excessive quantity of air or gas present at the site of percussion.

Dull or Flat sounds:

- This sound will be heard when there is no air or gas beneath the part percussed.

Tympanic sound:

- Characteristic musical ring which is like that produced by striking a kettle drum. This type of sound is heard in pneumonia, pneumothorax and subcutaneous emphysema.

Metallic ringsound

- This tone is high pitched tympanic one and resembles the response obtained on striking an empty metal jug.

Cracked pot sound:

- Stimulates the sound that is produced by striking a cracked pot. Emphysema, pneumonia and pleurisy.

BALLOTTEMENT (REBOUND)

- This is performed by pushing the body wall sharply and forcefully so that internal structures are first propelled against the body wall then on recoil rebound against the operator's fingers.

SUCCUSSION (SHAKING)

- Succussion is performed to determine the fluid content of a viscous material.
- The shaking induces the fluid inside the viscous to produce an audible sloshing sound which can be detected by auscultation.

5. REGIONAL EXAMINATION

I. EXAMINATION OF HEAD

Facial expression – Abnormal expressions include:

- Rigidity- tetanus.
- Cunning leer/ maniachal expression- Rabies, acute lead poisoning.

Asymmetry of the facial bones

- Doming of forehead - Congenital hydrocepahalus.

- Bilateral enlargement of maxilla - Chondrodysplastic dwarfs.
- Swelling of maxilla and mandibles - Osteodystrophia fibrosa.
- Swelling of facial bones - Frontal sinusitis.
- Enlargement of maxilla or mandible – Actinomycosis.

Asymmetry of the soft structures

- It is evident and is most obvious in the carriage of the ears, degree of closure of the eyelids and situation of the muzzle and lower lip.
- Slackness of one side and drawing to the another – Facial paralysis.
- Ears rigidity, third eyelid prolapse & dilatation of the nostrils – Tetanus.

Carriage of the head

- Rotation on one side: Defects of vestibular apparatus.
- Deviation on one side - Unilateral involvement of medulla and cervical cord.
- Opisthotonus - Tetanus, Strychnine poisoning, acute lead poisoning, hypomagnesemic tetany, polioencephalaomalacia and encephalitis.

Inspection of Eyes – Eyes can be inspected for

- Visible discharges
- Protrusion of the eyeball - Orbital lymphamatosis
- Retraction of bulb - Dehydration
- Eyelids spasms & excessive blinking – Pain/ peripheral nerve involvement.
- Prolapse of nictitating membrane - CNS derangement – Tetanus

Inspection of Nose – Noses can be examined for dilatation of nostrils and discharges from nose.

Inspection of Mouth – Mouth can be inspected for

- Excessive salivation or frothing at the mouth- Pain in mouth or pharynx.
- Tremor of jaw muscle - nervous involvement.
- Swelling below the jaw/ Bottle jaw condition – Endoparasitic infestation.
- Inflammatory – Actinobacillosis and strangles.
- Edematous - Acute anaemia, protein starvation and congenital heart failure.
- Unilateral and bilateral swelling of the cheeks in calves - Necrotic stomatitis.

II. EXAMINATION OF NECK

Neck can be examined for:

- Enlargement of the throat - inflammatory (or) involvement of lymph nodes, salivary glands (or guttural pouches in the horse) or other soft tissues.
- Local enlargement located further down the neck - Goiter.
- Neck region should also be inspected for jugular pulse, jugular vein engorgement and edema.
- Local enlargement - Esophageal distension .

6. DIAGNOSIS

IMAGING TECHNIQUIES

1. RADIOGRAPHY

- Radiography (generation of transmission planar images) is one of the most commonly used diagnostic tools in veterinary practice even though other imaging modalities such as ultrasonography, CT, MRI, and nuclear imaging are also very important and commonly available in specialty practices and academic centers.
- Imaging provides a large amount of information by non-invasive means.

Indications

- Cardiorespiratory compromise
- Tumor staging
- Assessment of the skull and extracranial structures
- Abdominal pain Abdominal mass(es)
- GI dysfunction
- Urogenital dysfunction
- Musculoskeletal disorders
- Spinal disorders
- Screening of juvenile orthopedic disorders.

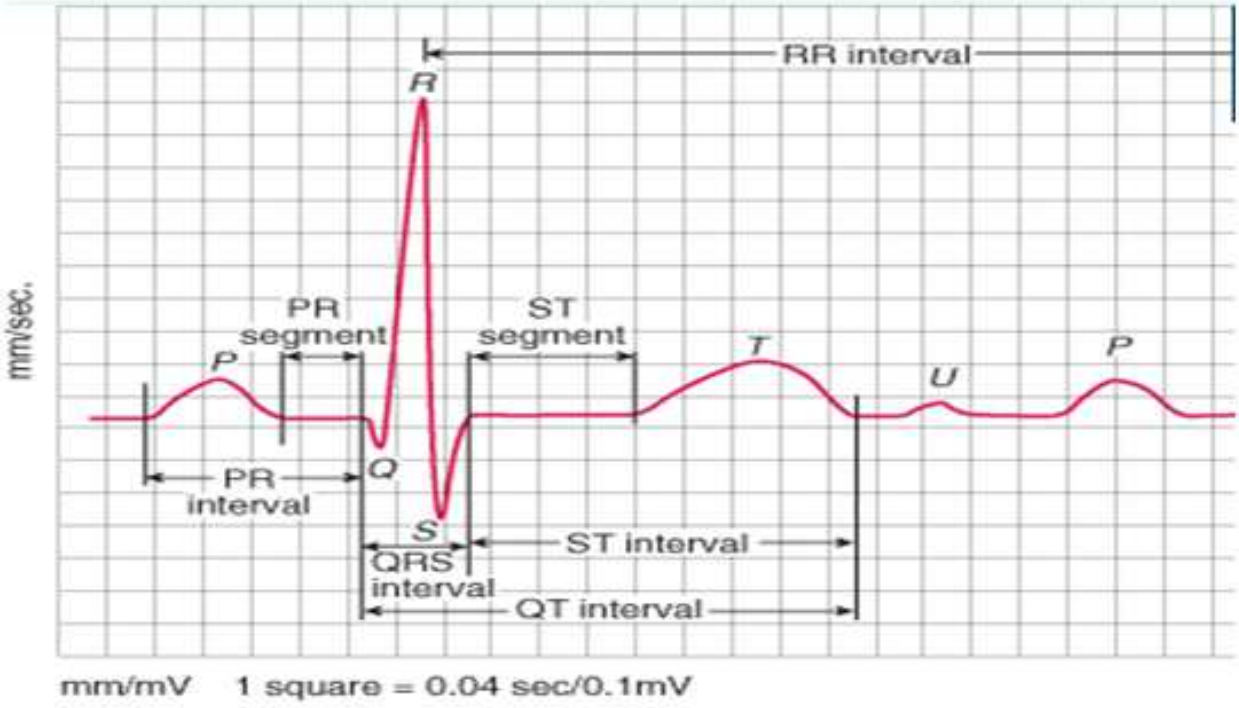
Technique

- This consists of 2 orthogonal projections of the abdomen, right or left lateral and VD projections.
- These projections include the structures from the cranial-most aspect of the diaphragm to the pelvic inlet.
- Radiographic techniques are based on patient thickness.
- The patient's hindlegs are gently pulled caudally to avoid their superimposition on the caudal abdomen and to spread out the abdominal contents.
- Abdominal radiographs are produced at full respiratory expiration

2. ELECTROCARDIOGRAPHY (ECG)

- An electrocardiogram (ECG) is a non-invasive procedure to record electrical activity of the heart.
- ECG is used commonly to evaluate the heart rhythm and identify abnormalities (arrhythmias) in the heartbeat.
- ECG helps to identify enlargement of the heart, a common finding with many heart diseases.
- ECG recording is divided into the P wave, QRS complex, PR interval, QT interval, ST segment and T wave.
- P wave = Atrial depolarisation.

- PR interval =Time interval between onset of atrial depolarization and onset of ventricular depolarization.
- QRS complex =Depolarization of ventricles, consisting of the Q,R,&S waves.
- QT interval =Time interval between onset of ventricular depolarization and end of ventricular repolarization.
- R-R interval = Time interval between 2 QRS complexes.
- T wave = Ventricular repolarization.
- ST segment plus T wave (ST-T) = Ventricular repolarization.



3. ULTRASONOGRAPHY

- Ultrasonography is the second most commonly used imaging format in veterinary practice. It uses ultrasonic sound waves in the frequency range of 1.5–15 megahertz (MHz) to create images of body structures based on the pattern of echoes reflected from the tissues and organs being imaged.
- The sound beam is produced by a transducer placed in contact with and acoustically coupled by means of a transmission gel to the animal. An ultra-short pulse of sound is directed into the animal, after which the transducer switches to the receive mode.
- Echoes occur as the sound beam changes velocity while passing from a tissue of one density to one of another density, even when the change occurs at nearly microscopic levels.
- The greater the change in velocity, the greater the strength of the echo. A small percentage of these echoes are reflected back to the transducer, which then reconverts the energy of the echoes into electrical impulses recorded by the computer in the ultrasound machine.

- The strength of the echo, the time required for the echo to return after the pulse, and the direction the sound beam that was sent are all recorded. Using information from multiple echoes, the machine creates an image that represents the appearance of the tissues when cut in the same plane on an anatomic specimen..

INDICATIONS

- Hepatomegaly, hepatic mass, or increased liver enzyme activity or bilirubin concentration.
- Splenomegaly or splenic mass.
- Renomegaly, small kidneys, renal masses, proteinuria, or renal insufficiency or failure Stranguria, pollakiuria,or urinary incontinence.
- Vomiting, diarrhoea or both Ascites.
- Evaluation for primary or metastatic neoplasia.

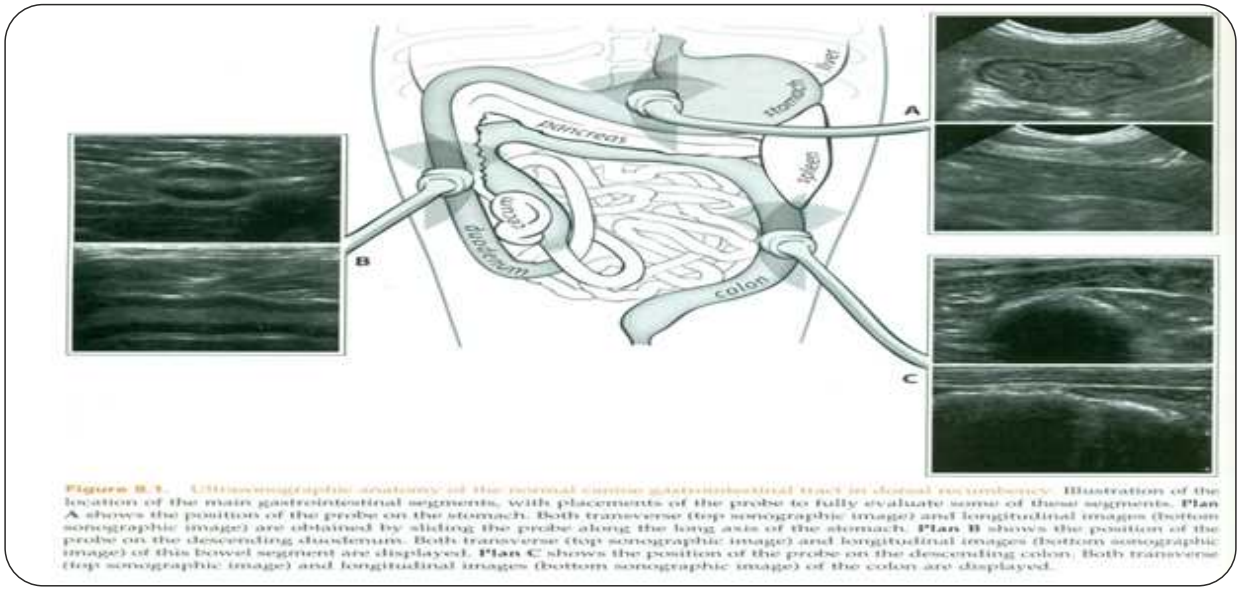
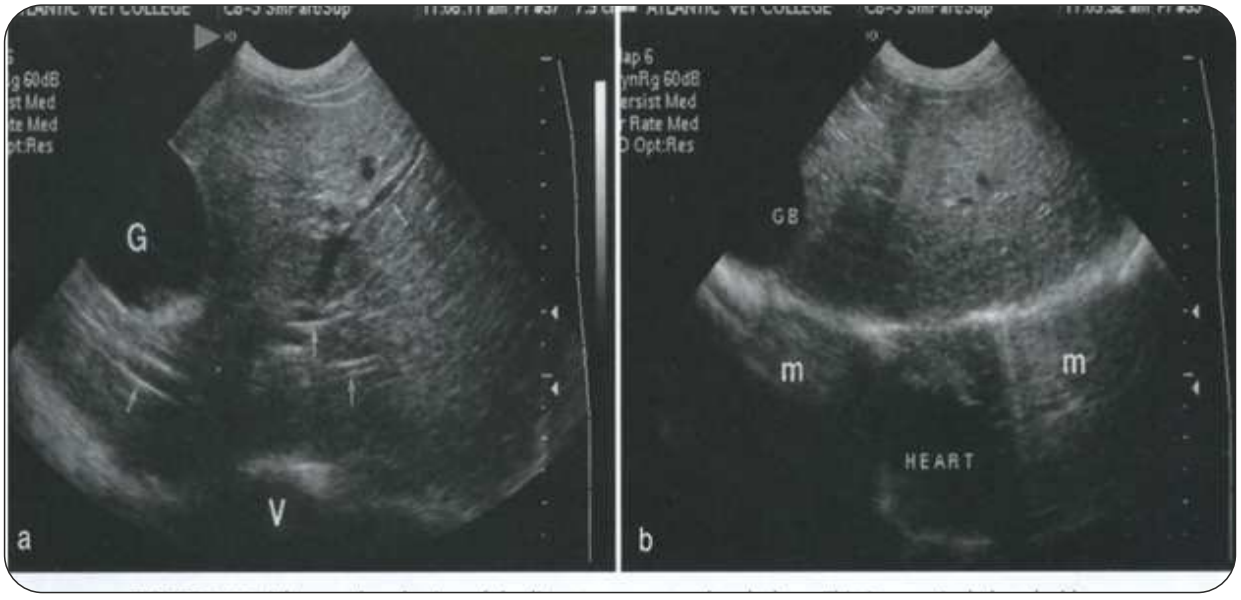


Figure 8.1. Ultrasonographic anatomy of the normal canine gastrointestinal tract in dorsal recumbency. Illustration of the location of the main gastrointestinal segments, with placements of the probe to fully evaluate some of these segments. **Plan A** shows the position of the probe on the stomach. Both transverse (top sonographic image) and longitudinal images (bottom sonographic image) are obtained by sliding the probe along the long axis of the stomach. **Plan B** shows the position of the probe on the descending duodenum. Both transverse (top sonographic image) and longitudinal images (bottom sonographic image) of this bowel segment are displayed. **Plan C** shows the position of the probe on the descending colon. Both transverse (top sonographic image) and longitudinal images (bottom sonographic image) of the colon are displayed.



Ultrasound evaluation of the liver, transverse to dorsal plane.

Modes of Echo Display

- There are three modes of echo display, two of which are used more frequently in clinical applications in veterinary medicine.
- **A-Mode (amplitude mode)** is the least frequently used, but it still may have special use for ophthalmic examinations and other applications requiring precise length or depth measurements. A-mode is the simplest of the three modes. The echo's origin and amplitude are displayed as spikes originating from a vertical baseline.
- **B-Mode (brightness mode)** displays the returning echoes as dots whose brightness or gray scale is proportional to the amplitude of the returned echo and whose position corresponds to the depth at which the echo originated along a single line (representing the beam's axis) from the transducer.
- **M-Mode (motion mode)** is used for echocardiography along with B-mode to evaluate the heart. Changes in the size and shape of organs, tissues, and structures are evident in most cases, but evaluation of the echo pattern is based on comparison with that of other organs and tissues Diseased organs may be either uniformly altered in echogenicity or exhibit focal or multifocal changes.

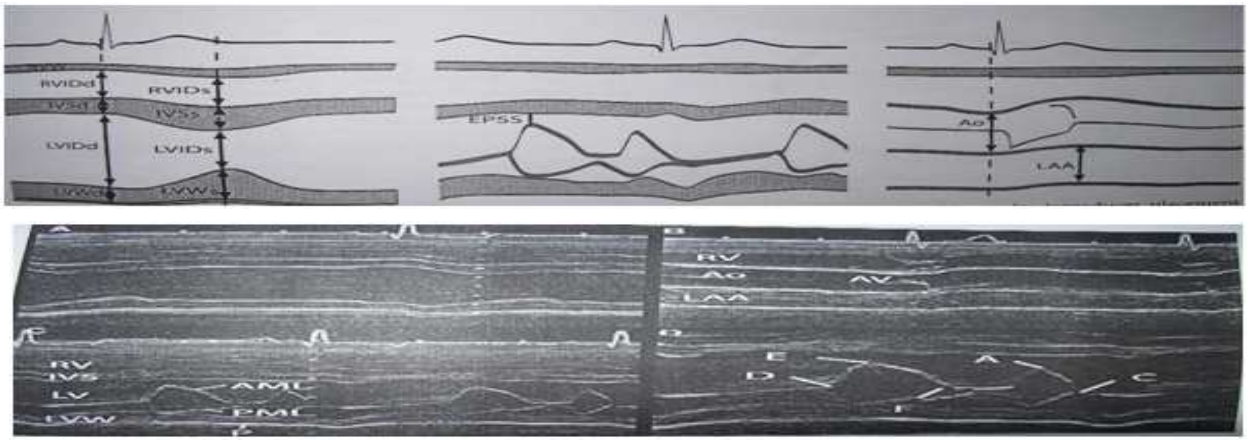
4. ECHOCARDIOGRAPHY

- Echocardiography or cardiac ultrasound permits noninvasive visualization of the inside of the heart including the aorta, the ventricles and atria, the auricular appendages, and all the cardiac valves.
- Dynamic images of the contracting heart are created with two-dimensional and M-mode images while the blood flow through the heart can be seen and measured with Doppler ultrasound.
- Defects also can be seen, including valvular lesions, cardiac shunts, cardiac and thoracic masses, pleural and pericardial effusions, myocardial diseases and stenotic lesions.
- More importantly, echocardiography allows assessment of cardiac chamber sizes, cardiac function, and blood flow.
- The transducer is placed in the cardiac window where the precordial impulse is felt (about the fourth to fifth intercostal space) and its position is adjusted to find clear visualization of the heart without lung or rib interference.
- Once the heart is located, the transducer is swept through the standard image planes from cranial to caudal and ventral to dorsal.

Types of echocardiography

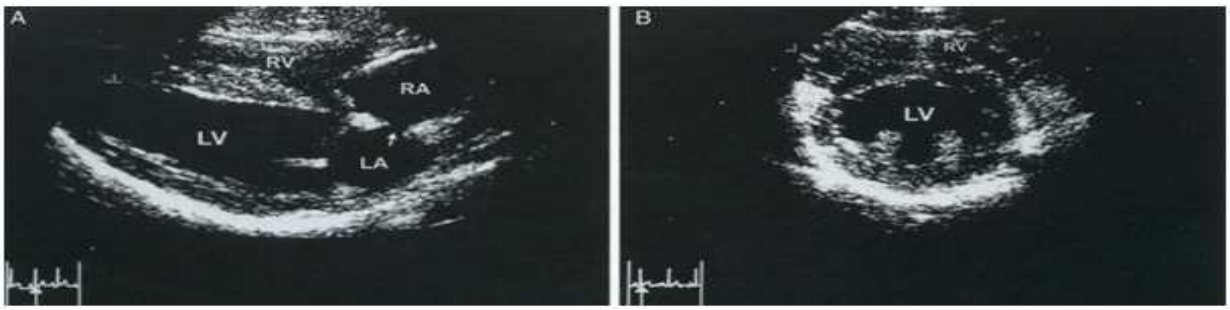
M-mode Echocardiography

- The M-mode echocardiogram yields a one-dimensional view of the cardiac structures moving over time.
- The echoes from various tissue interfaces along the axis of the beam are moving during the cardiac cycle and are swept across time, providing the dimension of time.



Two-Dimensional Echocardiography

- Two-dimensional echocardiography allows a plane of tissue (both depth and width) to be imaged in real time.
- Thus, the anatomic relationships between various structures are easier to appreciate than with M-mode echocardiographic images



Two-dimensional echocardiographic images.

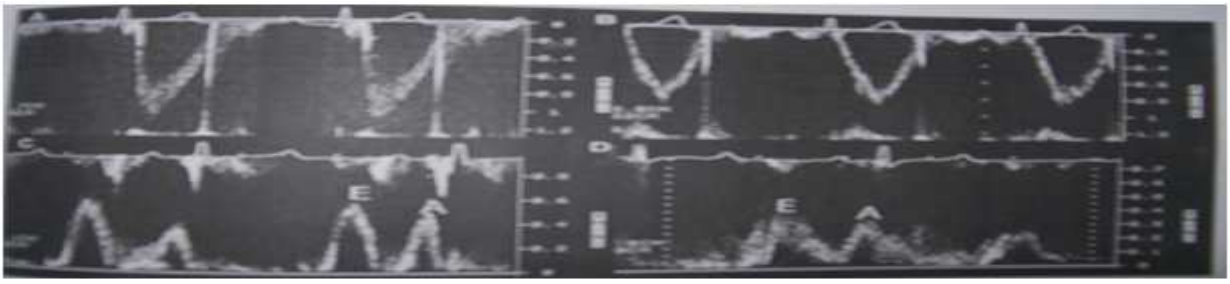
Doppler Echocardiography

- Doppler imaging allows evaluation of blood flow patterns, direction, and velocity; thus, it permits documentation and quantification of valvular insufficiency or stenosis and cardiac shunts.
- Estimations of blood flow and cardiac output can also be made.

Types of doppler echocardiography:

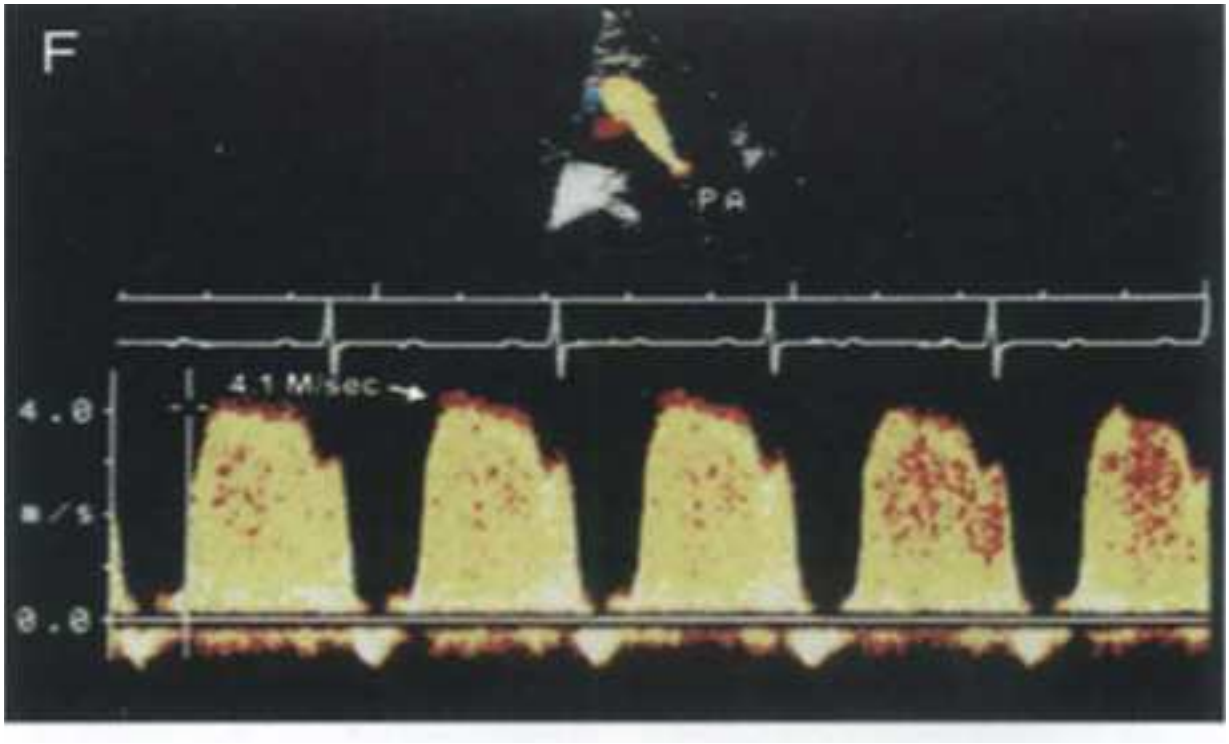
a. Pulsed wave (PW) Doppler –

Uses short bursts of ultrasound transmitted to a point (designated the "sample volume") distant from the transducer. Blood flow velocity, direction and spectral characteristics from a specified point in the heart or blood vessel can be calculated.



b. Continuous wave (CW) Doppler –

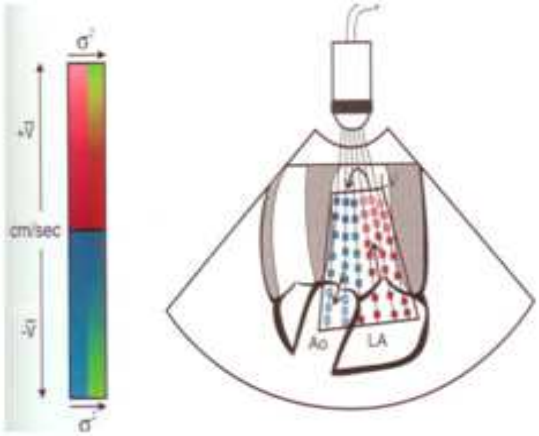
Uses dual crystals so that ultrasound waves can be simultaneously and continuously sent and received.high velocity flows can be measured.

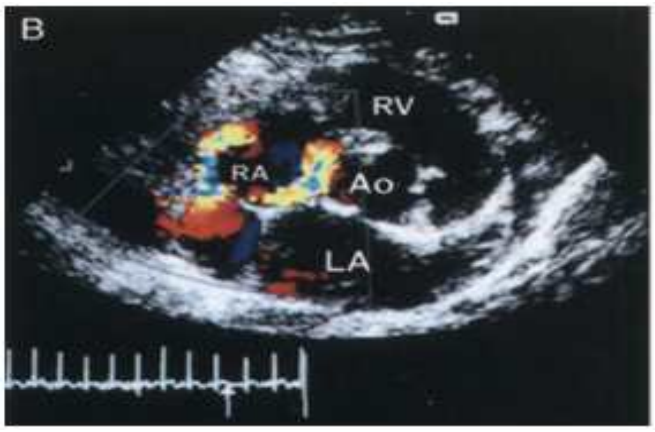


Pulmonary hypertension and cor pulmonale.
Continuous wave Doppler recording of right ventricular outflow.

c. Colour flow Doppler echocardiography

It is a form of PW Doppler ultrasonography which combines the M-mode and 2-D modalities with blood flow imaging. Most systems code blood flow toward the transducer as red and flow away as blue.





II. TREATMENT /THERAPY

- Applying the knowledge of pharmacology in treatment of diseases to bring back the sick animal to its normal state.
- Cost of treatment should not exceed cost of animal

1. GENERAL TREATMENT:

- Measures adopted to combat certain complications during the course of disease and to resuscitate vitality of animal.

2. SYMPTOMATIC THERAPY:

- To institute medical agents to get rid of certain symptoms which cause distress
- E.g.: Astringents; Enteritis
- Expectorants: cough
- Carminatives: Tympany

1. SPECIFIC THERAPY

- Administration of specific curative agent against certain diseases. It is possible when etiology is known
- Eg: Calcium borogluconate: Milk fever
- Praziquantel: Tapeworm infestations

4. PALLIATIVE THERAPY:

- This is given to prolong the life span of animal
- E.g.: Insulin in Diabetes

5. EMPERICAL THERAPY:

- Art of treating the patient by more experience gained through long time trail and error methods.
- Exact pathology and pharmacology is not known
- e.g.: Inflation of udder with air to treat Milk fever

6. RATIONAL THERAPY:

- Scientific method of administration of drugs based on pathophysiology of disease process and knowledge of drugs.
- E.g.: Silica in dimethicone in Tympany/bloat

7. PROPHYLACTIC/ PREVENTIVE THERAPY:

- All measures adapted to prevent diseases like quarantine, immunisation, carcass disposal, balanced nutrition .

III. DIAGNOSING COMMON PROBLEMS

1. PRODUCTION DISEASES

A.MILK FEVER OR HYPOCALCAEMIA:

- It is a production disease occurring most commonly in adult cows and buffaloes within 48-72 hours after calving. It may occur several weeks before or after calving.
- Depression of the levels of ionized calcium in the tissue fluid is the basic biochemical defect. High milk yielders and especially Jersey breed of cattle is more prone to this disease.
- The clinical signs are exhibited in three stages.

1. Stage of excitement and tetany:

   Animal is excited and hypersensitive, grinding of teeth muscular tremors, more in hind legs, stiffness, protrusion of tongue. Temperature is normal or increased by 1°F.

2. Stage of Sternal recumbency:

   Animal sits down on sternum. Head and neck deviated towards the flank. 'S' shaped posture of the animal. Temperature is sub normal. Animal responds to treatment only till this stage. If untreated the animal goes to next stage.

3. Stage of lateral recumbency:

Animal lies on lateral recumbency. Coma and death

TREATMENT:

- Calciumborogluconate 25% @450 ml slow intravenous morning and evening or intravenous followed by subcutaneous injections or gel calcium orally.
- **PREVENTION:**
- Prevention is by limiting calcium feeding during pregnancy and feeding of gel calcium before and after calving.

B. KETOSIS:

- Ketosis in ruminants is a disorder of energy metabolism characterized by ketonemia, ketonuria, hypoglycemia and low levels of hepatic glycogen.

ETIOLOGY :

1) Under nutrition / Starvation or feeding of low carbohydrate diet
2) Feeding of excess amount of protein rich diet
3) Excess feeding of silage
4) Deficiency of cobalt and phosphorus
5) High milk yield: Heavy drain of lactose through milk leads to negative energy balance.
6) Hepatic insufficiency, Adreno-cortical insufficiency Insulin deficiency

CLINICAL FINDINGS

- The disease is manifested in two forms:

Wasting type:

- More common in buffaloes.
- Animal exhibits gradual and moderate decrease in appetite
- Refusal of concentrate and decrease in milk yield.
- Woody appearance of the skin is seen buffaloes.
- A characteristic odour of ketones is detectable on breath and often in milk

Nervous type:

- Sudden onset and common in cows.
- Nervous signs like walking in circles, aimless movements,
- vigorous licking of the skin and inanimate objects.
- Moderate tremors and staggering gait.

TREATMENT:

- Glucose replacement therapy using Glycerine or Propylene glycol orally.
- 20% Dextrose Injection parenterally.
- Injection Catosal.
- Proper feeding of the animals during pregnancy.
- Prophylactic feeding of glucose precursors after calving.

C. Downer Cow Syndrome:

- The Downer Cow Syndrome is a condition which occurs in cattle usually following milk fever. It is characterized clinically by prolonged recumbency even after two successive treatments with calcium.

ETIOLOGY:

- Traumatic injuries of the medial thighs muscles and of the tissues around the hip joint and of the obturator muscles.
- This may be a result of oversized calf in the womb or when cow is forced to get up or walk on a slippery floor immediately before or following parturition.
- Traumatic injuries to the nerves of the limbs.

CLINICAL FINDINGS:

- Creeper cow: The animal is bright and alert. Moderate intake of feed and water. Temperature and respiration is normal. Proteinuria may be present which indicates muscle damage.
- Non-Alert downer cow: Animal in lateral recumbency with the head drawn back and don't eat or drink. Death may occur in 48-72 hours.

TREATMENT:

- Comfortable bedding to turn the cow from side to side several times daily to minimize the degree of ischemic necrosis.
- Attempts at slinging are usually unsuccessful unless the cow is partially able to get up on her own.
- Corticosteroids, NSAIDS, Nervine tonics and vitamin E selenium preparations can be tried.
- Sand is an ideal form of bedding.
- Physiotherapy: muscle damage.

CONTROL:

- Early detection and treatment of hypocalcemic /parturient paresis recumbent animals.
- If unable to stand,should be rolled from one side to another side.
- Dairy cows should be placed in a box for calving and left in that box until at least 48 hours after parturition in the event that milk fever develops.

2. INFECTIOUS DISEASES

I. BACTERIAL DISEASES:

1. ANTHRAX:

- Anthrax is an acute infectious bacterial disease cattle and sheep which can affect a wide variety of domestic and wild animals characterized by septicemia and sudden death with the exudation of tarry blood from the body or natural orifice.
- The disease usually occurs very suddenly. Affected animals are found dead often with no previous signs of illness.
- Humans are also susceptible to anthrax. The risk of human infection occurs when examining, skinning or cutting up an infected carcass.

ETIOLOGY:

- Gram positive capsulated, rod shaped, aerobic bacteria *Bacillus anthracis*.
- Transmission: Ingestion of spores. Transmitted through blood sucking insects and biting flies. Cutaneous form organisms gain entry through abrasions of skin.

CLINICAL SIGNS:

- The disease may appear in 3 forms

1. Per-acute form found in the beginning of an outbreak. The animals may be found dead without any premonitory signs.
2. Acute form: There is elevation of body temperature 104-108°F. Animal is depressed followed by respiratory distress,staggering convulsions,bloody discharges from mouth and nostrils shortly before or after death. Death takes place within 48 hours.
3. Sub-acute form: it is characterized by oedema noticed under the neck, brisket region, thorax, abdomen and flank.

DIAGNOSIS:

- History of sudden death of animals with bloody discharges from mouth, nostrils and anus must be suspected to have died anthrax.
- Demonstration of anthrax bacilli in the blood smears.
- When blood films are stained with polychrome methylene blue will show the presence of large square ended blue rods in short chain with pink capsule (mc Fadyean's reaction)

CONTROL:

- Periodical and regular vaccination.
- Strict quarantine measures.
- Carcass should not be opened.

2. BLACK QUARTER:

- It is an acute infectious and highly fatal, bacterial disease of cattle. Buffaloes, sheep and goats are also affected. Young cattle between 6-24 months of age, in good body condition are mostly affected.

ETIOLOGY:

It is caused by gram positive bacteria *Clostridium chauvoei.*

TRANSMISSION:

The disease spreads through ingestion of contaminated feed and contamination of wounds.

CLINICAL FINDINGS:

- Disease starts suddenly and temperature rises(104-106°F).
- loss of appetite, depression, dullness, suspended rumination
- difficult breathing, lameness in affected leg, crepitation swelling over hip, back and shoulder,
- Swelling is hot and painful in early stages whereas cold and painless later.
- Recumbency followed by death within 12-48 hrs.

TREATMENT:

- Treatment with cephalosporin group of antibiotic intravenous for 5 days.
- NSAIDS and anti-histamines to be used

CONTROL:

- Isolation of the infected animals from healthy stock. Disposal of carcass has to be done either by deep burial or burning.
- Proper disinfection of surgical operation instruments prior to operation. Don't allow grazing in affected area.
- Alum precipitated Black quarter vaccine 5ml subcutaneously every year before rainy season.

3. VIBRIOSIS:

Vibriosis is a venereal disease of cattle caused by bacteria spread at the time of coitus or at the time of artificial insemination and characterized by infertility with an improperly handled and treated semen increased number of services necessary per conception.

ETIOLOGY:

- The disease is transmitted from bull to cow and from cow to bull during natural service.
- During artificial insemination when infected semen is used the disease is transmitted to cow.
- Infection from bull to bull can occur at semen collection centre.

CLINICAL FINDINGS:

- In cattle, abortion is the chief sign of infection with greatest in first two months of gestation. Mild endometritis
- Failure to conceive- return to service at normal time. Early embryonic death- delayed return to service.
- Late embryonic death- abortion (usually 4-5 months)

TREATMENT:

- Infected cows can be treated with intrauterine infusion of broad spectrum antibiotics for elimination of organisms from female genital tract.
- Infected bulls are treated with a course of broad spectrum antibiotic parenterally along with local treatment of preputial cavity for 5 days.

CONTROL:

- In infected herd stop using natural service until at least two years after initial infection began. If a bull has to be bough the best policy is the younger the better.
- If mature bull, treat it with antibiotics before it is used to mate cows.
- Cows and use it on small number of cows only so that its fertility can be monitored before it is used for service in the main herd.

4. HAEMORRHAGIC SEPTICAEMIA: It is an acute, infectious disease of cattle and buffaloes characterized by sudden onset of disease, high temperature, edematous swelling of subcutaneous tissues particularly of throat.

ETIOLOGY:

- The disease is caused by gram negative bacteria *Pasteurella multocida*

TRANSMISSION:

- The organisms are normal inhabitants of respiratory tract, any stress causes outbreak.
- Direct transmission from infected to healthy animals by ingestion of contaminated feed and water.

CLINICAL FINDINGS:

- Septicaemic pasteurellosis flares up as an outbreak during the environmental stress.
- There is high rise of temperature (104-107°F), with lacrimal and nasal discharges, visible mucus membrane profuse salivation, and death within 24 hours.
- Concurrent shivering sub mucosal petechiation are evident.
- Some cases show signs of abdominal pain, death
- Edematous form: this form is more common in buffaloes. There is rise in temperature head, neck, dewlap become swollen due to infiltration of inflammatory exudate in the subcutaneous tissue.

TREATMENT:

- Any broad spectrum antibiotics can be used. Route of administration preferably I/V.
- Steroidal anti-inflammatory drugs like dexamethasone-5ml may be given I/V or I/M

CONTROL:

- An effective prophylactic vaccination of all susceptible animals in the enzootic areas once a year before the onset of the monsoon.

5. TUBERCULOSIS:

- Tuberculosis in cattle is a chronic infections bacterial disease of animals characterized by the progressive development of turbercles in any of the organs in most species.

ETIOLOGY: The disease is caused by *Mycobacterium bovis.*

TRANSMISSION:

- Inhalation of organism.
- Ingestion of the organism through contaminated feed and water.
- Direct transmission from infected to non-infected animal and indirect through faeces, urine and other excretions.

CLINICAL FINDINGS:

- Affected animals with extensive military tubercular lesions are clinically normal but progressive emaciation un-associated with other signs should always arouse suspicion of tuberculosis. Capricious appetite and fluctuating temperature.
- Hair coat is rough.
- Affected animals tend to become more docile and sluggish but eyes remain bright and alert.
- Chronic cough.
- Enlargement of lymph nodes.

TREATMENT:

- In cattle, it is not economically feasible. Hence detected cattle are culled because of public health concern.

CONTROL:

- removal of the infected animals, prevention of spread of infection and avoidance of further introduction of the disease.
- Detection of infected animals is by use of tuberculin test.
- Hygienic measures to prevent the spread of infection.

6. JOHNE'S DISEASE/ PARATUBERCULOSIS:

- It is a chronic infectious gastrointestinal disease of ruminants characterized by progressive emaciation and diarrhea.

ETIOLOGY:

- The disease is caused by *Mycobacterium Johnei* also called as *Mycobacterium paratuberculosis.*

TRANSMISSION:

- Natural infection occurs through ingestion when the calves are very young
- intra-uterine
- Contaminated food and water with faecal materials
- Milk may act as direct source of infection.

CLINICAL FINDINGS:

- Diarrhoea may be intermittent or continuous in nature.
- Faeces dark in colour and contain bubbles.
- The animal is hidebound, dry coat; weight loss is prominent,
- Severe dehydration results in death of the animal.

TREATMENT AND CONTROL:

- All the animals should be tested by faecal culture once in 6 months.
- Intradermal Johnin test is used as a screening test in the herd.
- Positive animals should be disposed off.
- Faeces should be removed and heavy lime dressings are to be done

7. LEPTOSPIROSIS:

- It is an acute or chronic or clinically inapparent contagious disease of domesticated and wild animals as well as man and manifested as anaemia, fever, hemoglobinuria, icterus and in ruminants predominating abortion, still birth and reproductive disorders.

ETIOLOGY:

- Leptospirosis is caused by the genus Leptospira. In cattle *L.pomona, L. grippotyphosa, L.canicola, L.Icterohaemorrhagiac* and *L.hardjo.*

TRANSMISSION:

- Direct contact with the urine of infected animals or ingestion of urine contaminated water or food.
- Contaminated pasture and soil.
- Transplacental infection has been considered as one of the ways of transmission in cattle.

CLINICAL FINDINGS:

- The disease in cattle and buffalo is manifested in 3 forms.

1. Peracute / acute form: Sudden in onset and the first sign is an elevation of body temperature, followed by anorexia, lassitude, hemoglobinuria, dyspnoea, icterus and abortion
2. Subacute/ mild form: The affected animals show signs of anorexia, depression, haemoglobinuria and colic.
3. Chronic/ recurrent form: The affected animals show less marked signs for a longer period. Abortion is the prominent sign.

Acute or chronic form of nephritis.

TREATMENT:

- A course of antibiotic like penicillin and streptomycin or any broad spectrum antibiotics are recommended for a period of 5-7 days.
- If kidney is involved, supportive therapy should be given to monitor kidney function like fluid therapy and diuretics.

CONTROL:

- Strict sanitary measures should be adopted in the farm to prevent contamination of food and water through urine of carrier animals.
- Rodent control should be undertaken.

8. LISTERIOSIS:

- It is an infectious fatal disease of wide range of animals and characterized by signs of meningoencephalitis. It also causes abortion, endometritis and repeat breeding in farm animals.

ETIOLOGY: *Listeria monocytogenes.*

TRANSMISSION:

- Infected feed and soil contaminated by urine, aborted fetus and uterine discharges of infected animals.
- Silage is considered as a potential source of transmission.

CLINICAL FINDINGS:

- The disease may be manifested in three types
- Encephalitis: prevalent form of disease in cattle. The affected animal is dull, depressed, high rise in temperature and dummy syndrome is noticed. Unilateral facial paralysis
- Abortion: In cattle abortions between 4-7th month of pregnancy followed by retention of placenta
- Septicaemia: Only new born calves and lambs suffer with signs of depression, pyrexia, diarrhoea, emaciation and corneal opacity.
- Signs of dyspnoea, opisthotonus and nystagmus

TREATMENT:

- The disease has to be treated with a broad spectrum antibiotic for a period of 5-7 days.
- Supportive therapy with fluids, nervine tonics, and anti-inflammatory drugs

9. TETANUS:

- It is an acute infectious disease of mammals caused by toxin and characterized by hyperaesthesia, muscular spasms and rigidity.

ETIOLOGY:

- The disease is caused by the toxins produced by *Clostridium tetani*. Spore forming Gram positive bacteria.

TRANSMISSION:

- Transmission in all animals occurs as a result of wound infection.
- Occurs due to wounds of castration, docking.
- Parturition and in young animals through umbilicus.

CLINICAL FINDINGS:

- The initial signs consist of restricted movement, muscular stiffness and difficult in walking.
- Decreased in milk yield, lock jaw and hypersensitivity on little stimuli.
- Prolapse of the third eyelid,
- Bloat is a characteristic sign in ruminants and rumen appears drum like.

TREATMENT:

- Neutralization of circulating toxin by antitoxin therapy
- Destruction of organisms by Antibiotic therapy
- Prevention of asphyxia.

CONTROL:

1. Through cleaning, removal of necrotic tissue and dressing of wounds.
2. Animals should not be allowed to graze near barbed wire fencing.
3. Sterile surgical instruments are to be used at the time of operation.
4. Tetanus toxoid should be given once in 6 months.

10. ENTEROTOXAEMIA:

- It is an acute, highly fatal disease of sheep and goats and characterized by diarrhoea, nervous symptoms, paralysis, convulsions, sudden prostration and death.

ETIOLOGY: *Clostridium perfringens* type D in the intestineand toxin.

TRANSMISION: Transmission is by ingestion of contaminated feed.

CLINICAL FINDINGS:

- convulsions. champing of jaw, opisthotonus condition, bloat, salivation, exhibit blindness and dashing against objects.
- Temperate may increase upto 2-3F more than normal.
- diarrhoea, loss of appetite, weakness, Glycosuria, hyperglycemia.
- staggering and knuckling, champing of jaws, salivation and rapid shallow irregular respiration.
- There may be bloat in terminal stages.

TREATMENT:

- Broad spectrum antibiotic initially parenteral in emergencies and followed by oral route. Intravenous dextrose saline to neutralize the toxin.

CONTROL:

- Annual ET Vaccination in the month of may.
- Feeding schedule should be monitored.
- Isolation of the affected and treatment be undertaken.

11. MASTITIS:

- Mastitis is the inflammation of the mammary gland, characterized by physical, chemical and microbiological changes in the milk and pathological changes in the glandular tissues of the udder.

ETIOLOGY:

- Infectious agents: *Streptococci* sps, *Staphylococcus* sps, *Corynebacterium* sps, *Pseudomonas* sps, *Klebsiellasps*, E.coli, *Proteus*, *Mycobacterium* sps, virus(pox), fungi, Mycoplasma.
- Non Infectious agents:Include physical trauma caused by suckling calves and barbed wives.

TRANSMISSSION:

- The source of infective agents is udder and environment.
- Contamination of milkers hand, milking machine cup may spread disease from infected to non-infected teats.

CLINICAL FINDINGS:

- Affected animals show changes in udder.
- Udder may be swollen, hot, painful and presence of abrasions, changes in milk is indicated by change in colour, consistency, presence of flakes, clots and blood.
- In systemic involvement is noticed, the affected animal shows loss of appetite, rise in body temperature, recumbency and all the four teats are involved.

TREATMENT:

- Strip all the milk from the affected teat.
- Apply ointments topical like Mastilep, wisprec ointment or inflagel.
- A course of broad spectrum antibiotic for a period of 5-7 days.
- A course of NSAIDS for a period of 3-5 days.
- A course of antihistaminics for a period of 3 days.
- Udder supportives like orally uniselit-10 gm or mammidium or masticare for 4 days.

CONTROL:

- Proper hygiene in the sheds and while milking the milkers hand to be washed thoroughly and use of teat dips after milking.
- Prompt attention to teat injuries, maintaining proper pressure in machine milking and suspected cases should be milked at the last.

II. VIRAL DISEASES:

1. RINDERPEST/ BOVINE PLAGUE.

- Rinderpest is an acute, highly contagious disease of ruminants and swine caused by a virus and characterized by high fever and focal erosive lesions confined to the mucosa and enteritis.

ETIOLOGY:

- RNA virus belonging to paramyxo group of genus Moribili virus. It is related to measles and canine distemper virus.

TRANSMISSION:

- Natural infection occurs primarily by direct contact of susceptible animal with infected animal by method of inhalation. Ingestion of contaminated food and water.

CLINICAL FINDINGS:

The disease is manifested in the four stages.

- Incubation stage: entry of the virus in the animal
- Prodromal stage: appearance of mucosal lesions following a marked rise of body temperature more than 104°F. Animal becomes dull, depressed and anorectic. There is drop in milk yield and profuse nasal and lacrimal discharges.
- Mucosal stage: There will be erosions and necrosis of mucus membrane of oral cavity. The chief sites of oral lesions inside of the lower lips and adjacent gums, commissures of the lips, under the tip of tongue and back of body followed by diarrhoea. Faeces is watery, dark contains mucus and blood and later necrotic epithelium.
- Convalescent stage: In this stage, the resolution of mucosal lesions and mucosa resumes integrity following healing of mucosal lesions and recovery takes place within few weeks.

TREATMENT:

- No effective treatment in Rinderpest. Antibiotics are used to control the secondary bacterial infections.
- Large doses of fluids and electrolytes to be given intravenous to prevent dehydration.

CONTROL:

- This disease has been controlled in India through National Eradication Progaramme i.e. Rinderpest zero programme, OIE has approved that India is free from Rinderpest.
- Slaughter of infected animals and vaccination of neighboring animals.
- Quarantine stations and check posts in the main cattle route to prevent spread of disease from one part to other .
- Rinderpest tissue culture vaccine 1 ml through subcutaneous route.

2. FOOT AND MOUTH DISEASE:

- It is an extremely contagious acute infectious viral disease of cloven footed animals, characterized by fever and formation of vesicles in the mouth and on the feet.
- Cattle, buffaloes, sheep, goat, pig etc are susceptible animals.
- There are several strains and sub strains of the virus which are antigenically distinct and no cross immunity between strains and substrains.
- In India O, A, C and Asia-I and their substrains are prevalent.

- TRANSMISSION
- The disease spreads by inhalation and ingestion, direct contact Incubation period 1-7days.

CLINICAL SIGNS

- High temperature 40-41°C (104-106°F).
- Anorexia followed by acute painful stomatitis, abundant salivation, saliva hanging in long ropey strings.
- Smacking of the lips and the animal chews carefully vesicles (1-2cm in diameter) appear on buccal mucosa, dental pad and the tongue.
- Vesicles appear on feet particularly in the clefts and on the coronet.
- Secondary lesions develop on udder, teats, mastitis.

CONTROL

1. Isolation of affected animals in the herd.
2. Vaccination of healthy animals.
3. Treatment of the sick animals.
4. Wash the mouth and feet lesions using potassium permanganate solution.
5. Foot lesions to be applied neemlent and antiseptic ointments to prevent flies and maggoted wounds.
6. Non-steroidal anti inflammatory drugs like Meloxicam- 0.2-0.5mg/kg b.wt-I/M for 3 days.
7. A course of broad spectrum antibiotics for 3 to 5 day to prevent secondary bacterial infections.
8. Calves above 4 months age should be vaccinated. Adult annual vaccination against FMD using oil adjuvant against FMD once in six months can be given subcutaneous or intramuscular.

3. RABIES:

- Rabies is an acute, infectious highly fatal disease of mammals characterized by signs of abnormal behaviour, nervous disturbances such as increased excitability and irritability, impairment of consciousness, paralysis and death.

ETIOLOGY:

- Rabies is caused by RNA virus of the family Rhabdoviridae and genus Lyssa.

TRANSMISSION:

- Bite of rabid dog or cat or rodents or even if the saliva of the infected dog when deposited on cuts or abrasions.
- In India, dogs are the main transmitter of the disease (95%).

CLINICAL FINDINGS:

- Rabid cattle appear in coordinated.
- Loss of appetite and sudden fall of milk yield.
- Excessive salivation and grinding of teeth with paralysis of muscles of deglutition.
- bellowing in low pitched voice is noted in cattle.

TREATMENT:

- No specific treatment is available for rabies and once signs are noticed, the animal dies due to rabies invariably.

CONTROL:

- Both the domestic and stray dog population has to be vaccinated annually against Rabies.
- Post bite therapy which includes vaccination against Rabies on 0,3,7,14,28 and 90th day.90th day dose is optional.
- The bite has to washed immediately and thoroughly with plenty of normal water and then dressed with and antiseptic.
- Tetanus toxoid can be given.

4. POX

- It is a contagious eruptive skin disease of cattle. It is mild cutaneous disease where the lesions are mostly confined to udder and teat.
- This disease has been recorded to be transmitted in human beings as milker's nodule.

ETIOLOGY:

- DNA virus of variolavacciania sub group of pox viruses. Cow pox virus is closely related to small pox virus. Both the viruses are related.

TRANSMISSION:

- Direct contact with the affected cows, milker's hands
- Mechanical transmission by insects and milking machine may transfer the infection from cow to cow in a herd.

CLINICAL SIGNS:

- Mild increase in temperature, suspended rumination, anorexia and depression.
- Udder is swollen, hot and sensitive typical pock lesions appear on the teat and udder.
- Pock lesions, Mastitis
- Swelling of eyelids, lacrymation, mucopurulent nasal discharge, red spots on udder, teat.

TREATMENT:

- The affected animals are isolated and treated.
- Anti-inflammatory can be applied to udder.
- A course of antibiotic to prevent secondary bacterial infection a
- Povidine iodine or any antiseptic ointment.

CONTROL:

- Strict hygienic measures are to be adopted.
- Isolation and segregation of the affected cattle to be made
- Teat dip may be used after milking .
- Calves should not be allowed to suckle infected mother. All the healthy animals should be milked first and diseased one at the last.

5. PESTE DES PETITS RUMINANTS (PPR)

- PPR is a subacute or acute highly contagious disease of small ruminants having resemblance to Rinderpest characterized by fever, loss of appetite, stomatitis, enteritis and pneumonia.

ETIOLOGY:

- PPR is caused by moribilli virus of paramyxovirus family.

TRANSMISSION:

- Direct contact with infected goat or sheep
- Indirect transmission occurs through contaminated food, water and other fomites.

CLINICAL FINDINGS:

- Acute form of the disease is characterized by high rise of temperature (104 -106°F), dullness, dry muzzle and congestive mucous membranes.
- There is profuse serous nasal discharge turns mucopurulent to purulent and signs of foul breath are evident.
- The discharge matt the nasal and ocular surroundings and some animals show conjunctivitis and matting of eye lids.
- Diarrhoeic faeces and contain mucus and blood.
- Subacute form is mostly seen in sheep and signs are observed in lower grade.

TREATMENT:

- A broad spectrum antibiotic for 5-7 days.
- Non steroidalanti inflammatory drugs (NSAID)
- Mouth wash with potassium permanganate and boroglycerine paste is applied.
- The affected animals should be fed soft gruel diet.

CONTROL:

- Hygienic measured in a flock.
- Animals purchased from market should not be directly introduced in to the flock.
- Sick animals should be segregated and treated.
- PPR tissue culture vaccine- 1ml- S/C every year has to be practiced.

6. BLUE TONGUE.

- It is an infectious, non-contagious arthropod borne viral disease predominantly of sheep and characterized by high fever, stomatitis, rhinitis, gingivitis and inflammation of intestine and sensitive laminae of the foot.

ETIOLOGY:

- RNA virus belonging to arthropod born Orbivirus of Reoviridae family.

TRANSMISSION:

- The disease is non – contagious and natural transmission occurs through biting insects.
- Blood sucking midges of genus Culicoides, sheep ked Melophagusovinus, mosquitoes like aedes transmit the disease mechanically.

CLINICAL FINDINGS:

- High fever persisting for 5-6 days with progressive reddening of the buccal mucous membrane.
- Acute form: This is characterized by high rise in temperature, nasal and lacrimal discharges and swollen gums, tongue and lips which results in drooling saliva, followed by ulceration and necrosis of dental pad and bluish appearance of the tongue. Cracks in the coronary band and separation of hoofs leads to lameness. Diarrhoea and pneumonia may be a feature.
- Sub-acute form: Mostly seen in cattle and generally goes unnoticed.
- Abortive form: Pregnant ewes when infected with the disease, abortions are common.

TREATMENT:

- To check secondary bacterial infections, antibiotics may be given parenterally.
- NSAIDS may be used to reduce inflammation and lameness.
- Mouth wash with antiseptic solutions may be undertaken for quick healing of the oral lesions.

CONTROL:

- Recovered sheep are immune for six months.
- Grazing should be avoided in areas where there are lot of vectors.
- Reduction of vector population by insecticides and also good water management, eradication of vectors
- Vaccination

7. CONTAGIOUS ECTHYMA OF SHEEP AND GOAT (ORF), CONTAGIOUS PUSTULAR DERMATITIS:

- Contagious ecthymais a highlyinfectious viral disease of sheep and goats characterized by the development of pustular and scabby lesions on the muzzle, lips and on the teats.

ETIOLOGY:

- The or f virus belongs to the genus para pox virus of the family Pox viridae.
- TRANSMISSION:
- The disease is transmitted by contact with affected animals or inanimate objects.
- Suckling lambs or kids are affected from the udder of affected ewes or does.

CLINICAL FINDINGS:

- Dullness, depression, anorexia and rise of temperature106-108°F.
- Profuse salivation and lesions develop initially as papules and then pustules, then thick scabs covering a raised area of ulceration and granulation.

TREATMENT:

- Treatment is aimed at prevention of secondary bacterial infection.
- A course of antibiotics for 5-7 days may be used with Povidine Iodine and other fly repellants.

CONTROL:

- Affected animals should be seggrated from rest of the flock.
- Strict hygiene and sanitary measures to be adopted in the farm.
- Hands to be washed thoroughly after attending the affected flock.

III. GENERAL SYSTEMIC STATES

- Mammals and birds maintain a relatively constant body core temperature, even when the external thermal environment shows extreme variation. Such animals are called homeothermic animals.
- This homeothermic state is achieved by modifying the rate of heat loss from the body or the rate at which heat is produced. So, the body temperature is an indication/reflection of the balance between heat gain and heat loss.

HYPOTHERMIA

- Fall in body temperature (or lower than normal temperature) that occurs when excess heat is lost or insufficient heat is produced in the body.

ETIOLOGY

- Excessive loss of heat due to cold atmospheric temperature, rainfall and speedy winds.
- Insufficient heat production - Insufficient body reserves, low birth weight, Insufficient feed intake.

CLINICAL FINDINGS

- Cold extremities, shivering/ trembling, and subnormal temperature. Weakness, decreased activity.
- Bradycarida, weak pulse and collapse of major veins are characteristic. Death is common when body temperature falls below 35-degree

DIAGNOSIS

- History, Clinical and physical examination findings
- Clinical pathology – no characteristic changes

TREATMENT & CONTROL

- If the animal is wet quickly dry off and place in a warming pen. Provide heat using heat lamps/ ordinary lamps/ infrared lamps/ rugs
- In neonates, if suckling reflex is present, give colostrum @ 50ml/kg body weight.
- Give 20% glucose parenterally or intraperitoneally @10ml/kg body weight (at a temperature of 39 degree
- Provide supportive therapy (Fluids, B-complex vitamins, antibiotics etc.), and treat for other concurrent ailments.
- Provide a dry, wind-free environment for animals nearing parturition and for sick and weak animals.
- Ensure intake of colostrum immediately after birth.

HYPERTHERMIA

Hyperthermia is an elevation of body temperature due to excessive heat production or excessive heat absorption or due to deficient heat loss, and the causes of these abnormalities are purely physical. The best example is heat stroke.

ETIOLOGY

- High environmental temperature or exposure to sunlight and poor ventilation.
- Severe muscular exertion especially when the humidity is high, animals are fat, have a heavy hair coat.
- Other causes - Dehydration, Excessive muscular activity as in Strychnine poisoning and Neurogenic hyperthermia due to damage of hypothalamus.

CLINICAL FINDINGS

- Restless, dull, stumbles while walking and tends to lie down increase in thirst and the animal seeks cool places.
- Heart rate and respiratory rate increases. initial sweating and salivation are followed by a marked absence of sweating.
- When the body temperature reaches 41^0 C or 106^0 F, respiration becomes laboured. This is followed by shallow and irregular respiration, rapid and weak pulse, collapse, convulsions and terminal coma.
- Death occurs when temperature reaches 106 -108^0 F or 41.5 – 42.5^0 C.
- Abortion, embryonic morality and infertility occur in prolonged periods of hyperthermia.

DIAGNOSIS

- History, clinical signs and examination of the environment.
- Clinical pathology – no characteristic changes

TREATMENT

- Provide shade and adequate water to drink
- Treat weak animals with IV fluids – 5% Dextrose or Normal Saline
- Wipe the body with a towel/ cotton soaked in thermo-neutral water.
- Alternatively apply slightly cool water by spraying/ immersion.
- Cold water enema is also useful.
- Supportive therapy – fluids, B-vitamins, antibiotics, antiemeticsetc

FEVER

- Fever is an elevation of core body temperature above the level that is normally maintained by an animal and is independent to the effects of ambient conditions on body temperature.

ETIOLOGY

- Septic fever ▪ Include infection due to bacteria, viruses, protozoa or fungi as localised or generalized infection, septicaemia etc.
- Aseptic fever like Chemical fever – injection of foreign protein, Surgical fever – due to break down of tissue & blood, Tissue necrosis or infarction

CLINICAL FINDINGS

- Depression, anorexia, muscle weakness, increased thirst Increased heart rate with a decrease in amplitude and strength of arterial pulse
- Hyperpnoea, Oliguria & scant faeces Elevated body temperature

DIAGNOSIS

- CBC and serum biochemistry
- Microbiological testing
- Cytological analysis of body fluids
- Exploratory cytology and biopsy

TREATMENT

- To control fever use antipyretics. eg. Meloxicam, Flunixinmeglumine, Phenyl butasone, Acetyl salicylic acid, Paracetamol, Carprofen etc.

SEPTICAEMIA

- Septicaemia is the acute invasion of the systemic circulation by pathogenic bacteria, which may cause sepsis or septic shock.
- If the infection is not adequately controlled, the bacteria localize in various organs. (Sepsis is a potentially life-threatening condition caused by the body's response to an infection).

ETIOLOGY

- Gram negative bacterial organisms – *Mannheimia hemolytica*, *Salmonella* spp., *E.coli*, *Klebsiella* spp. etc.
- Gram positive bacterial organisms – *Bacillus antracis,* α-haemolytic *Streptococcus*, *Streptococcus* suis Type-I, *Actinobacillus equuli, Erysipelothrixinsidiosa*
- Viral organisms - Bovine Viral Diarrhoea (BVD) and Bovine Malignant Catarrh, Classical swine fever etc.

CLINICAL FINDINGS

- In septicaemia, animal becomes dull and weak.
- Rise in body temperature, respiratory distress, tachycardia, tachypnoea, hypotension, cold extremities and dehydration.
- Submucosal haemorrhages under the conjunctiva and in the mucosae of the mouth and vulva and subepidermal haemorrhages are seen.

DIAGNOSIS

- Diagnosis is based on history, clinical signs and laboratory findings. PM lesions include submucous and subserous haemorrhages may be seen in internal organs.

TREATMENT

- Fluids
- Antimicrobials
- B-complex vitamins
- Other supportive therapy NSAIDs are used

TOXAEMIA/ ENDOTOXAEMIA

- Toxaemia is a clinical systemic state caused by widespread activation of host defence mechanisms to the presence of toxins produced by bacteria or injury to tissue cells.

ETIOLOGY

- Toxins are of two types: antigenic toxins and metabolic toxins.
- Antigenic toxins: These are produced by bacteria and to a lesser extent by helminthes..
- Antigenic toxins are divided into exotoxins and endotoxins.
- Exotoxins are protein substances produced by bacteria which diffuse into surrounding medium.

CLINICAL FINDINGS

- Depression, muscle weakness
- Fever and congested mucous membrane etc. resulting in shock, disseminated
- In the early stages, heart rate and cardiac output increases
- Cardiac output decreases and CRT increases, skin and extremities become cool and animal become hypotensive and hypothermic.

TREATMENT

The principles of treatment of endotoxemia or septic shock include:

(1) Remove the foci of infection.

(2) Administer broad-spectrum antimicrobial agents with a Gram negative spectrum or a combination of antibiotics depending on severity. Eg.Fluroquinolones, aminoglycosides etc. (3) Aggressive fluid and electrolyte therapy

(4) NSAIDs or Glucocorticoids to inhibit products of the cyclooxygenase pathway (inflammation).

(5) Other supportive therapy depending on the condition of the animal.

SHOCK

Shock is a life-threatening condition associated with reduced blood supply to vital organs in the body.

ETIOLOGY

1) Hypovolemic shock: Hypovolemic shock occurs due to a reduction in the circulating volume of blood as a result of loss of plasma or free water.

2) Haemorrhagic shock: Haemorrhagic shock occurs when there is a reduction in circulating blood volume due to rapid loss of blood.

3) Maldistributive shock: Maldistributive shock occurs when there is a reduction in circulating blood volume due to increased capillary permeability, pooling of blood in capacitance vessels

4) Obstructive shock: Obstructive shock occurs when venous return of blood back to heart is reduced or prevented by a mechanical obstruction.

CLINICAL FINDINGS

- Depression, weakness, lethargy and recumbency
- Pale grey to white and dry mucous membranes,
- Low body temperature, Cold skin and extremities, and a prolonged CRT (> 3-4 seconds).
- Heart rate is increased, Pulse is small and weak – 'thready pulse',
- Terminal stages are characterised by profound depression, very low blood pressure, inability to raise veins, cardiac arrhythmia, extreme coolness of the body and death.

DIAGNOSIS

- History, clinical and physical examination findings.
- Ultrasound/ X-ray/ Abdominocentesis/ Thoracocentesis: to identify internal bleeding.

TREATMENT

- Isotonic crystalloid fluids
- Fluids for restoration of extracellular volume (ECF) must contain Na
- Haemostatslike Ethamsylate, Botropase
- Blood transfusion: PCV < 12% is indicative of blood transfusion in large animals.

DEHYDRATION

Dehydration refers to a general systemic / clinical state in which the water content of the body is lower than normal and characterised by oliguria, dry mucous membranes, sunken eyes and a less elastic skin.

ETIOLOGY

- Inadequate water intake – Deprivation of water, a lack of thirst in systemic diseases, inability to drink water as in oesophageal obstruction etc. Here, water content of the body falls, but electrolytes are not lost from the body.
- Excessive fluid loss – diarrhoea, vomiting, polyuria, burns, lactic acidosis, gastric dilatation,
- Hypotonic loss: Fluid lost has a higher concentration of water than plasma.
- Hypertonic loss: This refers to the loss of sodium in excess of water.

CLINICAL SIGNS

- Reduced or absence of urination Dry, hard or scanty faeces Coolness of extremities – ear tips, distal part of limbs
- Increased CRT: > 2 seconds
- Increased heart rate, Loss of skin elasticity, dryness of the skin and

TREATMENT

- Fluid deficit is corrected by providing adequate water to drink.
- Animals which do not show any desire to drink are given water by oral route/ via a naso-gastric/ oro-gastric tube.
- IV administration is the choice of last resort.

IV. FIRST AID TECHNIQUES

1. Management of snake bite envenomation

- There are about 200 species of snakes in India of which about 52 are poisonous and four among these are deadly poisonous..
- Immobilize in the same way as a fractured limb
- Use bandages or cloth to hold the splints, not to block the blood supply or apply pressure
- Do not apply any compression in the form of tight ligatures, they can be dangerous
- Excitement and mobilization can result in rapid spread of venom to the whole system.
- Get to Hospital Immediately
- Do not make cuts or incisions on or near the bitten
- Start treatment as for any critically ill patient
- Make the airway patent by Oxygen therapy
- Provide treatment for shock
- Anti-venom therapy with polyvalent anti-snake venoms (ASV) is available which is effective against cobra, krait, Russell's viper and saw scaled viper. It's available as both lyophilized (5 year shelf life) and liquid (2 year shelf life) forms.
- Cold chain is necessary for liquid form and lyophilized form has to be maintained at 25°C. Both are of 10ml constituted anti-venom.

2. POISONING

- ✓ Access to potent poisons cause sudden death in animals.
- ✓ Poisons such as herbicides, insecticides, rodenticides, and metals account for the majority of the poisoning cases.
- ✓ Clinical signs associated with poisoning conditions vary according to the type of poison and its action.
- ✓ Most of the agents either cause nervous excitation or nervous weakness. Vomiting and diarrhoea are the common findings in heavy metal toxicities and the severity of signs depends on the quantity of poison ingested over time.
- ✓ Common poisoning conditions in all species of animals

  Accidental herbicide/ pesticide poisoning/ OP poisoning/ OC poisoning Nitrate/ Nitrite toxicity

  Ectoparasiticide toxicity – Amitraz, Flumethrin toxicity, synthetic pyrethroids like cypermethrin and deltamethrin

  Drug toxicities – penicillin, anthelmintics, ivermectins
- Heavy metals – Lead, mercury Herbivores are more susceptible to plant poisonings. Ruminants are highly susceptible to urea/ NPN toxicosis.
- Hydrocyanic acid poisoning occurs in ruminants due to ingestion of rubber leaves or tapioca leaves.
- Other poisonous plants are Lantana camara, Mimosa invisa, Strychnine poisoning etc.

Attending to poisoning cases:

- Poisoning in farm animals may be due to feeding of toxic plants and fodder treated with agricultural chemicals which are used by the farmers.
- The affected animals should be shifted to a place to prevent intake of more poison and to be provided with clean fodder and drinking water.
- The poison in the stomach should be diluted by giving plenty of water through stomach tube.
- The alkaloid poison present in most of poisonous plants can be oxidized by dilute potassium permanganate solution or can be precipitated by using strong tea decoction or catechu.
- To decrease the irritation of stomach starch gruel, milk, eggs etc., should be given.
- Purgatives like Epsom salts can be given orally to promote excretion of poison from the body.

V. PREVENTION OF DISEASES

Prevention is better than cure. Instead of treating sick animals, loss in productivity can be minimize by effective preventive measures.

Surveillance of animal diseases:

Monitoring is routine collection of information on disease and productivity in animals. E.g.: Regular recording of mastitis cases and milk production in a dairy farm.

Surveillance: It is an extension of monitoring & it has three distinct features.

1. Gathering, recording and analysis of data;
2. Dissemination of information to interested Parties so that
3. Action can be taken to control disease.

Objectives:

1. Rapid detection of disease outbreaks.
2. Early identification of disease problems.
3. Assesment of health status of population.
4. Fixing up of priorities for disease control and prevention
5. Identification of new and emerging diseases.
6. Evaluation of disease control programme.
7. Provide information to plan and conduct research.
8. To confirm disease free status in the population.

Surveillance includes

1. Detection of cases.
2. Registration of cases.
3. Confirmation by laboratory methods.
4. Reporting to higher authorities
5. Analysis
6. Feedback

ISOLATION:

- Isolation means segregation of animals which are known to be or suspected to be affected with a contagious disease from the apparently healthy. Such segregated animals should be housed in a separate isolation ward situated far away from the normal animal houses.
- If such a separate accommodation is not available, the segregated animals should be placed at one end of animals.

QUARANTINE:

- Quarantine is a Roman word which means forty days.
- It is an oldmethod of disease control that is still very valuable.
- Quarantine means isolation of animals that are either infected or suspected of being so or of non-infected animals that are at risk.
- Quarantine measures may be applied at the national or regional or herd level.
- The period of Quarantine depends on

1. Incubation period of the disease agent.
2. Time taken for the infection to be confirmed. (Time taken for confirmation of lab reports)
3. Time taken for the infected animal to become non-infectious either with or without treatment.

DISINFECTION:

- Disinfection means destruction of pathogenic microorganisms from a place so that the place becomes free from infection.
- Disinfectant, germicide or antiseptic is a substance able to kill organisms and their spores at appropriate concentrations.
- Disinfectants: The common disinfecting agents are sunlight, heat and chemical disinfectants. Sunlight possesses strong disinfecting properties.
- Animal houses must be so constructed that sunlight falls in the sheds at least for some time during the day.
- Application of heat by steam, by hot water,by burning or by boiling is an effective method of disinfection.

Disinfection of animal houses:

- Daily scrubbing and washing of houses and the action of sunlight falling in the houses are
- All floors, walls upto a height of 1.5m, interior of mangers, water troughs and other fittings and equipment coming in contact with animals are all to be disinfected.
- The first step in disinfection of animal houses is removal of all filth, as the power of disinfectants is greatly reduced in the presence of organic matter.
- Floors, walls upto a height of 1.5m, interior of water troughs and mangers should be well scrubbed and all dung, litter etc. should be removed and stacked separately, where animals cannot reach.
- The heat generated within the stack in the course of time will kill all germs. In case of an outbreak of anthrax the dung, litter etc. should first be disinfected in situ by thorough sprinkling of suitable disinfectant.
- If the floor is of earth which is generally the case in Indian villages, the top 10 cm earth should be removed and disposed off along with litter.
- After the removal of filth the place should be scrubbed and washed with 4% hot washing soda solution (i.e; 4kg washing soda in 100 liters of boiling water).
- The approved disinfectant solution should then be coated liberally over the place by sprinkling or preferably by spraying and left so to act for 24 hours.
- After this period the animal house should again be washed with clean water and left to dry by wind and sunlight.
- The interior of water troughs and mangers should be white washed. (This can be done even routinely at fortnightly intervals.) The house is then fit for housing healthy animals.

DISPOSAL OF CARCASSES:

- Proper disposal of carcasses of animals died of contagious diseases is of utmost importance in preventing the spread of disease and as in case of anthrax, to prevent human infection.
- Carcasses should never be disposed by depositing them in or near a stream of flowing water, because this will carry infections to points downstream.
- An animal died of a contagious disease should not be allowed to remain longer in sheds as biting insects, rodents etc can reach it.

- Unless approved by a veterinarian (even then only in disinfected place) it is not safe to open carcasses of animals that have died of a disease.
- All carcasses should be disposed off properly either by burying or by burning.

BURIAL OF CARCASSES:

- The most common method of carcass disposal is burial.
- This is a reasonably safe method if done deeply enough and in soil from which there is no drainage to neighboring places.
- Deep burial is necessary to prevent worms carrying bacterial spores to the surface as well as to prevent jackals from digging up the carcass.
- The pit should be so dug that the highest part of the carcass must be at least 1.5m below the level of the surrounding terrain, the width and length of the burial pit depending on the size of the carcass.
- Bedding used for the dead animal, its excreta, feed left over by it and the top 5cm soil from where the dead animal was lying (if the floor is not cemented) should also be buried along with the carcass.
- Drainage of water out of the burial place can be checked by seeing to it that the burial place is an area where the general water level is at least 2.5m below the ground.

BURNING OF CARCASSES:

- The most sanitary method of destroying carcasses is to burn them preferably close to the site of their death without dragging them any more than is absolutely necessary even then only in a trolly.



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ESTRUS DETECTION

Objectives: To learn estrus detection in farm and companion animals using signs of estrus, estrus behaviour and use of various heat detection aids to overcome problems of heat detection.

COWS:

Signs of estrus:

- Mounting on other cows
- Increased frequency of urination
- Isolation from the herd
- Mucus discharge
- Chin resting and rubbing
- Standing to be mounted
- Muddy flanks and ruffled tail head
- Vulval edema and hyperaemia
- Bellowing, restlessness and trailing
- Decreased feed intake and milk yield

The best time to observe for signs of estrus are during the coolest times of the day, early in the morning, early afternoon and late evening.

Estrus detection aids: Estrus detection aids are needed in most herds in order to overcome the difficulty of estrus detection so that all animals in estrus are effectively identified and bred. These are only aids and should be used only in conjunction with visual observation programmes and not as a substitute for visual detection.

1. Records:
   - These aids require recording off all heats (whether the animal is to be inseminated or not) including those observed in early post partum period and should be used on a daily basis.
2. Heat expectancy charts:
   - Heat expectancy charts are available in the form of calendar that are organized on a 21 day cycle.
   - This simple management aid allows heat to be recorded so that the next heat can be predicted and the cows can be watched closely around the time of approaching heat.
3. Breeding wheel:
   - These are wall mounted reproductive record systems that use color coded pins or markings to indicate the day of estrus.
   - By turning a transparent plastic dial or by sliding the plastic cover on a daily basis, the future heats and reproductive events can be anticipated.

4.Mount detection aids:

Detection Aid	Application	Detection Method	Management Considerations
Kamar ® Heat mount ® detector	Apply with separate adhesive between tail head and hip bone over the sacrum of cow	Detector remains white until triggered by weight of mounting animal, then it turns bright red	Detectors may become partially activated, making it hard to tell if heat has occurred. Detectors can become dislodged from female.
Estrotect™ Heat Detector	Apply with self-, adhesive between tail head and hip bone over the sacrum of cow or heifer	Detector remains silver until friction of mounting animals reveals fluorescent colour under scratched-off silver layer	Low branches, gates and other cattle; can lead to a false positive. Detectors can become dislodged from the female
Bovine Beacon®	Glued to tail head of cow or heifer	Contains fluorescent dye that glows in the dark when cow or heifer is mounted by another animal	Low branches, gates, and other cattle can lead to a false positive Detectors can become dislodged from female animal
Tail Head Markers	Smear liberal amounts (at least 2-3”wide) of, crayon, chalk, paste, or paint marker on the tail head of cow or heifer.	When marker is rubbed off tail head (hair will be ruffled and pulled back) the cow or heifer has stood to be mounted	Low branches, gates, other cattle, humidity, and rain can lead to a false positive. May need to reapply every few days.
Chin-Ball Marker	Fit marker device under the chin of a teaser (gomer) bull or androgenized cow or heifer	An animal wearing device mounts and slides off the cow or heifer in heat, leaving an ink mark on the back and hip of female.	Maintenance is necessary for continuous use (ink must be refilled). Harness straps may break or stretch. Some markings may be from chin's resting instead of mounting.
Heat Watch® II	Place small, digital radio transmitter in a piece of polyester material (patch) and glue onto the tail head of cow or heifer.	Every time there is a mount, data are sent from that transmitter to a small radio receiver(base station) in the proximity of the heat detection area. Data generated on every mount include the female mounted, date and time of the mount and duration (in seconds)	Patches can become dislodged from females. Transmitters can fall out of patches if not adequately secured. Batteries must have proper charge Increased heat detection accuracy over other aids

1. **Vaginal electrical resistance:**
   - This method is based on the concept that the electrical resistance (ER) of vaginal fluids decreases during proestrus and through the estrus due to increase in the volume and ionic composition of the cervical and vaginal fluids.
   - The estrus probe is designed to monitor these changes where in "low" probe readings are associated with estrus.
2. **Pedometers:**
   - Cattle are more active during estrus and thus spend more time walking and standing than resting.
   - Monitoring activity through the use of pedometers is a potentially valuable method for identifying cows in estrus.
   - With the use of pedometers it is possible to identify some silent heat cows which fail to show obvious signs of estrus.
   - Data storage capabilities in which the steps taken during a given activity period can be counted and stored.
   - Visual alert systems, which consists of a flashing light to alert the management personnel.
   - Analytical capability whereby the pedometer can compare the activity that has occurred in a preset time period to the activity preceding that period. This capability allows comparison of activity within individual animals and thus increases the specificity of the system.
   - An internal power source to operate the counting mechanism and the data storage provide a relatively long functional lifespan of the pedometer.
   - Recently the development of a device containing a piezoelectric sensor implanted in the perineal region of the cow can detect steps taken by a cow.

MARES:

Signs of estrus:

- Winking of the clitoris
- Squatting or lowering of the pelvis
- Lifting of the tail
- Frequent urination
- Seeking out the company of other mares, gelding and handlers.

Estrus detection aids:

1. **Teaser animals:**
   - The animal used as the teaser may well be the most valuable animal on the breeding farm.
   - The teaser should be aggressive, vocal and enthusiastic. However, the teaser should tease without excessive roughness such as kicking or biting the mare.
   - Having more than one teaser and alternating them as teasing stallions may prevent loss of interest in the mares and allowing a teaser stallion to breed occasionally helps maintain interest in the mares.
   - A pony stallion which is obviously small, easy to handle and typically very sexually aggressive can also be used as teasers.

- Geldings given testosterone every 10 to 21days have been used with some success as teasers.
- Vasectomized stallions or the intact, active stallion, fitted with a marking harness, have been used for estrus detection in free- running mares.

2. Teasing records:

- An accurate record keeping system involves evaluation or scoring the mare's response to a teasing stallion.

DOES:

Signs of estrus:

- Estrus females seek out the male.
- Exhibit constant bleating and restlessness.
- Loss of appetite.
- Rubbing up against herd mates.
- Redness and swelling around the vulva.
- Thin mucus discharge from the vulva.

Estrus detection aids:

1. Estrus behaviour:

- A rag is rubbed on the bucks sent glands (located caudo medial to horns) and to store this rag in a tightly covered container. When the container is opened and presented to the doe each day; the doe in estrus becomes attracted to it and gets excited by the smell of the rag.

2. Apronized buck:

- Introduction of an apronized buck into a herd of does at the beginning of a breeding season will not only elicit estrus within 5 to 8 days but can also be used to detect does in estrus.

3. Vaginal smears:

- The appearance of more than 50 per cent desquamated, eosinophilic, polyhedral epithelial cells in smear are indicative of estrus.

4. Speculam examination:

- Direct examination of the cervix using a speculum may be more helpful in detecting estrus.
- At the onset of estrus, the vaginal mucosa is reddened and moist but little mucus is present.
- As heat progresses, a variable amount of transparent mucus is visible in the cervix and on the floor of the vagina which later turns cloudy and finally becomes cheesy white at the end of estrus.
- Conception is best when the doe is bred at the stage when her cervical mucus is cloudy and the cervical os is relaxed.

EWES:

Signs of estrus:

- Ewes will search out the ram and stand to be mounted by him or other ewes but not as often as cattle.
- Rapid tail wagging or raised tail.
- Nervousness and increased vocalization.
- Decrease in milk production and appetite
- Physical characteristics include, reddened, swollen vulva (not easy to detect because of wool and small size of vulva).

Estrus detection aids:

1. Teaser rams:

- Teaser rams when fitted with a marking harness or brisket paint (paste of paint powder and mineral oil applied to the brisket of the ram) will seek out and breed ewes in heat leaving a mark on the rump of those ewes.
- The ratio of ram to ewe will be 3:100. In order to avoid breeding vasectomized or apronized rams may be used.

SOWS:

Signs of estrus:

- Immobilization or Lordosis
- Redness and swelling of the vulva, increase in vaginal secretions
- Off feed, rooting or mounting penmates
- Nudging other females
- Vocalization
- Erect or "perked" ears
- Moist vulva
- Desire to seek out boars

Estrus detection aids:

1. Back pressure test:

- Heat detection in sows can be done by performing a back pressure test where the herds person applies pressure on the back flanks and underline of the sow simulating the action or feeling of a boar mounting a sow.
- If the sow stands rigid and "locks up" in expectation of being mounted and bred by a boar, then she is in estrus.
- Along with the immobile stance "cocking" of the ears or twitching if she is a floppy –eared breed indicates that the sow is in estrus.

2. Pedometers

- Pedometers to measure the increased activity around estrus have been successfully used to detect estrus in sows.

3. Vaginal electrical resistance

BITCHES:

Signs of proestrus:

- Proestrus is usually defined as beginning when vaginal bleeding is first seen and ending when the bitches allows the male dog to mount and breed
- Early proestrus behaviour includes an increase in playful, teasing activity but the female discourages any mounting attempts made by the male.
- As proestrus progresses the female becomes more receptive by increasingly seeking males, playing and teasing.
- Vaginal bleeding begins as diapedesis of erythrocytes through the endometrium and subepithelially as capillaries rupture within the endometrium.

- Some dogs cease vaginal bleeding as proestrus proceeds into estrus. In these bitches the bloody discharge fades and becomes transparent to straw coloured.
- Vulva slowly enlarges throughout proestrus.
- As proestrum proceeds into estrum the vulva softens.

Signs of estrus:

- The estrus phase includes the time during which the bitch allows a male to mount and breed.
- Bitches in estrus show receptivity to the male by crouching and elevating the perineum (Lordosis).
- Pressure placed on or near their lower back causes the tail to be held off to one side.
- Vaginal discharge straw coloured or pink fluid
- The vulvar swelling in an estrus bitch is reduced and it becomes soft and flaccid.

Estrus detection aids:

1. Sexual behavour
2. Vaginal exfoliative cytology
3. Vaginoscopy.
4. Hormone assays.

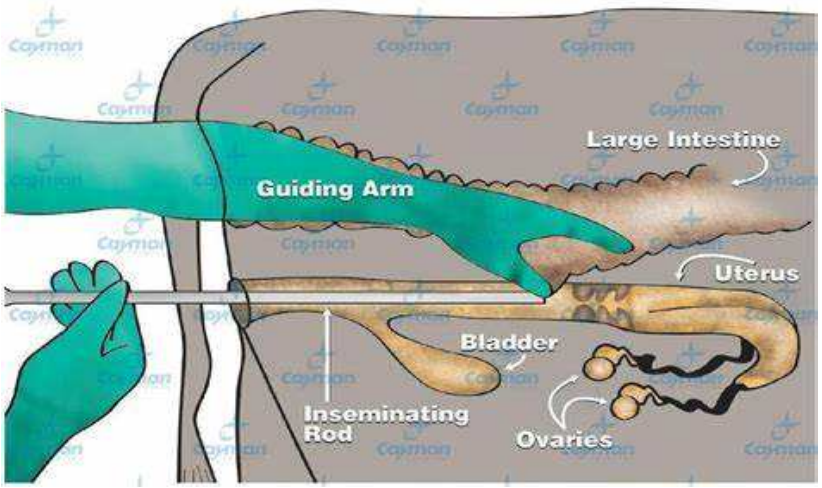
ARTIFICIAL INSEMINATION

Brief Note:-

Artificial insemination is the technique in which semen with living sperms is collected from the male and introduced into female reproductive tract at proper time with the help of instruments. This has been found to result in a normal offspring. In this process, the semen is inseminated into the female by placing a portion of it either in a collected or diluted form into the cervix or uterus by mechanical methods at the proper time and under most hygienic conditions. The first scientific research in artificial insemination of domestic animals was performed on dogs in 1780 by the Italian scientist, Lazzaro Spallanzani. His experiments proved that the fertilizing power reside in the spermatozoa and not in the liquid portion of semen. Few further studies under research station conditions helped this technique to be used commercially all over the world including India.

Artificial insemination equipment/ Materials

Vaginal speculum – To examine the vaginal cavity, Disposable gloves, A.I pipette glass or A.I gun – used for insemination, A.I. Sheaths, Absorbent material (cotton), Antiseptic solution, Cryo cans – for long term storage for semen straw, Liquid Nitrogen Measuring Dip Stick – used to measure the level of LN2 in container, Goblet – plastic container which hold the semen straws, Canister – metal containers within which the goblets are placed, Straw Holding Clamps – to hold the semen straw during freezing, Straws Cutters – used to cut AI straws.



Recto Vaginal Method of Artificial Insemination in cattle

I. METHODS IN CATTLE

1. Recto Vaginal Method

In cattle the safe and best method of insemination is "Recto vaginal method of insemination". Cow which is in heat is well controlled placing it in a Travis. The inseminator will get ready by wearing a plastic apron, gumboots and gloves. The semen straw after thawing (keeping the semen straw in lukewarm water at 37^0C for 30 seconds to convert the frozen semen into liquid and the sperms become motile) is loaded in a sterilized A.I. semen straw tip (Lab seal) should cut at right angle and the tip of the gun is covered with a plastic sheath. The inseminator will insert the gloved left hand into the rectum after applying the soft soap or other lubricant on the glove and back racked the animal and the hand is further inserted and will catch hold of the cervix through rectal wall. The A.I gun loaded with semen straw is passed through the vulva to vagina and cervix and observed with the hand in rectum that the A. I gun reaches the mid cervix and the body of uterus then the semen is deposited by injecting the gun and after depositing the semen the gun is removed. The empty straw and sheath were discarded.

2. Speculum Method

In this method spectrum is placed in the vagina of the cow, which provides passage outside to the site of insemination, then inseminating tube is passed through the speculum and semen is deposited at the cervix in this insemination method.

Cattle Vagina Dilator



3. Vaginal Method

Hand is passed through the vagina and the inseminating tube is guided by hand to the site of insemination and semen is deposited. Here there is a risk of contamination and injury of female genitalia.

II. METHODS IN OVINE

Vaginal, Cervical, Cervico-Uterine or Laparoscopic

The simplest method is vaginal insemination, which could result in the lowest conception rate. The use of cervical and trans-cervical methods could give much higher pregnancy rates, but laparoscopic AI is the most effective one. However, it is also the most expensive and complicated method. Apart from the general trends, the publications show quite a wide range of rates: 31.25% (Anel *et al*., 2005) in vaginal, 18 (Yamaki *et al*., 2003); 42 (King *et al*., 2004); and 65-75% (Salamon & Maxwell, 1995; Donovan *et al.*, 2001, 2004; Stefanov *et al*., 2006) in cervical; 69.6 to 76.4% (Szabados, 2006) in cevico-uterinal; and 44.89 (Anel *et al*., 2005), 64 (Yamaki *et al*., 2003) and 69% (King *et al.*, 2004) in laparoscopic insemination. It should be noted that these results are affected according to the semen used (fresh, cooled, chilled or frozen (Perkins *et al.*, 1996; Moses *et al.*, 1997)



In general, the suggested dose of semen is 0.1 to 0.2 ml with about 50 to 100 million active spermatozoa. About 50 to 100 million spermatozoa is needed in one dose to vaginal insemination but 25 to 50 million are suggested for cervical insemination and 15 to 20 million is enough for laparoscopic AI (Kukovics, 1974; Jávor *et al*., 2006; Gergátz, 2007). However, several scientists have used much higher numbers: 106 (Fernandez-Abella *et al*., 2003), 50 to 300 (Ehling *et al.*, 2003) and 400 (King *et al.*, 2004) million spermatozoa in one dose of semen.

I. METHOD IN SWINE

AI of swine is widely practiced and is a very useful tool to introduce superior genes into sow herds, with minimal risk for disease transmission. In practice, fresh diluted semen (3 billion spermatozoa in 80-100 ml) is mostly used for intracervical insemination. The success of AI is largely determined by the semen quality and the insemination procedure. Different parameters and techniques can be used to assess semen quality. Although more advanced technologies offer more accurate information, in commercial AI centres, semen quality is assessed based predominantly on concentration, morphology and motility using simple, cheap and practically easy-to-perform techniques. Critical issues for AI involve estrus detection in the sow, timing of insemination and applying strict hygiene measures. Future developments will focus on new technologies to better assess semen quality in practice, to preserve semen for a longer time and to inseminate sows successfully using a lower number of spermatozoa using new AI techniques.

II. METHOD IN POULTRY

Insemination Procedure

Insemination can be performed using either vaginal or cloacal methods.

- Vaginal AI involves the insertion of a specialized insemination pipette into the hen's vagina to deposit the semen near the sperm storage tubules.
- Cloacal AI is a less invasive technique, where the semen is deposited into the cloaca (common opening for digestive, urinary, and reproductive tracts) of the hen.

Advantages of Artificial Insemination:

There are several advantages by artificial insemination over natural mating or servicing.

- There is no need of maintenance of breeding bull for a herd; hence the cost of maintenance of breeding bull is saved.
- It prevents the spread of certain diseases and sterility due to genital diseases. Eg: contagious abortion, vibriosis.
- By regular examination of semen after collection and frequent checking on fertility make early detection of interior males and better breeding efficiency is ensured.

- The progeny testing can be done at an early age.
- The semen of a desired sire can be used even after the death of that particular sire.
- The semen collected can be taken to the urban areas or rural areas for insemination.
- It makes possible the mating of animals with great differences in size without injury to either of the animal.
- It is helpful to inseminate the animals that are refuse to stands or accept the male at the time of estrum.
- It helps in maintaining the accurate breeding and calving records.
- It increases the rate of conception.
- It helps in better record keeping.
- Old, heavy and injured sires can be used.

Disadvantages of A.I:

- Requires well-trained operations and special equipment.
- Requires more time than natural services.
- Necessitates the knowledge of the structure and function of reproduction on the part of operator.
- Improper cleaning of instruments and in sanitary conditions may lead to lower fertility.
- If the bull is not properly tested, the spreading of genital diseases will be increased.
- Market for bulls will be reduced, while that for superior bull is increased.

PREGNANCY DIAGNOSIS

Definition : Pregnancy diagnosis is the procedure to ascertain conceptus in the uterus

Aim: Enable reproductive performance to identify non-pregnant animal, termination of unwanted pregnancies, monitor development of pregnancy, confirm presence/absence of twin, monitor early embryonic death, improve record keeping data.

Materials

Protective Clothing, Disposable long arm sleeves, Lubrication, Restraining the animal

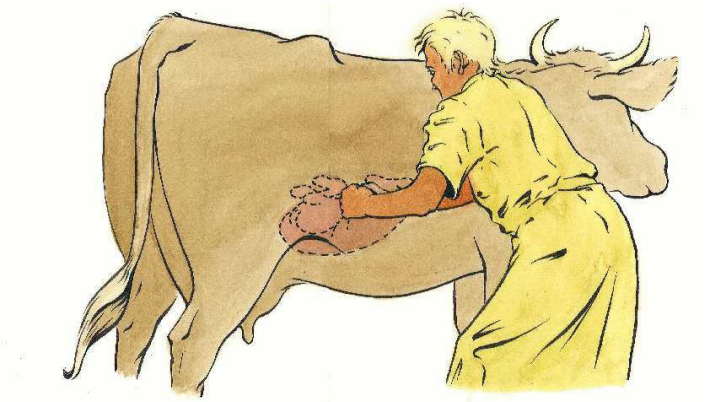
Purpose of pregnancy diagnosis

- An accurate and early pregnancy diagnosis is essential because-
- It helps in identification of non-pregnant animals which can be treated or re-bred at the earliest.
- It is required for certifying the animals for sale purpose.
- It helps in good management and economic feeding especially to avoid peri-partum complications.
- To prevent lapse of one season for breeding in seasonal breeders.
- To reduce using expensive hormonal techniques.

External and internal indicators

- **External indications**- these are not confirmatory but are just indicators.
- Breeding history- the animal should have been mated either by natural service or by artificial insemination.
- Cessation of estrus- it is the first indication of conception following service. Animal may be pregnant if not coming in heat during next 21 days after mating. It is not always reliable because-

- Sometimes owner may not see signs of estrus.
- Cessation of estrus may be due to pathology of uterus and ovaries.
- Even 3-6% pregnant cows may exhibit estrus signs during first trimester.
- Increase in abdominal size and body weight.
- Development of udder- usually at 4-5 months of gestation in heifers and at 7-8 months of gestation in pluriparous and older animals.
- Change in temperament- docile and quiet, moves carefully particularly during advanced pregnancy.
- Relaxation of pelvic ligaments – towards parturition
- Abdominal ballottement of fetus- from 6m onwards, in lower right flank by pushing fist and fetal movement can be felt.
- Fetal heart auscultation – 6-7 m onwards from right flank
- **Internal indicators**
- Vaginal examination- The method is not so reliable. In this method vaginal speculum is used to see accumulation of thick mucus discharge which covers the external os and forms pregnancy seal. The vaginal mucus membrane will be dry and pale. Cervix will be closed.
- Rectal examination of genitalia (Palpation per-rectum)- Most practical, conventional, inexpensive, immediate method of pregnancy diagnosis in large animals.
- Time for pregnancy diagnosis by rectal palpation- the pregnancy can be diagnosed at 35 days after conception by an experienced veterinarian. However, it should be avoided as there are chances of rupture of amniotic vesicle and early embryonic death by digital/hand pressure during manipulation. Therefore it should be performed at 55-60 days of gestation.
- **Certain changes in uterus and ovaries occur during pregnancy.** These changes are-
- In ovaries– one of the ovaries bears a CL which is ipsilateral to the pregnant horn. The ovaries can be palpated up to 4 month of gestation after that they are pulled ventrally and cranially along with pregnant horn.
- In uterus-
- Asymmetry of uterine horn and thinning of the uterine wall. Pregnant horn gets distended due to the presence of amniotic vesicle, fetal fluids and membranes and the conceptus.
- Slipping of fetal membranes (Fincher's technique)
- Location of uterus- depends on the length of gestation; uterus remains in pelvic cavity only up to 4 months then it descends down in the abdominal cavity from 5-6 months onwards.
- Palpation of fetus at various stages of pregnancy- not before 60 days of gestation due to small size of fetus and distended amniotic vesicle.
- Palpation of placentomes- placentomes start forming by 60-70 days but can be palpated 80 days onwards at the level of intercornual ligaments. At day 120 these are fully developed.
- Fremitus palpation- i.e. palpation of pulsation of middle uterine artery which is branch of internal iliac artery. Due to advancement of pregnancy the diameter of this artery increases and arterial wall becomes thin. Instead of regular pulse the artery gives thrill/whirr/gush sensation (like rushing of water in a pipe). It can be felt at 80-120 days of gestation. The prominence increases as pregnancy advances. In non-pregnant cows the diameter is 3-4 mm only whereas, in pregnant cow it varies between 1-1.5 cm.
- Middle uterine artery is located in the fold of broad ligament.



EXTERNAL METHOD OF DIAGNOSING PREGNANCY IN THE COW.

Changes observed during pregnancy in bovines by rectal palpation

Procedure

Restraint of the animal:

Restraining in a travis or chute is advisable as sudden movement of the animal might be injurious to both the arm and also the animal itself.

Points to be remembered while performing rectal examination:

- The gloved hand is inserted into the rectum in a cone shaped manner.
- In case of distension of intestines with air, grasping and gentle backward movement of the most posteriorly located contracted fold of the rectum helps to expel the air out and eliminate distension.
- The anal sphincter may present some difficulty but once the sphincter is dilated, the passage of hand becomes much easier.
- Presence of hand in the ampulii recti elicits the defecation reflex which is manifested in the form of peristalsis and tenesmus. Examination should be discontinued during a peristaltic wave.
- Frequent removal of the hand from the rectum during the process of evacuation of the fecal material causes aspiration of air into the rectum.
- While performing rectal examination, one must bear in mind that he/she is handling a living tissue that can be easily damaged.

Prevention of rectal trauma: The common causes of trauma are as follows:

- Forceful manipulations
- Manipulation of rectum distended with aspirated air
- Manipulation during peristaltic waves and tenesmus
- Prolonged manipulation and long fingernails
- Manipulation in long standing cases of diarrhoa and enteritis and in cases with extremely dry mucosa as in constipation

Since rectal examination depends on tactile sense, the pelvic inlet, the pelvic or pubic brim, the iliac shaft, the obturator and lesser sciatic foramen serve as consistent landmarks for general orientation and recognition of special organs and structures.

Palpation of the Cervix:

- The cervix, because of its distinct characteristics and relatively consistent position serves as the landmark for all gynaecological examinations.
- The cervix is palpated as a firm nodular structure lying on the midline of the pelvic floor
- The cervix is examined for its size, form and position.
- The size of cervix varies with

o Age

o Stage of reproductive cycle

o Presence or absence of abnormalities

The form gets distorted as a result of

o Cervicitis

o Cervical or peri and paracervical abscesses

- In a non pregnant cow, the cervix is usually located in the pelvic cavity along the midline and is freely movable.
- The freedom of movement greatly depends on the weight of the uterine horns and body.
- The cervix should be grabbed from the side with the fingers underneath the cervix and the thumb on top.
- If the reproductive tract is located far forward in the abdominal cavity, one can use the cervix to pull the reproductive tract into the pelvic cavity.
- The cervix of a pregnant uterus may be lifted relatively freely without the use of reasonable force until 60-70th day of pregnancy.

Palpation of uterus:

- The uterus can be identified and examined by following the cervix forward.
- The external bifurcation can be identified as the point where the two uterine horns branch from the uterine body.
- The uterine horns can vary greatly in size depending upon the reproductive status of the animal. At estrus, the horns tend to be in a turgid and muscular state.
- Acyclic and sterile animals will often have a very small or nearly- infantile reproductive tract.
- After calving, the uterine horns will be very large, with one uterine horn larger than the other and with the reproductive tract displaced into the abdominal cavity.
- Retraction or rolling of the uterus for its palpation is done in all animals where the cervix is found to be freely movable suggesting that the uterus is light weight and retractable.
- Rolling is done by using the middle finger to grasp the ventral intercornual ligament to pull the uterus back into the pelvic cavity.
- Grasping the ventral intercornual ligament for retraction of the uterus can be achieved by two ways.

1 The hand is made as small as possible by cupping, and the uterus is pressed against the pelvic floor or wall.

2 Once the uterus is retracted, it can be held in the retracted position if the straining is not too severe.

- Pregnancies, especially if older than 40 days, might occasionally be detected without retraction.
- The diagnosis that an animal is non-pregnant, should never be made unless both horns of the uterus have been thoroughly examined in their entire length

Palpation of ovaries:

- Bovine ovaries without structures are oval in shape and weigh 5 to 15 grams each. Older cows usually have larger ovaries than younger cows.
- The ovaries are usually located in the ovarian bursa, a pocket formed by the proper ligament of the ovary and the mesovarium, at the anterior edge of the broad ligament.
- The ovaries can usually be located slightly cranial to the pelvic inlet and slightly cranial and lateral to the internal opening of the cervix. The ovaries are pulled ventrally as the uterus enlarges during gestation or during pathological conditions that cause uterine enlargement.
- The following structures that are present on the ovaries of most cows: Ovulation depression (OVD), corpus hemorrhagicum (CH), corpus luteum (CL), follicle (F), and ovarian cyst (C).
- The ovulation depression feels like a small cavity (usually less than 1 cm in diameter) with roughened edges.
- The corpus hemorrhagicum is a soft structure, which forms in the cavity where the ovulation depression was located. A corpus hemorrhagicum approximately 1 cm in diameter is usually present for two to three days following ovulation.
- A corpus luteum is approximately 3 cms in diameter and increases the size of the ovary, often doubling it. Corpora lutea usually distort the shape of the ovaries in which they are contained.
- The increased size and distorted form of the ovary with a corpus luteum should be immediately recognized upon grasping the ovary.
- Most corpora lutea contain a "crown", an extension of the luteal tissue in the form of a prominence above the surface of the body of the corpus luteum. The crown represents the ovulation site.
- Normal bovine corpora lutea have a "liver-like" consistency, which is evident throughout the entire structure. A distinct line of demarcation between the corpus luteum and the ovarian stroma is usually palpable.
- Follicles feel like "blisters" on the ovarian surface. A follicle is smooth and round with a raised surface. The margins of follicles are not usually discernible.
- Fluctuation of follicular fluid can usually be detected. The follicles may be present at any time during the estrous cycle or during pregnancy.
- Occasionally, a corpus luteum is embedded entirely within the ovary. These corpora lutea do not have protruding crowns and are extremely difficult to identify.

Palpation of oviducts: The oviducts are usually not found during palpation unless some abnormality is present.

- **Differential diagnosis of pregnancy**
- Urinary bladder- may be confused with 3-4 m pregnancy. To avoid such mistake, catch hold the cervix, follow up to the horn, if enlargement is present then the animal may be pregnant and later on it can be confirmed with asymmetry, slipping of fetal membranes, fremitus and fetal bump.

- Kidney- left kidney in ruminants is loose and because of ruminal pressure it can come to pelvic cavity. It can be confused with fetal head and fetal parts. However, kidney is a lobulated organ and can be easily differentiated.
- Rumen- sometimes part of rumen is bulged in to the pelvic cavity and can be confused with pregnancy. However, rumen is doughy mass and pregnancy can be confirmed with asymmetry, slipping of fetal membranes and fremitus.

Stage	Uterus	Fetus	Placentomes	Middle ut. artery
35-40 days	In pelvic floor, slight fluctuation, slipping of fetal membranes, asymmetry of horns	Not palpable	-	No change
45-50 days	In pelvic floor, asymmetry of horn, slipping of fetal membranes, pregnant horn diameter- 5-6.5 cm	Not palpable	-	No change
60 days	Slightly over pelvic brim Appears as water filled balloon, diameter- 6.5-7.6 cm, slipping of fetal membranes,	5 cm long, can be bumped by hand rubbing	-	Increased pulse
90 days	Pulled well over the pelvic brim, 8-10 cm diameter	10-15 cm long palpable fetus	Small	Pencil sized
120 days	Not retractable with cervix pulled to the pelvic brim	25-30 cm long, anatomical parts may be palpable	Small	Fremitus +nt
150 days	In abdominal cavity	35-40 cm long , may be out of reach	Distinct	Diameter of 6-1.25 cm,
170-230 days	In abdominal cavity, Dorsal wall – tight and difficult to palpate	Out of reach	Quite variable	Diameter - 1.30 - 1.4 cm, increased fremitus
230-280 days	-	Fetal parts and movements/ reflexes distinguishable	Large sized	Increased fremitus

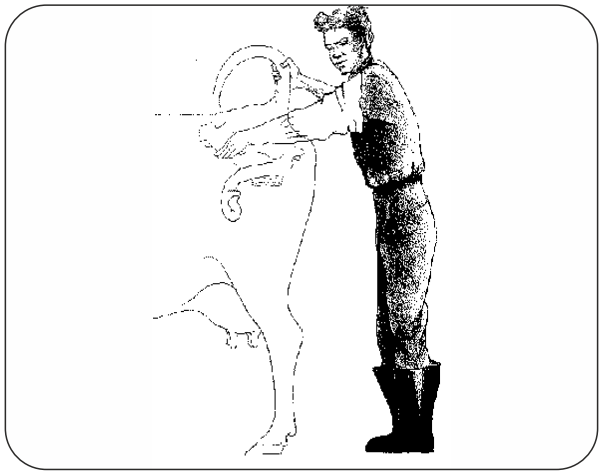
Clinical methods

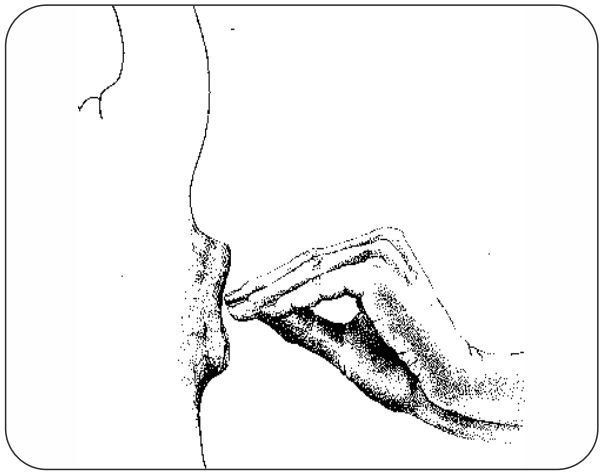
1. Transrectal palpation : cattle, buffalo, swine and mare
2. Radiography : sheep, goat, canine , feline
3. Ultrasonography : all species
4. Abdominal ballotement : cattle, buffalo, sheep , goat
5. Recto abdominal method :sheep

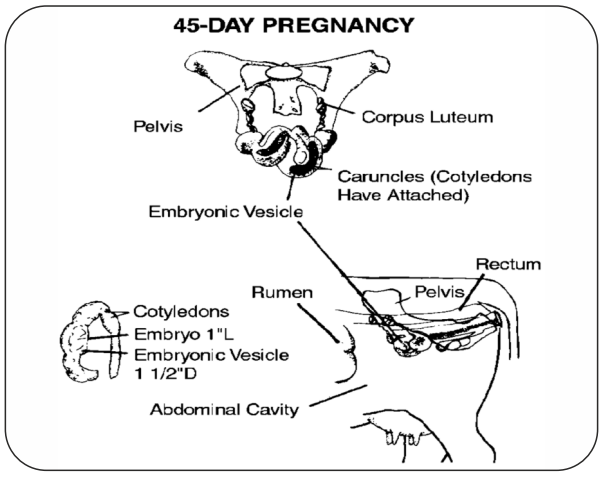
Trans rectal palpation in cattle

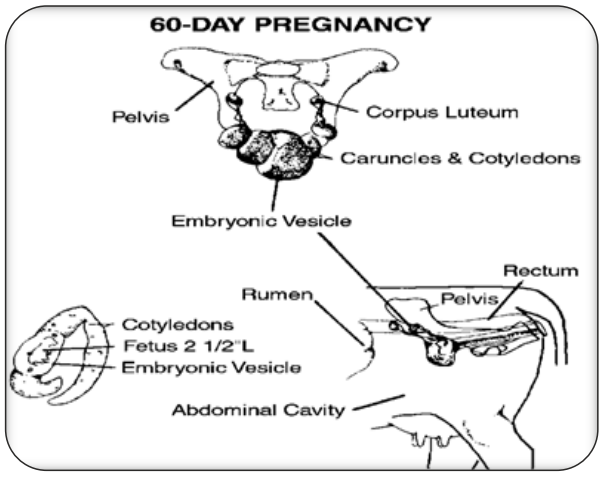
Precautions to be taken :

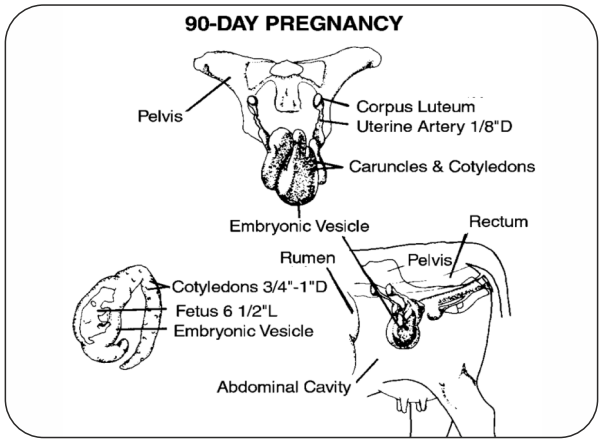
- ✓ Nail trimming
- ✓ Avoid vigorous movements of the hand (esp. Mare & Buffalo)
- ✓ Avoid palpations during a peristaltic wave.
- ✓ No exam without sleeves / gloves
- ✓ Avoid kicks and remove arms if animal moves (fracture)
- ✓ Avoid using dirty soiled sleeves/ gloves
- ✓ Replace gloves after 2-5 animals/each exam.
- ✓ Avoid rectal palpation of pyrexic animals (blood vessels are more fragile and bleed easily)
- ✓ Avoid per rectal examination in animals with rectal tear or rectal fistula (complication in mare; peritonitis)
- ✓ Careless palpation of the uterine horns - rupture of the amniotic vesicle - early pregnancy loss
- ✓ One of the oldest method. Most practical, conventional, inexpensive, immediate method of pregnancy diagnosis in large animals.
- ✓ Its not very difficult, but it requires experience, practice, and a thorough knowledge of the cow's reproductive system.

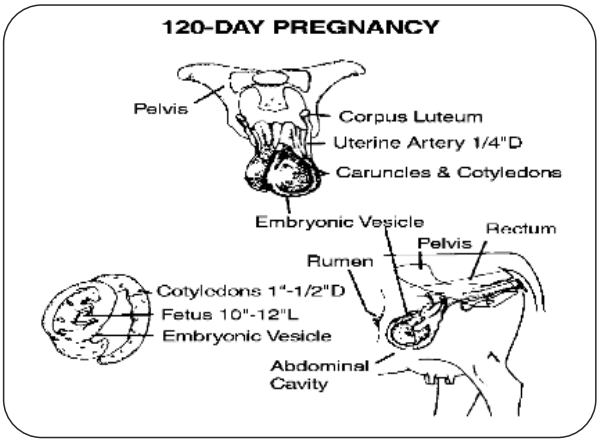


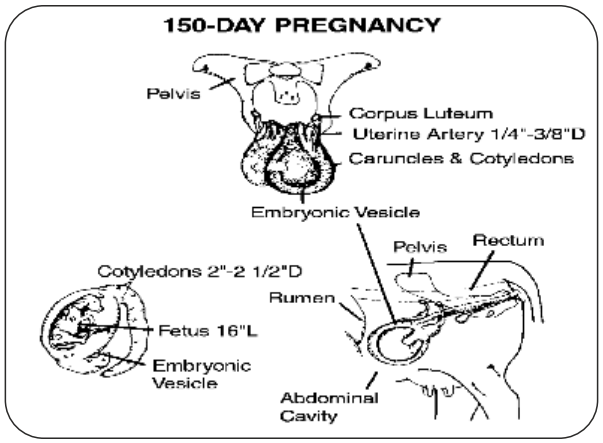


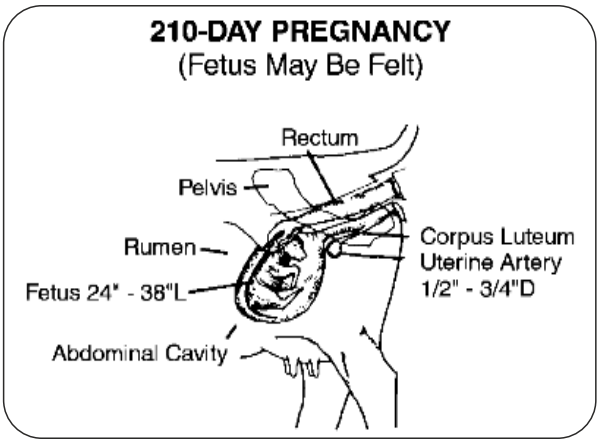








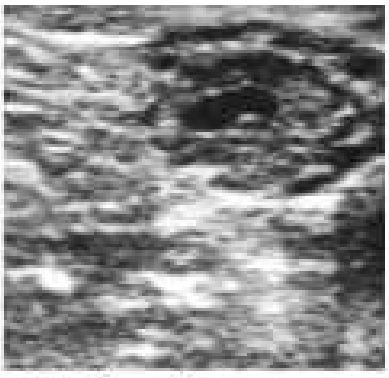


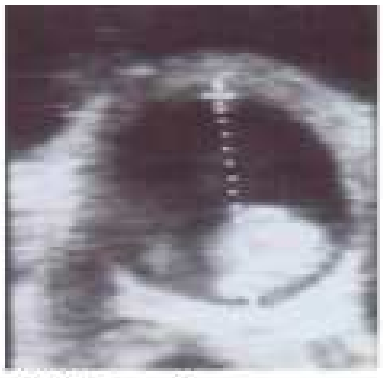


Ultrasonographic methods

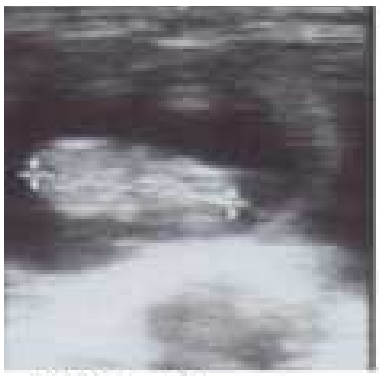
- Day 12 - Embryonic vesicle
- Day 20 - 25 - Embryo heart beat
- Day 55 - Genital tubercle
- Day 90 - Scrotal swelling & mammary teats enables gender selection




25 Day Pregnancy


30 Day Pregnancy


35 Day Pregnancy



43 Day Pregnancy



50 Day Pregnancy



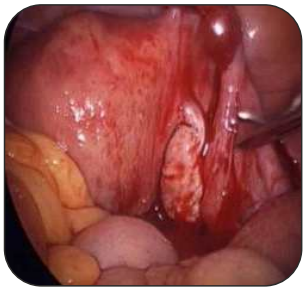
100 Day Pregnancy

Laproscopic method

- The method utilizes the concept of directly visualizing the genitalia in animals
- The method is **invasive** in nature, the **high cost** of equipment and clinic required, limits the use of this technique







LABORATORY TESTS

Barium chloride test: A test has been described for pregnancy diagnosis in the bovine species

- Non pregnant cows a white precipitate
- Pregnant animals the urine remains clear

METHOD –
2ml urine + 2ml Barium Chloride

OBSERVATION –
White precipitate

INFERENCE – Sulphate is precipitated as barium sulphate with barium chloride.



Progesterone Hormone Assay

- Specificity of around 98% (Less specific)
- Progesterone concentrations in milk or serum can be quantified using a laboratory RIA or ELISA procedures.
- Usually, samples are collected at 21 and 24 days after insemination.
- To use the milk progesterone test as a pregnancy indicator the milk sample must be collected between 21 to 24 days after the cow was in estrus and inseminated.

- Low progesterone would indicate that the cow is not pregnant and high progesterone would indicate that the cow has a functional corpus luteum and might be pregnant.
- Therefore, the test is most accurate in determining that a cow is not pregnant, because if the progesterone levels are low it cannot be pregnant.
- Reasons milk progesterone levels might be high between 21 and 24 days after insemination include:
  1. The cow is pregnant.
  2. The cow is in the middle of her estrous cycle but not pregnant due to: { an error in estrous detection and the cow was bred at wrong time } a longer than usual estrous cycle.
  3. Embryonic mortality: The cow conceived but the embryo died.
  4. Abnormalities, such as pyometra (accumulation of pus in the uterus or a dead, mummified fetus).

Punyakoti test

- One of the earliest written records of a urine-based pregnancy test can be found in an ancient Egyptian document. Wheat seeds when they are soaked in urine from pregnant cows which inhibits germination compared to urine from non-pregnant cows which stimulate germination has been described to be known as Punyakoti test. It is due to abscisic acid in urine of pregnant animal

Estrone Sulphate

Estrone sulphate is a conjugated steroid product of estrone, present predominantly in the bovine placentomes and it is the major estrone present in the fetal (allantoic and amniotic) fluids and maternal peripheral plasma of cows with measurable quantities detectable by day 52 onwards till the end of gestation.

Its concentrations increase from day 60 and plateau around day 150 after insemination.

However, reliable pregnancy detection is possible only after day 100 of gestation and therefore this test can only detect late pregnancy

Concentration of estrone sulphate in the maternal body fluids is a useful indicator for the placental functions especially those related to embryonic growth

- In zebu and crossbred cattle and Murrah buffaloes, Prakash and Madan reported below detection levels (<50 pg/mL) of estrone sulphate during the first two months, followed by sharp increase in the fourth month and values stabilized after reaching the highest levels in the sixth month of pregnancy.
- Levels of estrone sulphate in different maternal body fluids, namely, milk and blood plasma, can be utilised as the criteria for confirming pregnancy by after 110 day insemination in bovine species
- Estrone sulphate concentrations have also been frequently correlated to fetal numbers , as these are higher when the number of developing foetuses is more than one.
- Yet, estrone sulphate is not an ideal pregnancy biomarker as the plasma and milk profiles are influenced by many other factors such as genetic makeup, weight, parity status, and environment

Early Conception Factor (ECF)

Early pregnancy factor (EPF, also known as early conception factor—ECF)—a 10.84 kDa protein, is present in the sera of pregnant mammalian females, detectable

within 6 to 24 hours of fertilization and disappearing within 24 to 48 after death or removal of the embryo , EPF is present in the serum up to two-thirds of the gestation.

EPF remains the earliest serum benchmark for positive fertilization and hence successful conception.

This novel pregnancy-specific protein has high immunosuppressive ability which is demonstrated by rosette inhibition test, a bioassay first demonstrated in pregnant mice. Laleh et al. demonstrated significant differences in rosette inhibition titres of pregnant and open cows with values being 8–10 and 3–5, respectively.

- It is not strictly pregnancy specific because of its secretion from nonplacental sources such as tumors and transformed cell lines, which makes it an erroneous pregnancy detection method.
- EPF belongs to a family of heat shock proteins, though detected extracellularly and having immunosuppressive and growth factor properties.
- These properties are crucial to avoid rejection of an antigenically alien embryo and support its development. Therefore, with the advent of modern biosciences, there is hope that these changes could be identified and used as diagnostics for very early detection of pregnancy.
- However, the practicability of such an early test may still remain low due to high incidence of losses during the first 15 days of conception
- Interferon-τ, a novel type I interferon, is first produced by the conceptus between days 12-13 after insemination in sheep and days 14–16 in cattle
- High ovine IFN-τ levels are attained on days 12-13 before luteolysis could actually be triggered.
- In ruminants, IFN-τ, blocks transcription of estrogen receptor alpha and oxytocin receptors in endometrial cells, while downregulating the expression of enzymes cyclooxygenase-2 and prostaglandin F synthase , thus preventing PGF release necessary for luteolysis.
- IFN-τ, acting within the uterine cavity with extremely low levels in extrauterine tissues and peripheral circulation, prevents direct use of IFN-τ as an early pregnancy diagnosis molecule
- Rapid advancement of molecular techniques in the last two decades has opened new avenues for exploring this unique molecule as a pregnancy marker for ruminants through studies on IFN-τ stimulated genes (ISG)
- Green et al. shown that the differential expression of such genes is influenced by the parity of the animal, being more definite in heifers as compared to multiparous animals.
- These experiments have suggested IFN-τ stimulated genes to be potential pregnancy detection biomarkers; still there is no field level test available based on these markers.

Pregnancy Associated Glycoproteins (PAGs)

- Relocation of the extra embryonic trophoblastic cell layers to the endometrium between days 20 to 28 and secretions from the conceptus lead to successful implantation and continuation of pregnancy in ruminant species.
- The pregnancy associated glycoproteins (PAGs) are secretory products from the mono- and binucleated trophoblastic cells in bovine placentomes
- Among these glycoproteins, Butler et al. detected two pregnancy-specific proteins in the sera of pregnant cows, a 65–70 kDa and a 47–53 kDa protein at pI [iso electric point] 4.6 - 4.8 and 4.0 - 4.4, respectively.

- The former showed an immune reaction similar to that of α_1-fetoprotein, while the latter showed no reactivity with known proteins and it was given the name "protein B" or the "pregnancy-specific protein B" (PSPB) in bovines.
- Sasser and coworkers developed double antibody radioimmunoassay for the serological detection of PSPB for pregnancy detection in cattle and found serum levels increasing progressively from 1 ng/mL after day 30 to 9 ng/mL, 35 ng/mL, and 150 ng/mL after three, six, and nine months of pregnancy, respectively.
- The study claimed PSPB detection to be more accurate than the traditional rectal palpation method for pregnancy detection
- Green et al. developed a sandwich ELISA, using anti-PAG monoclonal antibodies, which were able to detect PAG in all pregnant animals with concentrations of 8.75 ng/mL on day 28, the highest at 588.9 ng/mL during the week of parturition, and very low levels within 4 weeks postpartum.
- Radioimmunoassay of pregnant sera of zebu cattle established PAG concentrations to be 6.0 ng/mL, 196.0 ng/mL, 1095.6 ng/mL, and 348.4 ng/mL at 8 weeks, at 35 weeks, at term, and at 2 weeks postpartum, respectively, a pattern similar to other breeds of cattle
- Results of PAG-RIA based pregnancy diagnosis in buffaloes have also been encouraging with a high degree of accuracy of diagnosis as early as day 31 with 100% sensitivity and 90–100% specificity.
- PAGs are used for development of bench-top pregnancy detection methods, which are now commercially available as BioPRYN (BioTracking, Russia), DG29 (Genex Cooperative Inc., USA), and IDEXX (IDEXX Laboratories, Inc., USA).
- BioPRYN blood test is the most extensively used PAG based kit for pregnancy detection in ruminants.

Milk ejection by low doses of prostaglandin

- ❑ Injection of low dose prostaglandin F2 alpha (non-luteolytic dose) **two weeks after breeding** resulting into milk ejection
- ❑ Pregnant animal showed an increase in the pressure in the milk ejection and alveolar milk volume collected by a teat Probe in comparison with non-pregnant cows
- ❑ Here prostaglandin facilitates release of oxytocin from posterior pituitary which causes its effect on mammary myoepithelium and finally causes milk ejection
- ❑ PGF 2 alpha is given @1 to 5 micrograms into ear vein 3 hrs after milking induces milk ejection in lactating cows within 2 mins
- ❑ This administration is accompanied by simultaneous increase in the blood flow through the mammary artery
- ❑ It is suggested that effect of prostaglandin on milk ejection is indirect and possibly secondary to release of oxytocin from posterior pituitary
- ❑ If a corpus luteum was present, the alveolar milk flow (1,276 +/- 570 ml) started 86 +/- 35 s later and pregnancy could be presumed.
- ❑ If the corpus luteum was no longer functional, the milk flow did not start again and the cow was considered not pregnant.
- ❑ The accuracy of positive results, ie 72.3%, significantly exceeded that obtained by radioimmunoassay of plasma progesterone used as a reference method, ie 68.6%

- ❑ With such a test, non pregnant cows can be re inseminated immediately and not only after a 3-week period.

Milk tests

Copper sulfate test:

- Milk when mixed with a few drops of 3% copper sulphate coagulates if the animal is pregnant

Mucin test:

- Vaginal mucus showed dark staining columnar epithelial cells as early as 20 day of coitus. (pregnancy cells)
- Efficacy- 94% from day 70 to end of gestation

Newer methods

- Radio immune assay,
- Radio receptor assay,
- Haemagglutination Inhibition test,
- ELISA
- Direct Latex Agglutination Tests

PREGNANCY DIAGNOSIS IN MARE

Trans rectal palpation in mare

- Precautions:
- ➢ Physical restraining of mare
- ➢ Inj. Tetanus Toxoid
- ➢ Tail bandaging , hair clipping & proper asepsis
- ➢ Palpation of cervix, uterus & ovaries
- ➢ **Mare**, the cervix is not easily palpable and hence the **ovaries are the land mark** for rectal palpation
- ➢ Mare during early pregnancy, hand is passed down the utero ovarian ligament to locate the uterus





Pregnancy staging

- Day 14
  - Increased uterine tone with firm and tubular uterus Cervix becomes long, firm and rope like
- Day 20
  - Central bulge in uterus, typically located at base of horn
- Day 28
  - Embryonic vesicle is size of egg yolk
- Day 35
  - Embryonic vesicle size of lemon
- Day 42
  - Embryonic vesicle size of orange
- At Day 56
  - Conceptus starts to occupy nearly the entire uterine horn and ½ uterine body
- At 72 days
  - Pregnancy is like an elongated football and is nearly similar to a 60 day pregnancy in cattle.
- **Palpation of Fetus**

➢ After 40 days and mobile after 70 days.

- **Location of the Uterus**

➢ The uterus is located in the pelvic cavity or just at the pelvic brim until day 90.

➢ At 100-200 days, the gravid uterus is positioned cranial to the pelvic brim in the abdominal cavity.

Ovarian palpation

➢ Position of the ovaries up to 60 days of pregnancy is similar to that for the non-pregnant mare.

➢ From then on, they are drawn cranially and medially but remain dorsal to the uterus.

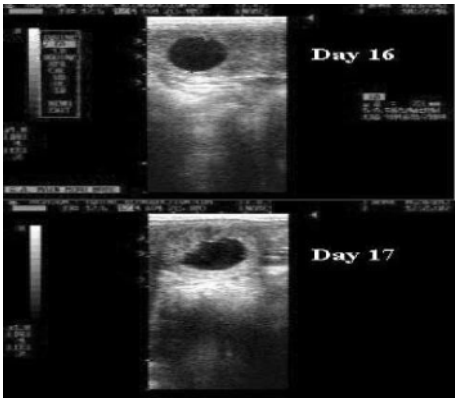
➢ The finding of both ovaries nearer to each other and close to the pelvic floor is a positive indication for pregnancy (3 to 5 months).

➢ From 5 months of pregnancy onwards, the ovaries usually are not palpable as they are under the broad ligaments

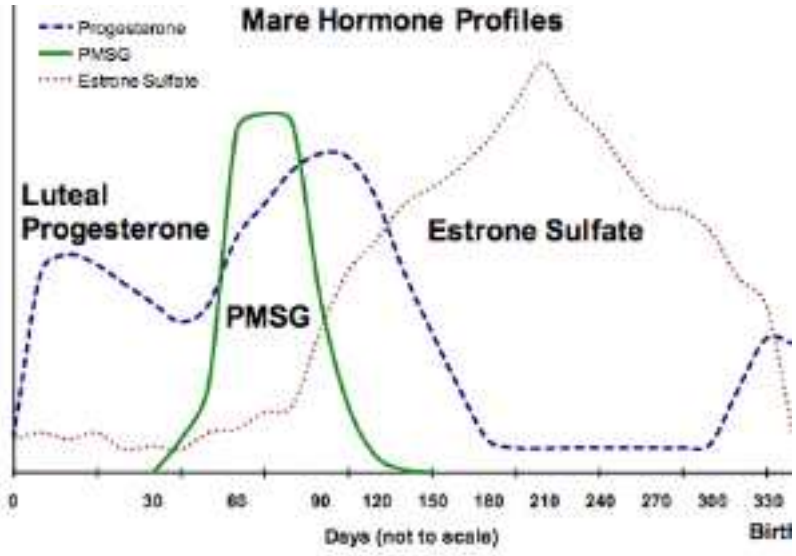
USG – MARE

➢ Most common & reliable method for early PD

➢ PD as early as 9-11 days



- **Day 12 – 14** – embryonic vesicle around 12 to 16mm diameter
- **Day 21-22** - Embryo proper visualized
- **Day 25** - Heart beats can be recorded
- **Between day 25-30** Developing fetal membranes visualized
- Most pregnancy losses in mare occur with in first 45 days of pregnancy



Progesterone : Days 14-45

- Progesterone analysis in serum samples is useful for distinguishing the different reproductive states of mares and it may be used to support diagnosis and monitoring of pregnancy.
- The expected stage of the cycle and the number of days post-breeding is very important when using this test for early pregnancy diagnosis.
- Progesterone should **not** be used for monitoring mid and late trimesters of equine pregnancy, as other *progestins* maintain the pregnancy

Estrone Sulfate : Days 90-Term

- The Estrone sulfate test is very useful and accurate for diagnosing pregnancy in mares from day 90 to term.
- Estrone sulfate is produced by the fetal-placental unit and is therefore a good indicator of fetal well-being.
- Estrone sulfate results slightly below or low normal pregnant range in mid- to late-gestation mares may indicate placentitis , severe stress, etc.
- These mares should be treated appropriately to prevent pregnancy loss.

Blood Estrogen:

- By **85** days of gestation, the concentration should exceed the maximum values of non-pregnant mare.

Urinary estrogen (Cuboni's Test) :

- Detects conjugated urinary estrogens.
- **Estrogens** (Estrone and Estradiol 17β) are present in **urine** of pregnant Mare. it is 100% accurate detection between 150-300 days of gestation
- Effective beyond 150 days of gestation and also predicts fetal viability

- **Procedure**

➢ To 15 ml of urine add 3 ml of conc. HCl. heat in a water bath for 10 minutes and then cooled under a tap.

➢ To this 18 ml of benzene is added and shaken vigorously for half a minute.

➢ The supernatant (mainly benzene) is collected in another tube and 3 to 10 ml of conc. H_2SO_4 is added and the mixture heated in a water bath at 80°C for 5 minutes, and then allowed to cool.

- Positive- Dark, oily green fluorescent color in the lower H_2SO_4 layer
- Negative- Absence of fluorescent color and presence of a brownish color



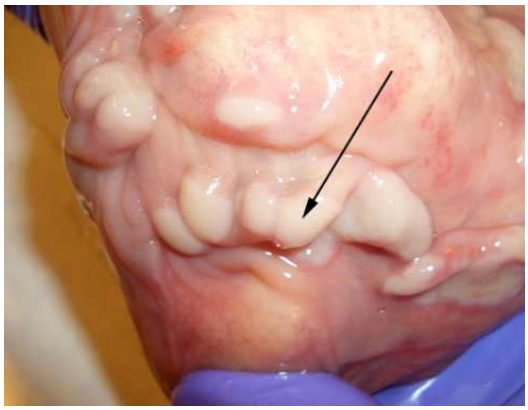


- PMSG : Days 45-100Pregnant mare serum gonadotropin (PMSG), also known as equine chorionic gonadotropin (eCG) , is a hormone that is secreted by the endometrial cups formed in the mare uterus 40 days after conception.
- Concentration of PMSG is measurable in most mares by day 45, rises rapidly and peaks at about 60 days, and is no longer detectable 100 - 150 days post-conception.
- This test is useful for the assessment of conception and endometrial cup formation.
- samples for the PMSG test be collected 45 to 100 days after breeding for accurate results.
- False positives can occur if the embryo dies after the endometrial cups are established - these mares won't cycle and will have high levels of PMSG until levels naturally decrease sometime after 100 days post-conception.
- It is strongly recommended that this test be followed by Estrone Sulfate testing or palpation to confirm pregnancy and fetal well being after 100 days.
- Mature endometrial cups appear as a group of pale plaques raising from the base of the gravid horn.
- They reach maturity around day 50 and degenerate around days 105 to 150 when their remains are sloughed from the uterine surface.
- Destruction of endometrial cups is accomplished by the attack of the maternal immune system and by intrinsic cellular mechanisms that are not completely understood.

Ascheim-Zondek test

➢ only animal species that secrete sufficient quantities of gonadotrophins that can be used as marker molecule for pregnancy diagnosis is equine. (Equine chorionic gonadotropin)

➢ eCG is secreted by endometrial cups in mare between **37 -140 days** but serum should be collected between 50 and 90 days just to reduce chances of false negative results.



Procedure for AZ test

- ❑ Injection of serum into 3.5 week old immature mice,
- ❑ Positive result leads to production of Ripe follicles in the ovaries and the presence of a swollen enlarged uterus
- False positive results can be there in cases of embryonic death or fetal death

Friedman Rabbit test:

- Inject 2ml of mare serum (IV) to rabbits (14 to 20 wk)
- laparotomy performed 24 h later.
- Positive test- presence of CL haemorrhagicum & uterine edema
- It is due to eCG in mare serum

On farm tests:

- Pregnamare (Commercial kit- eCG 40-100 days with 95% accuracy)
- which can detect the presence of eCG in blood of mares.

Pregnancy diagnosis by chemical and biological tests

Tests	Species	Days of gestation	Findings
Chemical tests			
$Bacl_2$ test (urine)	Cattle, buffalo	50-120 d	White precipitate – NP, No precipitate–P
$Cuso_4$ test (milk)	Cattle, buffalo	>30 - 40 d	If coagulates - P
Cuboni test (urine)	Mare	150-290 d	green fluorescent color-P, brown color–NP
Biological tests			
Ascheim-Zondek test (A-Z test)	Mare	50-120 d	Hyperemic ovaries of mice injected with serum of pregnant mare
Toad/Frog test	Mare	50-120 d	Spermatozoa in cloacal washings of frog/toad inj with pregnant mare serum

PREGNANCY DIAGNOSIS IN CAMEL

- **Camel** :- A striking feature of the genitalia of the female camel is the **shortness of the right uterine horn**. (**exclusive left horn pregnancies)**
- Cervix a s a landmark
- They are **examined in a sitting position** with both hind, and forelegs tied together separately with ropes

• Persistence of the CL is one of the earliest sign of pregnancy

1) Earliest detection of uterine change (increase in diameter and appearance of fluctuation) is palpable at about 40 days.
2) Between 60-70 days left uterine horn is increased about twice to its non gravid size has a thin wall and fluctuates.
3) Fetal membrane slip and placentome not seen.
4) The uterus is more cranial and ventral after the 3rd month of pregnancy.
5) The cervix is pulled forward and lies at the pelvic brim by 4 months.
6) At 5 months uterus is completely abdominal and fetus is not palpable.
7) Fetus becomes palpable after 6 months.
8) By the 9th month the fetal movements can be seen in the right flank

Cocking of tail in camel appears 14 to 15 days after

fertile mating and known to be 95% reliable female camel

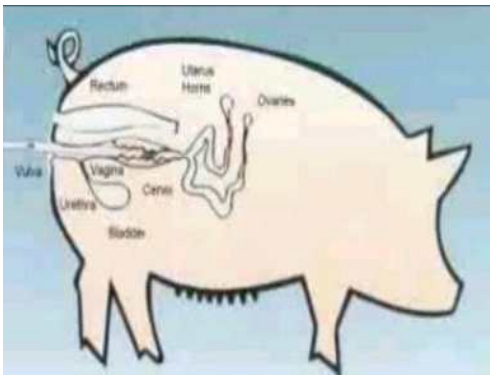


PREGNANCY DIAGNOSIS IN SOW

Trans rectal palpation in sow

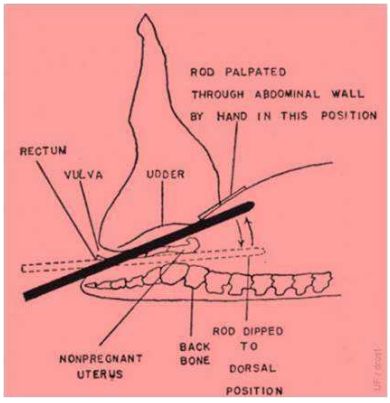
1) While standing in gestation crates or pens.
2) This technique is based on examination of the cervix and uterus, together with palpation of the middle uterine artery from to assess size, degree of tone, and type of pulse.
3) At around 21-30 days of gestation the bifurcation of the cornua is less distinct.
4) Cervix and uterine walls are flaccid and thin.
5) Fremitus can be identified at 28 days. Middle uterine artery is 5-8 mm in diameter and more easily identified.
6) Uterus becomes progressively thin walled and ill defined by 31-60 days and beyond 60 days the fremitus is very strong.
7) Piglets can only be palpated towards the end of gestation.

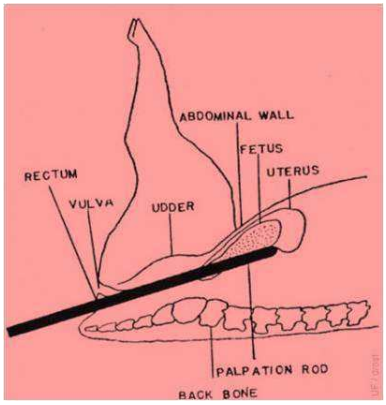




Recto abdominal palpation In sheep and goat

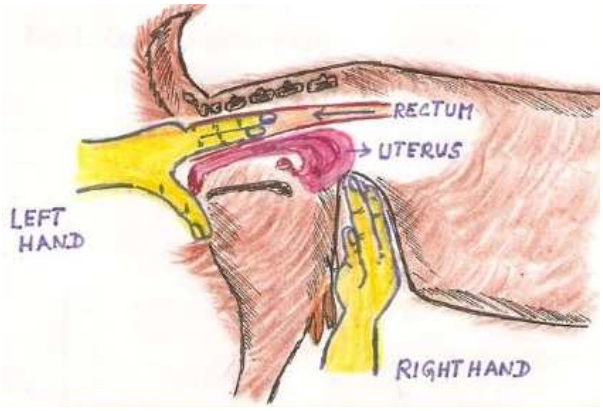
- It is a technique used for pregnancy diagnosis in sheep and goat.
- A hollow lubricated plastic rod (1.5×50 cm) with a rounded tip is inserted gently into the rectum to a depth of 30 to 35 cm.
- One of the hands is placed on the posterior abdomen while the rod is manipulated with other hand.
- Rod is moved up and down and from side to side until an obstruction is encountered and palpated against the abdominal wall till a decision is reached that the ewe or doe is not pregnant.



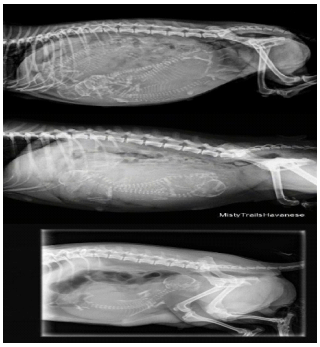


Abdominal ballottement and palpation

- Bimanual palpation for pregnancy diagnosis (palpation of uterus through fingers in the rectum and lifting the abdomen) has been reported for small ruminants.
- Palpation of fetuses through the abdomen is possible in sheep and goat only beyond 4 months of pregnancy



Radiography



- Used in small ruminants (sheep and goat), the companion animals (dog and cat) and rarely in pigs
- The technique is good in evaluating fetal numbers specially in dogs and cat, but is poor in evaluating foetal viability
- In sheep and goat, foetuses are visible by day 70 of gestation. Best done after day 90

Methods	Days earliest of pregnancy Findings	Progesterone
Cattle/Buffalo	22-24d	> 1.0 ng/ml in plasma
Sheep/ Goat	21-22 d	> 3.0 ng/ml in plasma
Sow	21 d	≥ 7.0 ng/ml in plasma
Mare	24 d	7-10 ng/ml till 150 d & then remain constant to1.0 ng/ml

Pregnancy diagnosis in sheep

- Procedures for diagnosis of pregnancy can involve detection of ewes that do not return to estrus.
- transabdominal, real-time ultrasonographic scanning (eg, 20–40 days).
- rectoabdominal palpation (from 70 days).
- abdominal palpation (from 100 days).
- measurement of plasma progesterone concentrations 18 days after breeding (detectable progesterone levels indicate an active corpus luteum); and
- laparoscopic examination (from 30 days).

Pregnancy diagnosis in goat

- Pregnancy determination in does is commonly performed using real-time ultrasonography
- Transabdominal ultrasound can detect pregnancy as early as 30 days, though it is most accurate after 45 days gestation.
- If possible, does should be fasted from food (12 hours) and water (4 hours) to improve speed and accuracy when performing ultrasonography in large herds.
- Transrectal ultrasound is more difficult and time consuming although it can diagnose pregnancy as early as 20 days.
- Ultrasonography can be used to count embryos most accurately up to 85 days gestation, which is important when managing does prone to preganancy toxemia in late gestation.

- Fetal sexing may be performed by skilled ultrasonographers between days 55 and 70 of gestation and is more accurate in singles versus multiples
- Radiography can be used to detect pregnancy with 100% accuracy after day 70 and can detect the number of kids after day 75.
- Progesterone concentrations can be measured in milk or serum.
- Samples must be collected precisely one cycle (19–24 days) after the doe is bred.
- Whereas low progesterone levels can confirm that a doe is not pregnant, high progesterone is not a positive pregnancy test, because it cannot differentiate between mid cycle, true pregnancy, or pseudopregnancy.

Pregnancy diagnosis by estimation of hormones & early pregnancy factors in different species

Estrone sulphate	
Cattle/Buffalo	72 d
Sheep/ Goat	40-50 d
Sow	20-30 d
Mare	40-100 d
Early pregnancy factors	
Cattle	4 d
Sheep/ Goat	1 d
Pregnancy specific proteins	
Cattle	24-28 d
Mare	Later half
Sheep/Goat	7-8 days

Pregnancy diagnosis by ultrasonography and radiography in different species

Methods	Days earliest of gestation	Findings
Ultrasonography		
Cattle/Buffalo	20-30 d	Embryonic vesicle, heartbeat (Transrectal)
Sheep/ Goat	20-22 d	Fetal fluids (Transrectal)
	45-60 d	Placentomes, heartbeat (Transabdominal)
Sow	24 d	Fetal fluid
Bitch	25-28 d	Fetal parts, heart beat (Transabdominal)
Mare	9-12 d	Embryonic vesicle
Radiography		
Sheep/ Goat	75-90 d	Fetal skeleton/bones
Bitch	35-45 d	Fetal skeleton/bones

Methods	Species	Days of gestation	Findings
Vaginal biopsy	Sheep	40 d	Stratifiedsquamous cell epithelium changes to cuboidal cell epithelium
	Sow	30-35d	2-3layers of epithelium :If pregnant (Estrus – 15-16 cell layer; Diestrus – 4 –5 cell layer)
Abdominal palpation	Canine	28-32 d	Table tenis ball like structure of 1.5-3.5cm diameter
Recto-abdominal palpation	Sheep	65-70 d	Obstruction felt – pregnant No obstruction felt – Non-pregnant

PREGNANCY DIAGNOSIS IN CANINES AND FELINES

Abdominal Ballottement and palpation

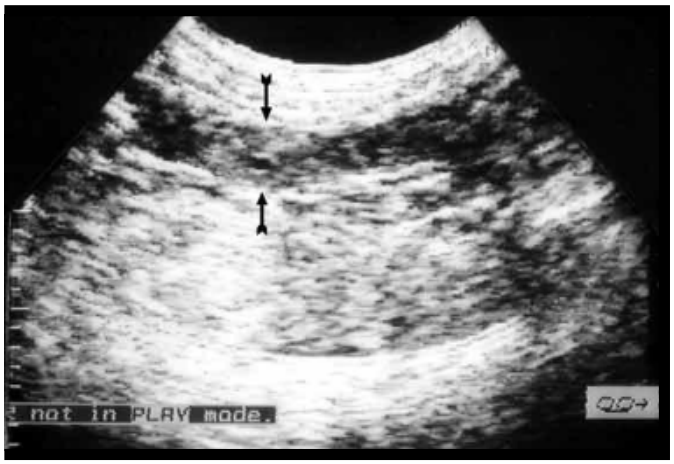
- Beyond day 55 it is easy to diagnose pregnancy by the abdominal palpation of the fetuses
- At about 30-35 days the accuracy (87%) depends on the palpation of tense conceptual swellings (6 to 30 mm in diameter)

Ultrasonography

- ➢ **Gestational sacs** are visible as early as 8-20 days post ovulation
- ➢ Heart beat can be recorded after 23 days
- ➢ Fetal movements can be seen after 34 days
- ➢ Useful after 4 weeks of gestation
- ➢ Best time 31-33 days after mating
- ➢ Repeat exam after week to diagnose false negative
- **Challenge :**
- ➢ Fetal number interpretations

Day 20 after LH surge

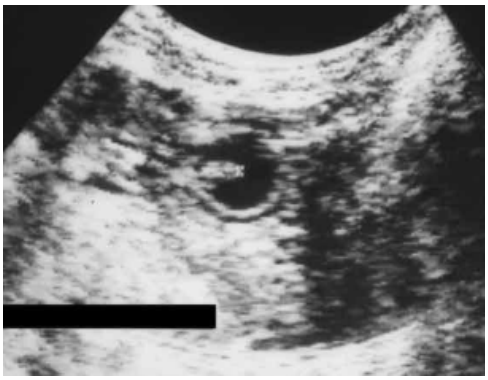
- Uterine vesicle (2 mm gestational sac)



Day 24 - Vesicle and embryo

- Embryonic mass is visible within the vesicle
- Embryonic heart beat visible as hyperechoic flickering element within the embryo.

❑ The diameter of the gestational sac is 8 –9 mm



Day 40 fetal skull and thorax

❑ The fetus is surrounded by anechoic (black) allantoic fluid.

❑ The fetal head shows the hyper-echoic (bright white) parietal bones lateral

❑ on the either side of the skull (bright white).



Day 47 fetal stomach and Kidneys

❑ The stomach (S) appears as an anechoic structure just caudal to the ribs.

❑ The left kidney (K) and right kidney appear as oval, bilaterally symmetrical, echoic structures with central anechoic urine filled renal pelvis.



Estimation of Gestational Age and Prediction of Parturition

- **Gestational Sac diameter (GSD)**

❑ Most accurate predictor of gestational age (GA) between days 20-37

❑ GA= (6xGSD) + 20

❑ Gestational age is based on days post LH surge

❑ GSD, CRL, HD and BD measurements are in cms

❑ Days before parturition is based on 65 + 1 days post LH surge



- **Gestation Age Calculations**
- **GA= (6xGSD) + 20**



- **Head diameter**
- From day 38-60-–most accurate predictor
- **GA= (15 x HD) + 20**



- **Fetal crown rump length (CRL)**
- Difficult to measure after day 48 due to flexion of fetus and increased fetal size which exceeds sector image field



Accuracy in Pregnancy Diagnosis

- ❑ Accurate in diagnosing pregnancy after day 20
- ❑ Accuracy of predicting the whelping date is independent of litter size. Less accurate for toy, miniature and giant breeds.
- ❑ Inaccurate if early examinations are done in relation to time of mating and not to the time of LH surge/ovulation
- ❑ Misdiagnosis - confusion of empty loops of intestine and early pregnancy
- ❑ False negative diagnosis
    - Fecal material hiding a conceptus
    - Acoustic artifacts produced by gas
- ❑ For better prediction accuracy
- ❑ One day needs to be subtracted from the estimated day of whelping for toy and miniature breeds
- ❑ Two days to be added for giant breeds

Estimation of Fetal Numbers

- ➢ Not a good method to estimate fetal numbers as only one sector of abdomen is imaged at a time
- ➢ Pups may be imaged a second time (giving too high number) or missed while scanning (giving too low number)

Measurement of Fetal Heart Rate

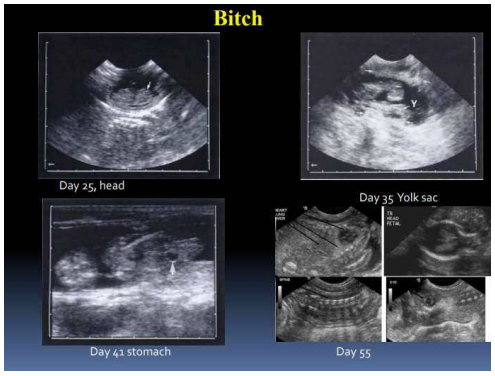
- ✓ Measurement of fetal heart rate may therefore be useful in decision-making when dog is presented with
    - History of apparent dystocia
    - History of perinatal puppy death
- ✓ Normal fetal heart rates - usually > 220 BPM
- ✓ Fetal distress was considered severe with values < 180 BPM at Day 58 - 62 of pregnancy.

Fetal Abortions/Resorptions/Fetal Death

- Signs of fetal death detected by ultrasound include the following:
    - Absence of heartbeat
    - Lack of fetal movement
    - Reduced volume and increased echogenicity of fetal fluids
    - Accumulation of gas within the fetal stomach, other fetal cavities or the uterus.
- Vesicle/fetal fluid is visible in most species between days 18-22
- Fetal heart beat can be seen between day 24-30 and the fetus itself between days 25-30 in most species.
- Bitch requires a trans-abdominal probe of frequency 3.5 to 5.0 MHz to visualize pregnancy with accuracy from 25-30 days.

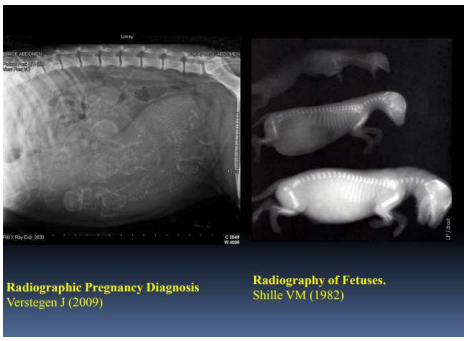
PROBE PLACEMENT FOR TRANS ABDOMINAL ULTRASONOGRAPHY

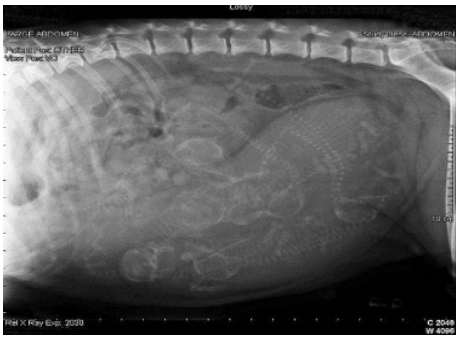




Radiology in bitch

- Useful diagnostic aid (>42 days)
- To identify more **accurately fetal number** and presentation
- Skulls are identifiable by 45 days
- At the end of 7 weeks [49 days] whole skeleton can be identified





Laboratory Test

- **C- Reactive Protein:**
  - Serum fibrinogen reaches peak 4-5 weeks after mating in pregnant dog.
  - This is C-Reactive Protein.
  - This is produced in response to tissue damage following implantation.
  - **Normal level: 100-250µg/ml at around 28-30 day**
  - **>300 µg/ml confirm pregnancy**
  - **High incidence of false positives** (inflammatory markers)

Relaxin Assay

- ✓ Relaxin determined in pregnant bitches from 20-30 days of gestation
- ✓ Source- produced by the ovaries and placenta in the bitch and cat
- ✓ In dog it has been established as a pregnancy-specific hormone/marker
- Commercially available- Canine Relaxin enzyme-linked immunoassay (ELISA) (Repro CHEK®) as early as 25 days after ovulation
- In Cat relaxin appears during the third week [21 Days] of pregnancy
- False positive rarely
- False negatives: fetal resorption
- advised re exam

ABORTIONS
(Specific and Non-specific)

DEFINITION

- Abortion is the expulsion of living fetus before it reaches a viable age/ completion of gestation , or more commonly the expulsion of a dead fetus of recognizable size at any stage of gestation.
- Economically, abortions are of great concern to the farmer, because the fetus is lost
- A prolonged period of uterine disease and sterility may follow
- Unproductive female must be maintained for a long period or sold
- if the cause of abortion is infectious, it threatens the rest of the herd.
- Agents which affect the fetus or its placental membranes or both results in abortions.
- The etiological agent of abortions determine the degree of damage to fetal membranes and endometrium and frequency of placental retention and sterility.
- Disease of the fetal placenta closely reflects in the maternal placenta due to their intimate contact.
- In dam, agents causing severe stress reaction can lead to abortion.
- Any abnormal genital discharge noticed should be investigated and closely monitored during subsequent estrus periods.
- In the cow, abortions after 4th month of gestation frequently results in placental retention

• **Infectious Causes**	• **Non-Infectious Causes**
• ***Bacterial*** Brucellosis (Br. abortus), Leptospirosis (Leptospira Pomona and others), Listeriosis (L. monocytogenes), Tuberculosis (Mycobacterium bovis) and Vibriosis (V. fetus venerealis).	• ***Chemicals, Drug and Poisonous plants*** Nitrates, chlorinated naphthalene's, arsenic, locoweeds, perennial broom-weed, pine needles.
• ***Miscellaneous Bacterial*** Streptococci, diplococci, staphylococci, E. Coli, Pseudomonas aeruginosa, Corynebacterium pyogenes, Erysipelothrix insidiosa, Hemophilus, Vibrio fetus intestinalis, Mycobacterium avium, Pasteurella multocida, Salmonella Para typhi B, S. cholera- suis and S. Dublin, B. anthracis Nocardia asteroids, and Mycoplasma.	• ***Hormonal*** Estrogens, glucocorticoids, progesterone deficiency.
• ***Viral*** Infectious bovine rhinotracheitis (IBR-IPV), Epizootic bovine abortion (E.B.A. or Chlamydia).	• ***Nutritional*** Starvation, malnutrition, vitamin A deficiency, iodine deficiency.
• ***Miscellaneous Viral*** Foreign diseases such as: foot and mouth disease, rinderpest, Rift Valley fever, bovine infectious petechial fever and tick borne fever; Native diseases as bovine virus diarrhea mucosal disease (BVD - MD) Myxovirus parainfluenza-3, malignant catarrhal fever and pseudorabies.	• ***Physical*** Douching, infusing or insemination of the pregnant uterus, rupture of the amniotic vesicle and/or trauma to embryo, removal of the corpus luteum, torsion of the uterus or umbilical cord, marked stress due to severe fatigue due to transport, work, severe systemic diseases, or major operations.
• ***Mycotic or Fungal*** Aspergillus spp., Mucorales Spp. (including Absidia, Mucor, Rhizopus), and yeasts.	• ***Genetic or chromosomal*** Certain defects of the embryo or fetus.
• ***Protozoal*** Trichomoniasis, toxoplasmosis, trypanosomiasis, anaplasmosis, babesiasis or piroplasmosis.	• ***Miscellaneous*** Twinning, allergies and anaphylactic reactions, tumors

BRUCELLOSIS
(Contagious or infectious abortion or Bang's disease)

Introduction

first described by bang (1897) in Denmark.

- Most important worldwide cause of abortion in cattle
- In cattle, abortion occurs during the last trimester of pregnancy and a subsequent period of infertility.

▶ Mainly infective for cattle, but occasionally in sheep, swine, dog and horses.

▶ **Incidence:** varies from 5-90% in a herd depending upon

- The number of susceptible pregnant animals
- Rate of transmission
- The virulence of the organism, and other factors

▶ **Causative agent**

- Small gram-negative rod, ***Brucella abortus***
- Grows intracellularly.

▶ **Transmission**

- Introduction of infection in to susceptible herds by purchase of an infected cow
- Occasionally carried by dogs or persons from one farm to another or contact of infected and susceptible animals across a line fence
- Frequently by ingestion of infected genital discharges of aborting animals that contaminate feed and water
- Through the mucous membrane of the eye and by intrauterine artificial insemination of infected semen
- Calves nursing infected cows may spread by fecal contamination of food ingested by susceptible animals
- Once infection is established in sexually mature animals, it tends to persists indefinitely
- By contaminated trucks/at fares or shows.



Transmission of brucellosis is primarily by ingestion of Brucella organisms which typically occurs in this setting by snoopy cows "inspecting" an aborted fetus.



Suspected cows should be isolated to prevent contact with the aborted fetus and fetal membranes- Six month old fetus is shown here.

Persistence of infection

- Organism is found in the chorion of the placenta.
- Persistent infection in the udder and the super mammary, retropharyngeal and internal and external iliac lymph nodes of adult cows and in the testes, epididymides, vasa differentia and seminal vesicles of bulls.
- After abortion, the organism does not persists in the uterus and disappears in 1-5 months.
- Occasionally organisms persists in joints and bursae.
- Abortions usually occur from 6-9 months of gestation

CLINICAL SIGNS

- Abortions usually occur from 6-9 months of gestation



Autolytic aborted fetus - 5.5 months

Autolytic aborted fetus - 6 months

- Premonitory signs of udder enlargement and vulval edema are often absent.
- Fetal membranes:
  - Edematous
  - Hemorrhagic
  - Leathery and necrotic
  - Brownish yellow pasty exudate in the uterochorionic space
- Retained placenta and metritis with a following period of genital discharge and infertility.
- After recovery, most cows carry their subsequent calves normally but a few cows may abort two or three times.
- Occasionally fetuses may be born alive but most are weak and premature and die within a few hours.
- Dead fetus may exhibit some autolytic changes of edema and hemorrhages of the tissues body

DIAGNOSIS

- Isolation of organism from fetal lungs, stomach or placenta
- In adult animals, organisms may be recovered from the milk or serum or from lymph nodes after slaughter
- Serological test for agglutinins in the blood
  - Tube and plate agglutination test
  - Heat inactivation test
  - Acidified plate antigen (apa) test
  - Acridine compound (rivanol) precipitation test
  - Complement fixation test (cft)
  - Two-Mercaptoethanol (ME) test.
- In non-vaccinated cow
  - 1:50 reaction is a suspicious reaction

- 1:100 reaction is positive.
- In officially calfhood vaccinated cow
- 1:100 reaction is suspicious
- 1:200 reaction is positive.

- Agglutination test on milk include the milk ring test (MRT) or Brucellosis ring test (BRT)
- Agglutination test may be conducted on seminal plasma from bulls in which it is highly effective in detecting an increased local antibody level and on vaginal mucus from cows when a virulent infection is present in uterus.

Milk ring test

- It is a simple and sensitive method of detecting Brucella contamination in milk.
- In this test, a Brucella antigen stained with hematoxylin is added to milk.
- Incubated in water bath at 70℃ for 40 to 50 minutes
- Any agglutinins in the milk, which are carried by the cream as it rises to the surface, react with the antigen.
- Blue ring at top indicates positive reaction
- Effective means of eradicating bovine brucellosis is by operation of test and slaughter policy, in conjunction with effective measures for controlling the movement of animals
- If disease is prevalent, reduce the spread of infection and lower the prevalence by intensive vaccination. A test and slaughter policy may then be adopted.
- Hygiene and sanitation
- Vaccination of calves with strain 19 from 3-7 months of age
- Testing and disposal or elimination of reactors
- Aborted fetuses and placentas should be buried or burnt and contaminated areas should be disinfected with 4% compound solution of cresol or similar disinfectant.
- *RB 51 vaccine:* the newer live-attenuated vaccine strain used currently. this is a "rough" variant of brucella abortus that lacks the o-side chain on its lps.
- Vaccination was mandatory in the past when the incidence of brucellosis was greater. today, the most common reason for vaccination is that vaccinated animals command a higher value at sale. however, some countries will not accept vaccinated animals for export.
- Vaccination should not conducted in pregnant animals because of the risk of vaccine-induced abortion

Treatment for brucellosis

- There is no permanent treatment for brucellosis in domestic animals, numerous drugs combination therapy has been recommended
- Chlortetracyclines, penicillin, streptomycin, oxytetracyclines have been used with fair amount of success.
- In canines streptomycin and tetracyclines/tetracycline and ampicillin are used as combinations
- Latest drugs used are rifampicin 600-900mg + doxycycline 200mg as single dose for minimum of six weeks is used

LEPTOSPIROSIS

▸ INTRODUCTION

- First described in cattle in USA by Jungherr (1944)
- Agent recovered by Baker and Little (1948)
- In cattle, outbreak of leptospirosis is characterized by abortion, still birth and weak calves
- Outbreak in cattle herd may be sporadic
- *Leptospira pomona* is the most common and serious of the five serotypes, as a cause of disease and abortion in cattle
- Incidence of abortion may vary from 5-40% of the herd depending upon the number of susceptible cattle in the last third of gestation, the numbers and virulence of the infective organisms and the opportunity for the spread of infection.

CAUSATIVE AGENT AND TRANSMISSION

- Small filamentous spirochete with about 40 serotypes, the most common of which are *Leptospira pomona*, *Leptospira hardjo, Leptospira grippotyphosa* and *Leptospira canicola*
- Organisms are readily destroyed by heat, sunlight, drying, acid and chemical disinfectants
- Survive for days or weeks in a moist environment at moderate temperatures as in stagnant ponds, streams or wet soil
- Enter by penetration of the abraded skin of the feet and legs when wading and by passage through the mucous membranes of the mouth and pharynx , nose and eyes by contact with contaminated water and feed or urine.



CLINICAL SIGNS

- Anorexia
- Drop in milk flow with a slack udder containing slightly thick "**gargety**" milk
- Marked drop in milk with thick, slightly bloody secretion, a flaccid udder
- Loss of condition
- Anemia ,hemoglobinuria
- Dyspnea , icterus and often death in 1-3 days
- **In all forms**: abortions occur in the last half of gestation, may occur from 1-3 weeks after recovery from the acute febrile stage
- Not all susceptible infected cows in advanced pregnancy will abort
- Occasionally an infected cow will give birth to a live, weak calf that dies within few days
- Retained placenta and its sequelae of metritis and infertility are common.

DIAGNOSIS

- Based on clinical symptoms together with necropsy findings widespread petechia indicative of a severe septicemia.
- Culture of fetus/ fetal membranes for leptospira in lab animals/media is seldom successful.
- Silver staining of liver and kidney sections. dark field microscopy.
- Use of fluorescent antibody technique to stain leptospires in infected urine from aborting cows; culturing of urine may also be successful.
- A variety of serological tests have been recommended.

TREATMENT

- Since eradication of leptospirosis is not possible, control and treatment of bovine leptospirosis may be accomplished by:
    - Hygiene and sanitation
    - Vaccination
    - Antibiotic therapy
- Treatment of acute stage:
    - Parenteral administration of large doses of antibiotics including penicillin 3 million units and streptomycin 5 gm twice daily or tetracyclines 2.5 -5.0 gm daily /450 kg animal for 5 days.
- Treatment of carrier state: similar
    - A single injection of dihydrostreptomycin at a dose level of 25 mg /kg would eliminate the carrier state.

LISTERIOSIS

- Sheep & goats are mostly affected and also rarely in cattle.
- It is also called as silage disease since there is an association between listeriosis and the feeding of poor-quality silage.
- Main disease causing meningitis associated with abortions.
- *Listeria monocytogenes* causes sporadic abortions during end of gestation.

Transmission & pathogenesis

- Is through ingestion or by penetration of mucous membranes of the respiratory system or conjunctiva, as well as the central nervous system.
- *L. monocytogenes* is ubiquitous in the environment, being present in the soil, sewage effluent, bedding and foodstuffs; it persists as it is particularly resistant to the effects of drying, sunlight and extreme temperature.
- Organism has a predilection for the placenta, causing placentitis and cause abortion

Treatment of listeriosis

- Chlortetracycline@10mg/kg body weight for 5- 7 days intramuscular route
- Penicillin 44000IU /kg body weight for 5 to 7 daysfor 5- 7 days intramuscular route
- Sulphonamide @100 to 150 mg/kg body weight daily for 3 days
- Supportive therapy with fluid and electrolytes

Control of Listeriosis

- Litter and beddings of the infected animals should be carefully disposed by burning
- Rotten vegetation should not be fed
- Premises should be thoroughly disinfected
- Restriction of ensilage feeding should be made in enzootic areas
- Tetracyclines should be added in feed as preservative measure when there is an outbreak
- Killed vaccine can be used to reduce incidence in sheep
- Live vaccine can be used to protect sheep dose 2ml at 3 months of age s/c

Clinical Signs

- Usually abortions are sporadic occurring towards the end of gestation & pyrexia prior to or after abortions.
- Characteristic multiple grayish/yellow necrotic foci on liver of aborted fetus are specific in this disease

DIAGNOSIS

- Isolation & identification of organism in the abomasum and liver of the fetus.
- Direct smear examination using placenta and vaginal discharges

SALMONELLOSIS

- Caused by *S. paratypi, S. dublin* but *S. typhimurium* is endemic in cattle throughout the world.
- Transmission of the disease is through contaminated feed & water.

Pathogenesis

- Following infection of pregnant heifers with s. dublin, the organism rapidly spreads to the liver, spleen, lungs and adjacent lymph nodes of the dam and is associated with pyrexia.
- A week later it spreads to the placentomes causing a second episode of pyrexia. the placentome is damaged due to its endotoxin, causing necrosis, placental failure, fetal death and abortion

Clinical Signs

- Following grazing of pasture contaminated with slurry from animal units, human sewage or infected river water.
- The classical signs in adult cattle include a marked pyrexia, severe diarrhoea & dysentery associated with abortion.
- Abortions occur in **late pregnancy** & rfm is a common sequelae.

Diagnosis

- Diagnosis by isolation of the organism from fetal tissues and membranes, uterine discharges or vaginal mucus & serological tests can be used, especially the sat.

TREATMENT

- Chloramphenicol 25-50 mg/kg body weight daily for 5 – 6 days
- Ciprfloxacin 5- 10 mg/kg body weight for 5- 7 days i/m
- NSAIDs for inflammation
- Astringents to check diarrhoea
- Fluids and electrolytes to check dehydration

Control

- Fetuses and fetal membranes together with contaminated bedding should be disposed of safely.
- Adequate cleansing and disinfection of premises should be performed.
- Vaccination against *S. dublin* with the *strain 51 live vaccine* & combined with a closed-herd policy & effective hygiene measures. killed vaccines & bacterins are available largely against s. typhimurium

Escherichia coli

- **Escherichia coli -** sporadic abortions due to *E.coli* have been reported. following stress, the organism reaches the fetus and placenta via blood or ascending the genital tract

Treatment for Escherichia coli

- Chloramphenicol 25-50 mg/kg body weight daily for 5 – 6 days
- Furazolidone 60 mg/kg for 5-7 days orally
- Ampicillin 7-10 mg/kg bodyweight for 5-7 days orally or parentrally
- Astringents to check diarrhoea
- Fluids and electrolytes to check dehydration
- **Haemophilus somnus** causes abortion, endometritis, vaginitis and cervicitis.
- It may be one of the organisms responsible for granular vulvovaginitis. Lesions of the placenta occur within the cotyledons with an acute, non-suppurative placentitis.

TREATMENT

- Streptomycin 5 to 10 mg /kg body weight for 3 to 5 days /tetracycline 5 – 10mg /kg body weight for 3 – 5 days /potentiated sulpha-drugs 15- 30 mg /kg body wirht for 5 – 7 days twice daily all through i/m route

VIBRIOSIS

- **INTRODUCTION**

- A venereal disease of cattle caused by vibrio fetus venerealis spread at the time of coitus or at the time of artificial insemination with improperly handled and treated semen, and characterized by infertility with an increased number of services necessary per conception.
- **CAUSATIVE AGENT**
- Vibrio fetus venerealis.
- Organism may appear as motile, or non-motile, gram-negative, short, comma-shaped rods, or as double spiral shaped filaments.

TRANSMISSION

- V. fetus venerealis is found only in the female genital tract and its contents, fetus and placenta, and in the prepuce and semen of the bull.
- Organism usually invades the uterus about 7 days after natural service to an infected bull.
- It remains there for about 13 weeks until a local immunity develops and the infection is eliminated.
- Infection may remain in the cervix and vagina for 8-18 months or more.
- Rarely a cow may carry infection through a normal gestation period.
- Young bulls of under 5 years of age are difficult to infect.

- **CLINICAL SIGN**
- Insidious in manner in which it enters the herd.
- Until signs of infertility with failure of conception occurs in large number of cows, the condition may not be recognized for several months or more.
- **Acute type of infertility**
    - Introduced by an infected bull in to a clean or susceptible herd.
    - Marked drop in conception rate, occasionally to less than 10%.
    - Infertility may a last for 2-6 months or more.
    - Immunity develops by this time and conception will follow breeding to an infected or uninfected bull.
- **The chronic or subacute type**
    - Characterized by a history of an acute infertility problem.
    - In some herds the infertility may be limited to the portion of a herd served by a single bull, or it may involve all cows bred naturally, while cows being bred artificially with antibiotic treated semen conceive normally.
    - Examination of bull and its semen usually reveals no abnormalities or explanation for the infertility.
    - Abortions may occur in both the acutely and chronically affected herds, but more frequent in acute outbreaks.
    - Some heifers have a natural immunity or develop it promptly and conceive within 2 months. Other conceive promptly but remain carriers of the organism for months. While other remain infected for months, have many services or abort.
- **Specific signs**
    - Vibriosis may fail to become established in a susceptible animal after coitus with an infected bull, either due to natural resistance or because of low number of organisms. conception and normal gestation may occur. Occasionally the infection fails to establish itself in the uterus and cause the early death of ovum or embryo. Gestation continue for some months and then terminate in 3-8 months in abortion.
    - Endometritis.
    - Infertility or failure of conception.
    - Long estrous cycles.
    - Abortions
        - Occur from 4 months to 7 months of gestation.
        - Some indication of impending abortion after 4-5 months with presence of vulvar dischare and slight vulval edema.
        - Some enlargement of udder.
        - In late abortions, placental retention occurs.
        - Pyometra rarely observed.
        - Intercotyledonary spaces filled with thick , purulent viscid material.
        - Cotyledons - greyish white in color with much cheesy exudate between the maternal caruncle and the fetal cotyledon.
        - The membranes may be thickened and edematous.

- Amniotic fluid turbid due to fetal diarrhea.
- aborted fetus - autolytic changes of subcutaneous edema, thin, blood fluid in the body cavities, and in the stomach a thick, yellow, flocculent turbid material that usually contains many vibrio.
- Lack of libido in bulls.

DIAGNOSIS

- On the basis of the herd history or symptoms.
- A careful review of breeding records.
- Careful physical examination of the individual animals in the herd, including the bull.
- Cultures of vaginal, cervical or uterine mucus.
- Culture of V. fetus from semen and preputial smegma.
- Culture of aborted fetuses.

TREATMENT

- Genital contact between infected and non-infected animals should be prevented.
- Control of V. fetus in frozen semen is more difficult than in the extended liquid semen because the glycerol interferes with the effect of the antibiotics on the organism.
- Intrauterine infusion of 1 gm of streptomycin together with penicillin in an aqueous or oil base. Elimination is most efficient if administered within 24 h after service to an infected bull.
- Infusion of dihydrostreptomycin 5 gm in 10 ml of a 50% aqueous solution into the preputial cavity and massaged through skin for 5 minutes while the orifice is closed. Repeat for 5 days. at the time of first and third treatments, administer dihydrostreptomycin 22 mg/kg bw, s/c

INFECTIOUS BOVINE RHINOTRACHEITIS (RED NOSE) - INFECTIOUS PUSTULAR VULVO -VAGINITIS (IBR-IPV) VIRUS

▶ INTRODUCTION

- Common cause of abortion in cattle in usa and other countries.
- This is a herpes virus and has many features similar to rhinopneumonitis virus, a herpes virus in horses, and herpes simplex virus in humans.
- Clinical morbidity may vary from 10 - 100 % and mortality is generally under 10 %.
- Deaths in prenatal fetus and neonatal calves may be high.
- Although generalized viremia develops in nearly all ibr-ipv infections, localized manifestations of the disease occur that confuse the diagnosis.
- The conjunctiva is reddened, swollen and contains necrotic pustules and ulcers.

CLINICAL FORMS OF DISEASE

- ***Upper respiratory form:*** characterized by fever (104-107f), anorexia, depression, reddened nasal mucous membrane, and nasal discharge, pustules and ulcers in the mucosa of the nose, pharynx and trachea, infrequent coughing and drop in milk production lasting for 2- 7 days.

- ***Conjunctival form:*** exhibits marked lacrimation changing to a mucopurulent profuse discharge from the eyes along with septicemic signs exhibited. The conjunctiva is reddened, swollen and contains necrotic pustules and ulcers.
- ***Neonatal digestive form:*** in young calves from birth to 2-3 weeks of age is associated with a high mortality and is characterized by severe signs of septicemia resembling that associated with e.coli but exhibit necrotic lesions in the mouth, pharynx, larynx, esophagus and fore-stomachs with diarrhea and death within 1-3 days.
- ***Meningo - encephalitic form:*** seen occasionally in young cattle 4-10 months of age. characterized by dullness, in-coordination, tremors, amaurosis, opisthotonus, coma and death within 3-4 days.
- ***Vulvo-vaginal form:*** generalized septicemia, pustules and ulcers of the vaginal and vulvar mucosa and purulent discharge. occasionally small abscess beneath the mucus membrane are observed.
- ***Preputial form:*** in bulls is characterized by pustules and ulceration of the penis and prepuce, severe degenerative changes of the seminiferous epithelium and a period of infertility or sterility lasting up to 3-4 months.
- **Prenatal or abortive form:** characterized by infection and intra-uterine death of the fetus and abortion 2-5 or more days later may occur in all 3 trimesters most common from mid gestation to term. Incidence in a herd vary from 5-60% depending on virulence of the organism and number of susceptible cows in advanced pregnancies. RFM occurs in 50% of abortions.
- **Intra-uterine form:** caused by necrotizing endometritis when IBR - IPV virus is present in semen at the time of AI. Results in erect edematous uterus and short cycle of 9-15 days length.
    - Abortions may occur from 2 weeks to 2-3 months after any form of disease in pregnant animals but is rarely observed in vulvo -vaginal form.
    - Signs of impending abortion are usually not observed. Aborted fetuses are invariably expelled dead with a degree of autolysis.
    - Placenta shows autolytic non-distinctive lesions characterized by edema and presence of yellow brown amniotic fluid. Hemorrhages and petechiae are often widespread in the fetus.
- Culture of fetal organs and fluids especially fetal cotyledons may recover the IBR-IPV VIRUS
- Signs of impending abortion not observed.
- Aborted fetuses are invariably expelled dead with a degree of autolysis.
- Premature births or living fetuses or calves at term not reported.
- Calves normal at birth may become infected and die in 24-48 h of infection.
- Lesions in aborted fetus is of diagnostic value.
- No evidence of uterine disease.
- Placenta: autolytic non-distinctive lesions characterized by edema, and presence of yellow, brown amniotic fluid.
- Autolysis of fetus always present to a varying degree with reddish-brown subcutaneous edema and dark red watery fluid in the body cavities.
- Widespread hemorrhages and petechiae are observed in the fetus.

Microscopic characteristic lesions

- Focal necrosis in the liver, lymph glands, kidneys, other organs and placenta.
- Most striking gross change occur in kidneys: marked hemorrhagic edema.
- Severe hemorrhagic necrosis confined largely to the cortex and often severe that the medulla and part of the cortex floats in dark red fluid.
- Adrenal glands: pin-point necrotic and white foci.
- Intranuclear inclusion bodies are seen infrequently in the autolyzed fetuses.

DIAGNOSIS

- Culture of fetal organs and fluids and especially the fetal cotyledons.
- Serological testing using serum neutralization test: best conducted on double serum samples taken at the time of the acute illness, when most samples are negative, and again 2-6 weeks later.
- In cases of abortion, the serum titers are usually elevated in the dam at the time of the abortion, but a second sample taken 2-3 weeks after abortion may reveal a rising titer.
- In herd out break: representative samples should be taken from normal, recovered, aborting or acutely ill. samples should be taken in as near sterile manner as possible in sterile vacuum vials.
- Blood testing and isolation of new arrivals in to the herd with a second sample taken 1-2 months later.
- Animals with positive titer should be considered as potential carrier.
- In an outbreak, contact between animals should be kept at a minimum.
- In vulvovaginal or preputial form of the disease, breeding should be stopped for 3-4 weeks.
- In severe cases, apply oily antibiotic preparations locally to the ulcerated mucous membranes of the genital tract.
- In valuable animals suffering from the respiratory form, administer antibiotics to prevent pneumonia or secondary respiratory complications.
- In abortions:
  - Destroy the fetus and fetal membranes.
  - Isolate the cow from other pregnant susceptible animals for 3-4 weeks.
  - If calves are infected and ill, prevent contact with pregnant animals.
- IBR-IPV vaccines are available either alone or in combination with BVD-MD (Bovine Virus Diarrhea-Mucosal Disease) virus or parainfluenza virus. keep vaccines well refrigerated to maintain potency.
- Pregnant cows at any stage of gestation should not be vaccinated with IBR-IPV vaccine.

EPIZOOTIC BOVINE ABORTION (EBA)

▸ **INTRODUCTION**

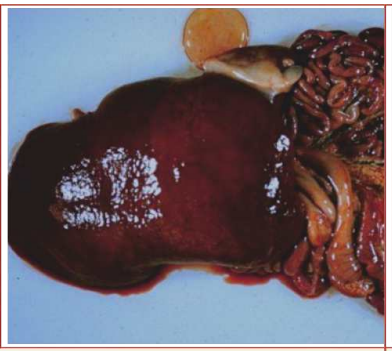
- Abortions are confined to the habitat of the argasid tick ornithodoros coraceus.
- Early studies suggest that it is caused by an agent of the psittacosis lymphogranuloma, chlamydia group of organisms (Storz *et al*, 1960).
- Authenticity of the the isolation of organism and its role in pathogenesis is debatable.
- These organisms differ from most viruses in that they are susceptible to antibiotics, they grow well in the yolk sac of chick embryos and they have developmental cycles during which large elementary bodies are formed.

- Abortions occur 6-8 months of gestation.
- Incidence vary from 30-40%, occasionally up to 75% or more of susceptible females aborting.
- In susceptible herds, all ages would abort, thereafter largely limited to heifers.

CLINICAL SIGNS

- Outbreaks occur without any premonitory signs of illness or impending abortion.
- Primarily affects the fetus, no clinical evidence of infection in cow.
- Abortions occur from 4 months to term; most common at 7, 8 and 9 th months.
- Fetuses are expelled dead at term or calves born alive and weak, succumb later.
- Aborted fetuses are not autolysed.
- Aborted fetus exhibit characterisitc lesions of anemia, and extensive petechial hemorrhages of the conjunctival and oral mucosa and skin.
- Subcutaneous tissues edematous, especially those of the head.
- Body cavities usually contain straw coloured fluid.
- Striking lesion: swollen, coarsely nodular yellow coloured liver, develops secondary to chronic vascular lesions and chronic passive congestion.
- Petechial hemorrhages in most organs and tissues.
- All lymph glands enlarged and edematous.
- Basic histological change: granulomatous inflammatory process or a diffuse or focal reticulo-endothelial hyperplasia irregularly involved in all organs.
- Fetal membranes edematous: Not of diagnostic value if entire placenta is not expelled.
- Entire placenta if expelled: inter-cotyledonary tissue of the apices of the placenta often tough, leathery and reddish white in colour and the edges of the cotyledons contain small round focal areas of necrosis.





Epizootic bovine abortion, or Foothill Abortion, appears to be geographically limited to the western United States. Live fetuses may be aborted, and most dead fetuses are fresh. Fetal lesions include granulomatous hepatitis and lymphoid hyperplasia in the lymph nodes. Once a heifer or a cow aborts and remains in the area she will be immune.



Epizootic bovine abortion, or Foothill Abortion, appears to be geographically limited to the western United States. Live fetuses may be aborted, and most dead fetuses are fresh. Fetal lesions include granulomatous hepatitis, which is generally periportal, and central veins are dilated.

DIAGNOSIS

- Complement fixation test on paired samples taken at the time of abortion and 2-3 weeks later - if rising titre is observed - diagnostic value.

CONTROL

- Attempted by ensuring that susceptible animals are exposed to ticks before they become pregnant.

BOVINE VIRAL DIARRHOEA (BVD)

INTRODUCTION

- BVD was initially recognized to cause diarrhea, and more recently shown to cause infertility.
- Due to the importance of fetal infection, to be considered primarily as a disease of reproduction.
- BVD was first recorded as a cause of bovine abortion in UK in 1980.

Causative agent

- BVD virus is a pestivirus.
- Related to the viruses of border disease of sheep and classical swine fever.
- Two main biotypes
    - A cytopathic strain
    - A non-cytopathic strain.

TRANSMISSION AND PATHOGENESIS

Infection with non-cytopathic strain in utero between days 30-125, results in birth of calf persistently infected with virus.

- Infection of cows at other stages of pregnancy causes early embryonic death and abortion, with aborted fetuses exhibiting abnormalities of the CNS and ocular systems.
- Infection in last third of pregnancy does not cause immunotolerance, but results in birth of calf that is immune to the disease.
- Bulls excrete virus in their semen following spontaneous, persistent and chronic infection.
- Seen in young animals (6-24 months)
- Disease characterized by
    - Pyrexia ,anorexia
    - Watery diarrhea
    - Nasal discharge ,buccal ulceration, lameness.

DIAGNOSIS

- Introduction of persistent infected cows or heifers in to susceptible herd should be viewed with concern.
- First signs are abortions and birth of congenitally deformed calves.
- Fetuses may be fresh, autolyzed or mummified.
- Virus can be isolated from fetus, particularly lymphoid tissue such as spleen.
- Immuno-cytochemical identification of bvd viral proteins in fetal tissue, especially kidney, lung, or lymphoid tissue.

- A substantial rise in neutralizing antibodies in herds experiencing abortions and the presence of antibodies in serum of new born calves or thoracic fluids of abortuses.

CONTROL

- Extensive culling of persistently infected animals.
- Do not breed from persistently infected cows.
- Screen all newly purchased animals before introduction in to the herd.
- A sero -positive animal would be safe to purchase but a sero -negative one requires to be free of virus to assure freedom from risk.
- In pregnant cows, killed vaccines can be used but not modified live virus vaccines.

BLUE TONGUE

- **Blue tongue** is mainly a disease of sheep and deer, but cattle and wild ruminants are important reservoir hosts for the virus.
- The virus is primarily transmitted by insect bites. culicoides species are the main vectors and there may be some transmission by ticks, keds and mosquitoes.
- Bulls that are infected by blue tongue virus can transmit the virus in their semen.
- In cattle, clinical disease is rarely caused by blue tongue virus but it does have a number of effects upon bovine reproduction.
- Infection of susceptible cattle causes a viraemia, during which the virus can cross the placenta.
- Infection of the post-hatching embryo can result in its death and, if susceptible herds are bred during the season of maximal infection with the virus, seasonal infertility can resultinfection later in pregnancy can lead to abortion or mummification of the fetus Treatment for blue tongue
- NSAIDs- to treat inflammation and pyrexia
- Antibiotics to prevent secondary bacterial infections like tetracyclines, penicillins, cephalosporins, fluroquinolones
- Anti histamines
- Fluids and electrolytes

MYCOTIC ABORTIONS

- **INTRODUCTION**

- Frequent and consistent cause of abortion in cattle.
- Sporadic abortions.
- Incidence: 5-10%.
- **Frequently isolated fungi are**
  - Absidia spp
  - Rhizopus spp
  - Mucor spp, and
  - Aspergillus spp
- **Other fungi implicated are**
  - Mortiella wolfii, and
  - Petriellidium boydii

CLINICAL SIGNS

- Infection does not always cause abortion.
- Infected live calves can be born.
- Abortions occur between 4-9 months; mostly between 7-8 months.
- Appearance of characteristic lesions on the placenta and calf.
- Whole or part of the placenta appears discolored when shed - either grey, yellow or reddish brown
- Inter-cotyledonary areas of the allanto-chorion are thickened, wrinkled or leathery
- Cotyledons with attached portion of the caruncle appear thickened and have a cup-like or coffee bean appearance

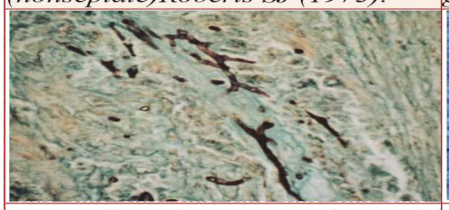
Fetal skin lesions: circumscribed, greyish white thickened patches similar in appearance to skin ringworm in calves and young cattle.



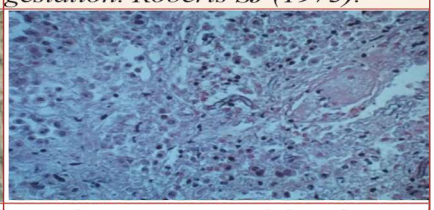
Mycotic lesions on a 6.5 month old fetus. The incidence of fetal lesions is 30 %; 75-80 % are caused by Aspergillus sp. (septate) and 10-15% by Mucorales sp. (nonseptate)Roberts SJ (1973).



Mycotic infection of the placenta grossly resembles that of brucellosis and campylobacteriosis. Abortion occurred around 6 months of gestation. Roberts SJ (1973).



Aspergillus fumigatus, the mold responsible for 75-80 per cent of fungal abortions in cattle.Roberts SJ (1973).



Histologic section of the placenta with mold infection. Roberts SJ (1973).

▶ Diagnosis

- Appearance of placenta is fairly typical.
- Fetal skin lesions are almost pathognomonic.
- Laboratory confirmation requires submission of placental tissue, preferably whole organ.
- Culture from placental tissue no value, as placenta is usually contaminated after expulsion.
- Culture from fetal lungs and abomasum more reliable, but contamination can occur.
- Reliable and traditional method: identification of fungal cells in histological sections of placenta.
- Potassium hydroxide "crush" mount of non-fixed tissue.
- Conclusive diagnosis of mycotic placentitis (*Kirkbride,1990*)
  - Characterisitic lesions of placentitis present in association with presence of mycotic elements.
  - Characteristics lesions of fetal dermatomycosis present in association with presence of mycotic elements.
  - Fetal bronchopneumonia associated with mycotic elements.

- Serological tests at present, unreliable and cannot be used for routine diagnosis.

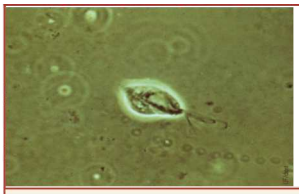
Treatment for mycotic abortions

- Griseofulvin - horse 100 mg /kg body weight for 20 days ,cattle 10 to16 mg/kg body weight for 15 to 50 days ,dogs and cats 7 to 20 mg /kg body weight for 14 to 50 days . through oral route
- Thiabendazole 2 to 5.5 mg /kg bodyweight for 14 to 21 days, orally
- Ketoconazole 10 mg/kg body weight for 14 -21 days , orally

TRICHOMONIASIS

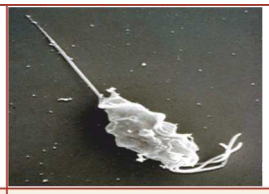
- **Etiology**

- Protozoan, trichomonas fetus.
- Piriform, 10-25 mm in length by 5-10 mm in width (structures with * can be seen without staining).



Causative organism of trichomoniasis, Tritrichomonas foetus, a protozoon. Three flagella are distinguishable. The live organism has a tumbling motion

Drost M (1980).



Scanning Electron Micrograph of Tritrichomonas foetus, a protozoon. Three flagella are distinguishable

BonDurant RH (2008).

- **In cow/heifer -** method of spread is venereal.
- Infection (localizes in the vagina, uterus and oviduct) following initial exposure (breeding) does not interfere with conception.
- Mucopurulent discharge present in some cases usually small quantities and therefore seldom observed.
- Embryonic wastage is attributed to inflammatory changes (uterus and fetal membranes).
- Average stage of gestation at the time of abortion is 3 months.
- Subsequent susceptibility to reinfection and severity of reinfection depends on(delay in calving) depends on the infection-free interval preceding re-exposure.
- Cow may carry infection thorough a normal gestation, rarely, raises the possibility of carrier cows.
- Palpable postcoital pyometra and abortion after 5th month gestation are sporadic.
- **Bull** - asymptomatic.
    - Localizes in the secretions and epithelium lining the penis, prepuce and anterior portion of the urethra.
    - Low incidence of infection in bulls of less than 4 years of age however can be chronically infected.

DIAGNOSIS

- Tentative diagnosis is based on clinical signs after eliminating other common cause of herd infertility.
- Definitive diagnosis is based on the presence of the fetus.

HERD CONTROL

- Prognosis for infected herd is generally good, provided control measures are adequately implemented.
- Details involving the implementation of control measures for a specific herd will vary.
- Control measures should be based on the epidemiology of the disease and the particular herd.
- Proven control methods are
    - Depopulation
    - Artificial insemination
    - Quarantine
    - Removal of infected bulls and sexual rest, and
    - Selective culling combined with the use of young bulls.

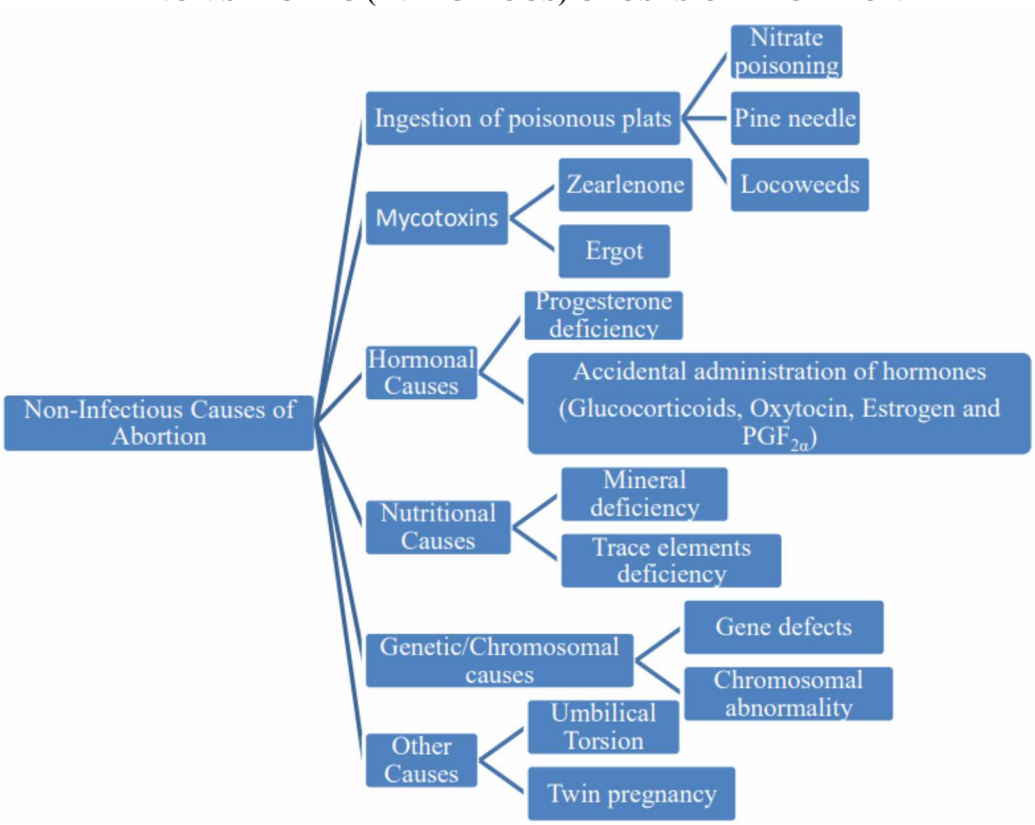
TREATMENT

- Cow/heifer - due to temporary nature of the infection, treatment of individual cows has not been thoroughly investigated.
- Bull - prognosis in an individual bull - excellent. as young bulls of less than 4 years of age recover spontaneously, they do not need any treatment.
- Three 5-nitroimidazoles (dimetridazole, ipronidazole and metronidazole) are all effective as systemic treatment agents.
- Dimetridazole (1,2-dimethyl-5-nitroimidazole) emptryl,
    - 50 mg/kg orally, daily for 5 days.
    - 10 mg/kg i v daily for 5 days to 50-100 mg/kg in single dose.
- Ipronidazole (1-methyl-2isopropyl-5-nitroimidazole) ipropran, hoffman-la roche, usa.
- First pretreat with procaine penicillin 7000 iu / kg im for 2 days.
- Ipronidazole 30 gm in 60 ml sterile water im on day- 1, followed by 15 gm in 30 ml of sterile water on days 2 and 3.
- Metronidazole (1-b-hydroxyethyl-2-methyl-5-nitroimidazole).
- Flagyl: 75 mg/kg for 3 successive injections at 12 h intervals to 10 mg/kg once daily for 2 days
- **Neospora Caninum** protozoan parasite which causes encephalomyelitis of dogs also causes bovine abortion.
- Transmission is through colostrum , fetal membranes and fluids from infected cows or oocyst -contaminated feed & vertical transmission.
- Infected dams give birth to apparently normal calves but congenitally infected or with neurologic limb defects. abortions can be sporadic but up to 30% are also common.

Treatment for Neospora Caninum

- Clindamycin 20 to 22 mg/ kg body weight twice daily for minimum of 3weeks to maximum of 2 months
- Trimethoprim-sulfamethoxazole 15 to 30 mg/ kg body weight twice daily fore 3 to 4 weeks

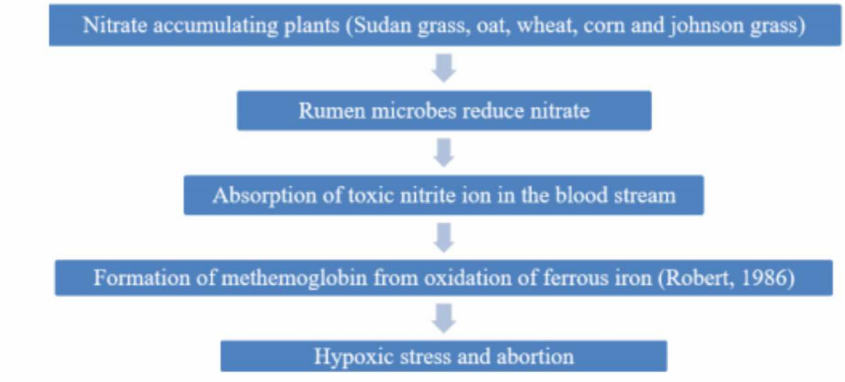
NON SPECIFIC (INFECTIOUS) CAUSES OF ABORTION



INGESTION OF POISONOUS PLANTS

- Nitrate poisoning (low land abortions):
- Ruminants-most vulnerable – cow and sheep
- Horses – rare
- Ingestion of
  - Nitrate/nitrite-contaminated water,
  - Nitrate fertilizer directly,
  - Or forage or hay grown in the area of a previous fertilizer spill.

Nitrate poisoning



- Pine Needle (Pine ponderosa):
- Consumption of pine needles in last trimester may cause abortion in bovines and mare
- Presence of chemical called isocupressic acid (ica) stresses the calf and causes premature parturition
- Locoweeds (species Oxytropis and Astragalus):
- Abortion in almost all classes of grazing livestock species active toxin swainsonine have deleterious effect on reproductive system and may result in vasoconstriction.

HORMONAL CAUSES

- Progesterone deficiency :
- Contributes to embryonic losses in mares and other livestock
- Progestogen supplementation can be used as treatment for pregnant mares whose endogenous progesterone production is suspected of being low. Altrenogest 150 mg/ml, 2ml/110kg body weight is normally used to feed such mares.
- Early habitual abortions duraprogen 500mg, after 45 days of pregnancy, repeat every ten days

late abortions dutraprogen 500mg for 3 days and then every week till end of gestation

- Accidental administration of Hormones :
- Various hormones have potency to induce abortion and terminate pregnancy in buffalo and cattle including prostaglandin f2α (pg), glucocorticoids, estrogen and oxytocin.
- The potency of abortion induction depends upon the stage of gestation.

Nutritional Causes

- Trace elements (Copper, Cobalt, Selenium, Iodine, Manganese, and Zinc) deficiency can cause abortions in livestock animals more likely in small ruminants.
- Copper deficiency associated with infertility, and embryo death in livestock animals
- Inadequate zinc levels have been associated with decreased fertility, abortion, and altered myometrial contractibility with prolonged labor.
- Low selenium is associated with abortion
- Vitamin A deficiency may also lead to abortion

Genetic/Chromosomal Defects

- Genetic defects - not very frequently diagnosed
- Occur in an individual animal rather than as a herd outbreak
- Genetic factors causing abortion may include mutations in gene, gene defects, chromosomal abnormality, polygenic defects etc

Physical Causes and Stress

- Severe trauma (faulty/harsh per rectal palpation) - rupture of amniotic vesicle or fetal heart or fetal blood vessels - may cause abortion.
- Accidental insemination in pregnant buffaloes during gestational estrous may induce abortion
- Intrauterine infusion or uterine lavage from day 6 to 70 days terminates pregnancy in mare and bovines
- Cervical and uterine manipulations - release of endogenous PGF2α and result in induction of abortion

Stress

- Activation of the hypothalamic-pituitary-adrenal (HPA) axis - activating ACTH and release of corticoids.
- Heat stress - embryonic death
- Cattle and buffalo embryos are sensitive to maternal heat stress during the first 2 weeks of gestation

Other Causes of Non-Infectious Abortion

- **Umbilical Cord Torsion :**
- It is common non- infectious cause of abortion in late gestation in mares, generally not seen in other livestock animals
- **Twin Pregnancy :**
- Twin pregnancies result in high rates of abortion, stillbirth, and neonatal mortality in mares.

CLINICAL MANAGEMENT

- Need to consider as a serious threat and more emphasis on their diagnosis, prevention and treatment should be provided.
- In stall fed animals pine needles, locoweeds, mycotoxins contaminated feed should be avoided.
- In poor body score condition animals, high energy rich feed with mineral supplements should be fed.
- To control genetic causes of abortion up to some extent, the inbreeding should be avoided.
- Exogenous progesterone can be given in case of corpus luteum insufficiency

GENERAL CONSIDERATIONS OF ABORTIONS

- It is important that the appropriate specimens for diagnostic laboratory assistance are properly collected, handled and submitted so that they arrive promptly in good conditions for examination.
- The best specimens include the aborted fetus and fetal membranes and maternal serum, urine and vaginal discharge.
- If it is impractical to submit the whole fetus, perform a necropsy and submit the tissues and specimens.
- Weigh the fetus or estimate the weight and determine the age by crown-rump measurement.
- For histopathological examination, place 1/2 to 1/2 inch thick sections of tissues and whole cotyledons in 10% buffered neutral formalin (bnf): 10 volumes of bnf to 1 of tissue.
- Send directly or keep overnight at room temperature.
- Transfer fixed tissues to a small, wide-mouth, screw-capped jar or sealed plastic bag containing 1 to 2 volumes of fresh bnf.
- All specimens for microbiological examination should be placed in separate small containers, eg . whirl bags, then placed together in a larger container, and packed with enough ice, insulation, and packing to provide refrigeration and to prevent leakage until arrival at the diagnostic laboratory.
- Specimens should be forwarded to the laboratory without delay.
- Preferably have someone take the fetus or specimens directly to the laboratory.
- As the time interval between collections and laboratory examination increases, chances for diagnosis diminish.

Origin	Fresh or refrigerated	10% BNF
Fetal membranes	• 2-3 infected cotyledons	• 2-3 infected cotyledons and surroundingICA
Fetus	• Abomasal contents 3-5 ml • Lung, Liver, Kidney - 1/2 to 1/2 • Spleen, blood sample or peritoneal or pleural fluid - 5 ml	• Lung, Liver, Kidney, Intestine and other organs with lesions.
Aborting cow	• Serum 4-5 ml • Vaginal discharge or cervical swab, Urine: 3-5ml	-
In contact cows	• Serum sample from 10 cows or 10% of the herd	-

UNIQUE DIAGNOSTIC PROCEDURE

Direct microscopic examination

- This can be performed in the practitioner's office for quick screening and diagnosis.
- Smears of infected cotyledons and abomasal contents, dried and heat-fixed, stained by gram and modified acid fast methods -- Campylobacters (characteristic morphology) and Brucellae (small red coccobacilli, blue background).
- Wet preparations examined by direct, phase contrast or darkfield microscopy.
  - Abomasal contents -- Trichomonads, Campylobacters, Leptopspire and fungal hyphae
  - Cotyledonary smears -- Campylobacter and fungi (clear with 10% KOH first)
  - Placental and uterine fluids -- Trichomonads and Leptospires
  - Fetal peritoneal fluid -- Leptospires
  - Maternal urine -- leptospires
- Immunofluorescence
- Bacterial culturing
- Viral examination
- Histopathology
- Toxins
- Plant-induced abortions.

Failure to diagnose

- Failure to diagnose the cause of abortion may result from:
- Inadequate specimens: maternal and fetal membrane samples tend to be neglected.
- Specimens arriving at the diagnostic laboratory in poor condition.
- Marked fetal autolysis: the longer the time interval between fetal death, abortion and laboratory examination, the less the chance of making a diagnosis.

- Lesions present but no pathogen identified: undiagnosed infectious.
- Non-infectious cause.
- More specimens required: submit as many aborted fetuses and fetal membranes and maternal specimens as possible until a diagnosis is reached.

OBSTETRICAL INSTRUMENTS AND EQUIPMENT USED IN CASE OF DISTOCIA

Objectives: To impart knowledge about the usage of different obstetrical equipment.

The instruments should be kept clean and sterile, chrome or stainless steel is desirable. During obstetrical operations, strict cleanliness of surgical procedures should be followed. It is necessary to have all the following obstetrical equipment for the handling of dystocia. Certain veterinarians become quite adapted to using particular instruments while others prefer different ones.

A) OBSTETRICAL INSTRUMENTS USED FOR TRACTION OF THE FETUS:

a) Chains and Handles: These are made of stainless or chrome plated steel in lengths of 75 to 120 cms. They can be easily sterilized by autoclaving, boiling or chemical disinfection and are therefore excellent for work with the decomposed fetuses. These chains are supplied with detachable stainless steel handles. Chains are used mainly for traction on the limbs but can also be applied as a head snare.

b) Obstetrical traction ropes: These are made of synthetic material or cotton. They can be sterilized by the same means as chains, although being made of multi-filament material; they are not as easily cleansed. The ropes are used mainly for traction on the limbs but can also be used as a head snare.

c) Short blunt or sharp eye hooks: These are made of stainless steel used in pairs and are attached to a rope or chain. They are inserted into the orbits of the fetus and are used for traction on the head. Constant tension has to be applied so that their position is maintained.

Different types of hooks:

1. Obermayer's hook.
2. Frey Berger's hook (for live fetus).
3. Obstetrical hook (Russian pattern).
4. Obstetrical hook (Harris pattern).

d) Krey Schotler's Obstetrical hook: This is a multi-jointed traction hook. This is a very useful instrument, as it can be attached to the body of the fetus when other points of traction are unavailable. During traction, its sharp hooks enter deeper into the tissues of the fetus and avoid lacerations of the birth canal.

e) Snares: Made of thin twisted wire with a long thin handles are valuable in securing the lower law or the limbs. Since they tighten securely and are much less apt than are chains to slip off and injure the teeth or hooves.

f) Calf Puller: (HK model) is extremely helpful in careful professional hands when little help is available.

g) Forceps: A wide variety of forceps are used to relieve dystocia in sheep, swine, dogs and cats. Forceps delivery in multipara is necessarily limited to those fetuses that are in the pelvic canal or the body of the uterus just cranial to the pelvic inlet. Great care must be used in applying rigid metal forceps to the extremities of the live fetuses as they easily cause lacerations and injuries. Ex: Hobday's, Mc Lean's, Robert's etc.

B) INSTRUMENTS FOR SECTION OF FETUS:

These are used in fetotomy to reduce the size of the dead fetus.

a) Fetotome (Thygeson's): These are of many types and are used to protect and guide the fetotome wire. The fetotome widely used in U.S. is Benesch University fetotome. Fetotomes have the advantage over most chain saws or wire saws as they can cut at different angles while the latter can cut only in caudal direction. The fetotomes use a stiff type threader to place the wire saw through the fetotome. There are several types of handles for the fetotome wire.

b) Obstetrical knives: The blades of these knives are concealed, guarded and avoid laceration of the birth canal during their operation.

c) Fetotomy knives:

1. Cowan's type with single\double finger ring.
2. Collin's type with guarded blade.
3. Coles's type.

c) Williams long cutting hook with a blunt point: This is very useful instrument for cutting the ribs of the fetus.

d) Wire saws: Its use will be quite dangerous to the animal as it lacerates the birth canal while sectioning the fetal body parts.

e) Long cutting chisel: Its usefulness in cutting the ribs is limited because of its possibility of injuring the birth canal. It can also be used for pelvic symphysiotomy (is a surgical method used to enlarge the pelvic inlet by splitting the ischiopubic symphysis). Pelvic symphisiotomy is performed in cases of feto-pelvic disproportion with live fetus in heifers aged less than 26 months.

C) INSTRUMENTS FOR REPULSION AND ROTATION

These are used for repulsion of the fetus out of the pelvic cavity, examining the fetus, or making space for manipulation of the fetus or its extremities, Epidural anesthesia is indicated and the operator's arm is the most commonly used to achieve this.

a) Kuhn's crutch repeller: It is useful when the fetus is firmly impacted in the pelvic inlet. It allows the operator assistants to provide the strength to repel the fetus and thus conserves the operator's strength. By use of this crutch the fetus can be repelled downward and forward, upward and forward or laterally and forward.

Note: In most of the fetuses the operations performed by this instrument can be performed with greater ease by the operator's hand arm. In anterior presentation repulsion is applied between the shoulder and chest or beneath the neck while in posterior presentation it is applied in the perineal region over the ischial arch.

b) Cammerer's detorsion rod: These are used to rotate the fetus along its longitudinal axis in cases of uterine torsion or fetal malposition.

DYSTOCIA

MANIPULATION OF FETAL MALPRESENTATION

FETAL MALDISPOSITION:- Abnormalities of presentation, position and posture (maldisposition) of the fetus render it difficult or impossible to enter or pass through the birth canal.

Diagnosis of fetal maldisposition:- A delay in fetal delivery with unproductive straining is an indication of fetal maldisposition. In normal birth, the fetal forelimbs and nose are seen at the vulva. In some maldisposition cases these normal findings are absent. In case of lateral deviation of the head, the fetal fore limbs alone may be seen at the vulva, while in the bilateral shoulder flexion the fetal head alone may protrude from the vulva. In breech presentation (Bilateral hip flexion) only the fetal tail may or may not be seen. The abnormality is confirmed by careful vaginal examination.

Treatment:- In many cases of fetal maldispositions, the uterine and abdominal contractions will force the abnormally disposed fetus tightly into or against pelvic inlet, making it difficult for the obstetrician to diagnose the abnormality or to take corrective measures. Hence, to provide more space the fetus must be repelled by placing the hand against solid fetal part such as the head, brisket or the hind quarters. The fetus is repelled from the pelvic inlet by gentle but firm pressure exerted by the obstetrician. The manoeuver can be aided by generous lubrication and also if necessary by instilling some warm water into the uterus especially in cases where the mal disposition has been present for some time repulsion and manipulation of the fetus is restricted due to the loss of fetal fluids and also by the uterine walls contracting tightly around the fetus. Maternal straining is often increased by attempts at fetal repulsion and in some cases an epidural anaesthesia is required.

Once the nature of the maldisposition is clearly identified the obstetrician should attempt to replace any abnormality into its correct position. Sharp pointed or hard extremities of the fetus such as the hooves, teeth or poll of the head should be covered by the obstetrician's hand to avoid damage to the uterine wall. Once the fetus has been returned to its normal birth posture it should be delivered by traction. If the maldispostion cannot be corrected or if after correction a degree of fetopelvic disproportion is found the fetus must be delivered by caesarean section or by fetotomy. The common maldispositions seen in cattle are as follows:-

A). MALPRESENTATION:-

1. Posterior presentation:- Posterior presentation is not normal in cattle. Assistance may be required when fetopelvic disproportion is also present. In posterior presentation the fetal hind limbs may be seen at the vulva with soles of the hooves showing dorsally. The orientation of the hooves can also occur in very rare cases with the fetus in the anterior presentation, ventral position and with deviation of the head, and care must be taken to ensure that the exact nature of the mal disposition is diagnosed.

Vaginal examination will permit the limbs to be followed up towards the hocks, hips and tail. The relative sizes of the fetal hind quarters and the maternal pelvis are compared and a decision must be taken as to whether traction is likely to be successful. Whenever the delivery of the fetus by traction in posterior presentation is planned the obstetrician must ensure that sufficient help is available before delivery is attempted.

2. Transverse presentation: - This may be dorso-transverse, ventro-transverse or latero-transverse depending upon whether the dorsal, ventral or lateral surface of the fetus is facing the pelvic inlet. An attempt is made to place the fetus in a longitudinal presentation by obstetrical version i.e., repelling one end of the body and applying gentle traction to the other end. Ideally the caudal end of the body is brought towards the pelvic inlet because the two hind limbs may be easily manipulated into the pelvis than the fore limbs and head. Once in a longitudinal presentation the fetus must be rotated from its lateral position into a dorso-sacral position. Delivery by traction follows correction of the mal-presentation. If the fetus cannot be corrected, the mal-presentation must be delivered by caesarean section or fetotomy.

3. Vertical presentation: - This is an extremely unusual malpresentation in which the fetus lying vertically across the pelvic inlet. The fetus may be in dorso-vertical, ventro-vertical or latero-vertical presentation depending upon which surface of body is facing the pelvic inlet. An attempt is made to place the fetus in a longitudinal presentation by repelling one end of the fetus and applying traction to the other end. If manipulative delivery fails the fetus must be delivered by caesarean section or fetotomy. The “Dog - sitting position” form of vertical presentation, which has been described in the mare, is rarely encountered in cattle. The abnormality should be suspected if the head and shoulders of the calf have been delivered but no further progress is possible even when modest traction is applied to the fetus. Careful examination of the case may reveal that the hind limbs are resting on the pelvic floor, thus preventing caudal extension of the fetal hind limbs to allow fetal delivery.

B). MALPOSITION: - In normal delivery the calf is in the dorso - sacral position with the spinal column beneath that of the dam. Abnormalities of the position includes: - Dorso-pubic position – in which the calf is "upside down" dorso-ilial position – in which the calf is "lying on its side". In these cases the fetus should be maintained into a dorso-sacral by the technique called as obstetrical rotation. An attempt is made to rotate the calf around its long axis by applying lateral pressure to the shoulders (or the hind quarters in a posterior position). This may be done by direct pressure or by moving the calf by sudden jerks from the side to side around its long axis before pushing it firmly back into position. In cases where little fetal fluid remains or the uterus has contracted tightly around the fetus, rotation prior to delivery may be difficult or impossible. In such cases rotation must be attempted as traction is applied. Downward pressure is exerted on one extended limb and upward pressure on the other.

C). MALPOSTURE: -

I) Lateral deviation of the head: - The fetal forelegs are normally found within the vagina and feet may protrude through the vulva. The head may not be immediately palpable but as the fore legs are traced upwards the base of the neck is palpable and further examination will indicate the position of the head. The head is usually found lying against the rib cage.

Treatment: - The fetus is repelled and the muzzle is located and covered by the obstetricians hand before being guided round in the arc of circle and up into the pelvis. If the muzzle is just beyond reach, the fetal head can be safely grasped using the eye sockets. A calving rope may be looped around the lower jaw, tightened and used to pull the head round with one hand while the obstetrician's other hand protects the uterus from damage by the calf's muzzle and teeth. If the head is even further forward traction may be applied to the bent neck in an attempt to bring the head within reach. If it is impossible to correct the malposture it may be necessary to perform caesarean section or fetotomy.

ii). Downward deviation of the head *:* - In mild cases, the fetal nose rests on the pelvic brim in the *vertex* posture. In more severely abnormal cases the head may be deviated downwards between the fore limbs and adjacent to the sternum in the *breech-head posture*.

Treatment: - Having located the forelimbs in the vagina, a search for the head is made. Repelling the fetus and lifting the muzzle up into the pelvis corrects the maldisposition.

Vertex posture: If the head is displaced below the forelimbs there may be insufficient space to bring it up into the pelvis unless one of the forelimbs is flexed and pushed back into the uterus. Once the head has been retrieved, the fore limb is relocated and the calf is delivered by traction. In cases where great difficulty is encountered in attempting to bring the head up, the cow may be casted and kept on dorsal recumbency. Gravitational forces may assist in bringing the fetal head down into the pelvis. If manipulative delivery proves impossible delivery must be performed by cesarean section or fetotomy.

iii). Retention of a fore limb: - This may involve carpal flexion or shoulder flexion affecting one or both forelimbs.

a). Carpal flexion:- If one leg is involved, the normal leg and the head are found protruding within the vagina. The flexed carpus of the other foreleg is found at the pelvic inlet or impacted in the vagina.

Treatment:- The fetus is repelled and the flexed carpus pushed upwards and forwards from the obstetrician so that the missing foot can be more readily found. The foot is cupped in the hand and brought carefully into the pelvis. Occasionally lack of space and maternal straining can make the maneuver difficult as the obstetrician is trying to raise the carpus and retrieve the fetal foot at the same time. In this case a calving rope can be placed around the fetlock and is used to bring the foot within reach while the obstetrician repels the carpus. Once the foot is within reach, it must be cupped in the hand and brought into the pelvis as before. In rare cases where manipulation is impossible and fetotomy may be required in case of death of calf.

b). Shoulder flexion:- If both legs are involved, the fetal head alone may be found in the vagina or protrude from the vulva where it may become swollen and edematous. If one limb is only affected the other limb often protrudes from the vulva with the head.

Treatment:- The fetus is repelled to allow the retained limb to be found and manipulated into its correct position. If the head is grossly swollen, generous lubrication and firm pressure are needed to push it back into the vulva and towards the uterus. If the calf is dead and repulsion is difficult, the head may be amputated using a scalpel or fetotome. Once the calf has been repelled the missing limb or limbs are located by searching the uterus. The calf's neck is followed down to the shoulder. The obstetrician's hand is advanced down the limb towards the carpal joint. The limb is grasped and brought up into the carpal flexion position and then the foot is brought into the pelvis, as described above. In some cases it may help to loop a calving rope around the retained limb and slip it down towards the carpus. Gentle traction on the rope will bring the carpal joint within reach of the fingers. If correction of the malposition is impossible, delivery can be done by caesarean section or fetotomy.

iv) Retention of hind limb:- This occurs in some cases of posterior presentation and may involve hock flexion or hip flexion of one or both hind limbs.

a). Hock flexion:- The tip of the fetal tail may protrude from the vulva and the flexed hocks are palpable either at the pelvic inlet or impacted within the pelvis. If one limb is only flexed at the hock the other may be extended through the vulva.

Treatment:- This is aimed at extending the flexed limb and bringing the foot up into the pelvis. Great care must be taken to ensure that the uterus is not damaged in the manipulation. Plenty of lubrication is essential and the fetus is carefully repelled by pressure on its perineal region. One of the fetal hind feet is located and cupped in the obstetrician's hand. The foot is drawn backwards and upwards in the form of an arc of the circle into the pelvis. Upward pressure is exerted on the hock. In some cases both movements (raising the foot and exerting pressure on the hock) can be accomplished with one hand. If this is impossible, the obstetricians may have to transfer from one position to the other. A calving rope can be looped round the pastern joint and then taken between the hooves and used to lift the foot backwards and upwards gently whilst the obstetrician pushes up on the hock joint. Care must be taken to protect the uterus from damage by the fetal hoof. The second leg is dealt with in a similar fashion. Lack of space may make the manipulations more difficult with the second limb and further repulsion may be required to provide room to extend the limb. If the hock joint is ankylosed and the fetus is dead the lower limb is amputated just below the hock with a fetotome.

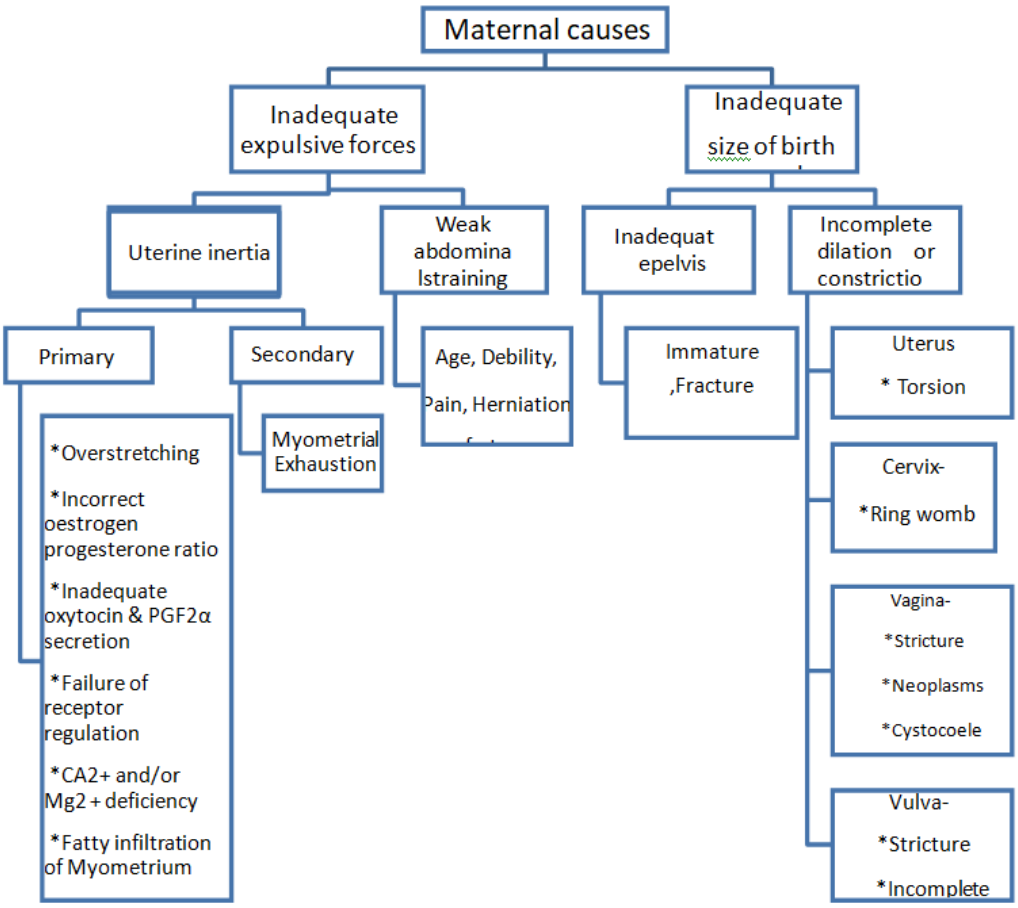
b). Hip flexion (breech presentation or croup presentation):-

The tail may protrude from the vulva or be held against fetal flank. The fetal hind quarters are palpable on vaginal examination. The hind quarters may be level with the pelvic inlet or lying in front of and below the level of the pelvic floor.

Treatment:- The aim is to convert the hip flexion into hock flexion and then extend the limbs into the posterior presentation. Exerting pressure on the rump repels the fetus and the obstetrician reaches down one of the limbs to locate the hock joint, which is pulled backwards and upwards into the flexed position. It may help to pass a calving rope round the limb and slide it down to the hock. Gentle traction on the rope may help to bring the hock joint within reach. The flexed hock is extended as described above and the second limb is dealt with in a similar manner. If correction of the malposture is impossible, the limbs may be removed by fetotomy in dead fetus; in the live calf, caesarean section may be performed.

MATERNAL CAUSES OF DYSTOCIA AND ITS MANAGEMENT

Maternal causes of Dystocia:



1. Uterine Torsion

Rotation/ Twisting of uterus along its longitudinal axis is called Uterine torsion. The torsion of uterus can occur at body of uterus (pre-cervical uterine torsion), cervix, or may involve vagina (post-cervical uterine torsion). It can be clockwise (right side) or anti- clockwise (left side). Degree of torsion may vary from less than 45 to more than 360, though 180º right side uterine torsion is most common in buffaloes.

Diagnosis

Site and side of uterine torsion can be assessed by per-vaginal and per-rectal examinations.

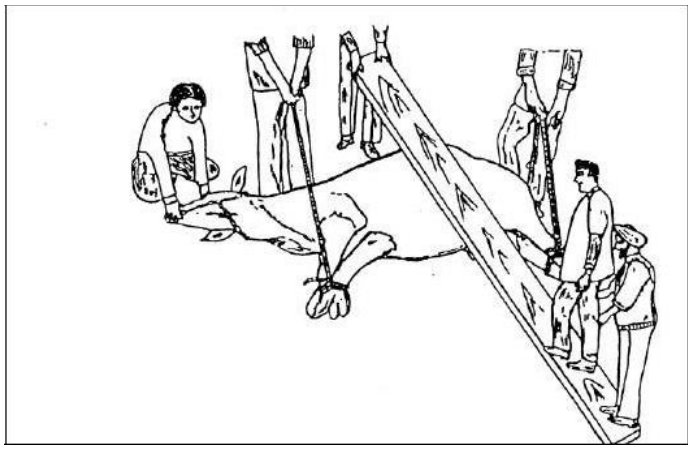
Per-rectal examination:

Per-rectal examination reveals the stretched broad ligaments that can help confirm the side of uterine torsion. In right side uterine torsion, left broad ligament will be stretched over the body of uterus and right broad ligament will be stretched below the body of uterus. In left uterine torsion the right ligament will be stretched over and the left ligament will be below the uterus.

Per-vaginal examination:

In post cervical torsion, the hand will not touch the cervix and the direction of rotation of hand will reveal the side of uterine torsion while in pre-cervical uterine torsion the cervix will be palpable per-vaginally.

Treatment



A number of methods like abdominal ballottement, per-vaginal rotation of fetus and laparotomy have been suggested, but modified Schaffer's method has been found to be the best to achieve detorsion of uterus in buffaloes. In this method, the dam is casted and rotated in the direction of uterine torsion. The fetus is fixed in position by external pressure of a plank kept in inclined manner on the abdomen of the animal with 2-3 persons standing on the end touching the ground while one person modulates the pressure on the end of plank away from the ground. It is highly successful if the case is fresh (presented within 36 h of the development of torsion). If the case is moderately delayed (presented within 36-72 h), the success of detorsion is significantly reduced and fetal delivery may be achieved in 50 per cent cases only due to failure of cervical dilation. Majority of cases, which are more than 72 h old, may require cesarean section due to development of utero-omental adhesions.

1. Uterine Inertia

Primary Uterine Inertia

In this condition, although the cervical dilation occurs and the fetus is in normal presentation, position and posture but it is not delivered due to lack of uterine contractions. The process of birth begins but do not continue into second sage labor. The most common cause of primary uterine inertia in dairy cows and buffaloes is considered to be hypocalcaemia, over distension of the uterus because of dropsical fetal conditions, general debility and environmental disturbances, inherited weakness of uterine muscle, toxic infections, myometrial degeneration, senility and nervousness.

Treatment: Calcium borogluconate IV and 15 - 20 I.U of oxytocin IM or IV.

Secondary Uterine Inertia

Occurs due to exhaustion as a result of dystocia. When the uterine musculature becomes exhausted subsequent to failure of delivery of a maldisposed or oversized fetus or due to obstruction in the birth canal, then the condition is known as *secondary uterine inertia*. The contractions in the uterus then stop or become weak and transient. The animal shows no progress in parturition after the second stage of labor. The fetal membranes are ruptured and the cervix dilated. If dystocia is prolonged without fetal delivery, the fetal fluids are expelled out and the uterus contracts tightly around the fetus.

Treatment: It is necessary to correct the primary cause of dystocia and deliver the fetus.

2. Displacement of uterus

Sometime in advanced pregnancy due to rupture of the abdominal muscles, the uterus is displaced through the hernia. This is characterized by an acute abdominal swelling usually on the right ventral side. The pregnancy is not affected but often due to extreme ventral displacement, normal delivery of the fetus does not occur. In such cases, delivery is to be assisted.

3. Incomplete cervical dilatation

Cervix in ruminants consisting of 3 – 5 fibrous annular rings. During late pregnancy and first stage of parturition, the cervix undergoes several structural changes and dilates under the effect of hormones (Estradiol, Relaxin, Prostaglandin), so as to facilitate easy delivery of the fetus. However, once the concentration of estrogens starts receding, it contracts irrespective of fetal delivery (secondary contraction). Secondary contraction of cervix has no treatment and usually the fetus is delivered by cesarean section. During primary contraction of cervix (cervix fails to dilate due to hormonal imbalance) some hormones like prostaglandin (parentral or intracervical), estrogens or glucocorticoids may be tried. To hasten the cervical dilation, Valethmate bromide can also be injected parenterally. Hypocalcemia may be one of the causes for incomplete cervical dilation that is characterized by weak uterine contractions. Care must be taken to decide about the time period to wait before it is decided to manipulate such a case.

4. Defects of bony pelvis

Fracture of the bones of pelvis usually the shaft of ileum, results into callous formation or improper joining leading to narrowing down of the pelvic inlet or outlet that results into dystocia. Heifers, which conceive at a lower age, are still growing and have narrow pelvis that results into dystocia due to feto-pelvic disproportion.

Diagnosis

Pelvimetry and per-vaginal examination can help to predict the state of narrow pelvis

Treatment

Depending upon the pelvic volume, fetotomy or cesarean section is performed. However, small fetus can also be delivered through mutations without fetotomy or cesarean section.

5. Vulvar and vaginal stricture

The stricture or narrowing of vulva and vagina can occur due to healing of lacerations and tears during previous parturition or handling of dystocia. These can be diagnosed at per- vaginal examination, however, no definite treatment is yet available. Hence, attempt should be to avoid or minimize injuries to the genital tract.

6. Soft tissue obstructions

These occur due to development of tumors or cysts. Pedunculated (benign) tumors can be removed surgically. There is no successful treatment yet standardized for diffused tumors.

7. Vaginal Cystocoele

Protruding of the urinary bladder either through the aversion of the organ through the urethra or prolapse through a rupture on the vaginal floor. Prolapse through a rupture on the vaginal floor is more likely in the cow and buffalo. Since the prolapsed bladder may obstruct the birth canal it is suggested to identify the organ and replace it back after repelling the parts of the fetus under epidural anaesthesia and ample lubrication. The vaginal rupture must be sutured after re-placement of the urinary bladder. The fetus can then be delivered.

8. Failure of Abdominal Expulsive Forces

The birth fails to occur despite the presence of normal preparatory signs and first stage labor. In cases of abdominal distension fetus must be delivered with assistance with the patient in recumbent position. In conditions, like traumatic pericarditis a caesarean is suggested.

CAESAREAN SECTION

CLINICAL CASES

Caesarean section is an option for treating dystocia that is commonly employed when the guidelines for extraction indicate that vaginal delivery would be unsafe for dam or foetus and fetotomy is not a viable alternative because the foetus is alive or there is inadequate room to place the fetotome.

Indications

- ✓ Fetal monsters
- ✓ Fetal emphysema or over sized fetus.
- ✓ Incomplete relaxation of cervix
- ✓ Uterine torsion not responded to the conservative repositioning
- ✓ Pelvic fractures or lesser pelvic diameter of mother.
- ✓ Bicornual pregnancy in mares, in which the fetus is beyond the reach of obstetrician.
- ✓ In swine in case of prolapse of vagina, uterus, rectum and uterine inertia, excessive adipose tissue around the birth canal and production of specific – pathogen – free (SPF) piglets.
- ✓ Primary and secondary uterine inertia in bitch and sow

Caesarean section in cattle

Anesthesia and surgical preparation

Caesarean section in the cow is performed with the animal under local analgesia. If the flank approach is used, a paravertebral block, inverted L block or a line block may be used. For the paramedian approach, a high epidural inverted block or line block may be used. Casting with a rope, with or without sedation, is a supplementary restraint for cows in which a ventral approach is used. The surgical area is clipped and is prepared for aseptic surgery in a routine manner.

Site of operation:

1. The left paralumbar or flank approach – is the standard incision for a viable or recently expired, uncontaminated fetus and a cow capable of tolerating surgery in while standing. It had inherent risk of rumen prolapse.
2. Right- flank – if there is marked distention of the rumen or when clinical examination dictates that removal from right side, would be difficult to remove by left flank side. It had risk of small intestine evisceration.
3. Ventral approach – used in the case of dead fetus

a.) Ventral paramedian incision – the most common ventral approach, requires the cow to be placed in dorsal recumbency. The recumbent approach is preferred in many instances because it allows the uterus to be completely exteriorized. It is more advantageous for extracting oversized fetuses and is associated with a lower incidence of abdominal contamination than in the standing approach. The incision, 20 -25 cm long is made midway between the midline and the subcutaneous abdominal vein and extends from the umbilicus caudal to the mammary gland. The incision passes through the skin and underlying rectus abdominus muscle. The peritoneum is lifted and opened to expose the uterus, which is usually covered by the omentum. The omentum is pushed forwards and the uterus exteriorized through the laparotomy incision.

b.) Ventrolateral oblique approach- which may be performed with the animal in lateral recumbency. Both the techniques reduce the contamination of the peritoneum, which may occur during removal of emphysematous, contaminated fetus and its associated debris.

Bovine flank laparotomy and abdominal exploration

- Left flank or right flank laparotomy
- A vertical incision is made in the middle of paralumbar fossa extending from 3-5 cm ventral to the transverse processes of the lumbar vertebrae for a distance of 20-25 cm for rumenotomy in a large cow; it may be advantageous to make the incision cranial to the midway point. For caesarean section, the incision may begin 10 cm ventral to the transverse process and may extend 30-40 cm.
- To incise the skin, reasonable pressure should be exerted on the scalpel to ensure complete penetration. This incision is continued ventral so that the skin is opened in one smooth motion. Separation of skin and subcutaneous tissue reveals fibers of the external abdominal oblique muscles and fascia. This layer is incised vertically to reveal the internal abdominal oblique muscle. A similar incision through the internal abdominal oblique muscle reveals the glistening aponeurosis of the transverse abdominal muscle.
- Then the muscle is picked up with tissue forceps and is nicked with a scalpel in the dorsal part of the incision to avoid cutting rumen. The incision through the transverse abdominal muscle and peritoneum may be extended with scissors or a scalpel for entrance into the peritoneal cavity.

Following entry into the peritoneal cavity, the surgeon manipulates the portion of the uterine horn containing the fetus and attempts to exteriorize an area of hysterotomy (exteriorization is often not possible). Often it is help to grasp a leg within the uterus and to use it as a handle to lift the uterus. The uterine incision is usually made over a limb, but in certain malpositions, the area over the head may be incised. The uterus should not be incised over a limb that is in the body of uterus, but rather, as close to the tip of the horn as possible. This technique allows the uterine horn to be exteriorized for suturing (incisions near the body of uterus must be sutured within the abdominal cavity). The incision must be long enough to allow the removal of the fetus without further tearing or extending of the uterine incision. The incision should be made parallel to the long axis of the uterus and on its greater curvature because this area has fewest large vessels. An attempt should also be made to avoid incising caruncles. The fetus is then removed. The surgeon attempts to retain the uterus so the fetal fluids do not fall back into the peritoneal cavity. An assistant holds the fetal limbs and apply the traction to deliver the calf. The traction is applied first dorsally and laterally from the laparotomy wound and then caudally towards the hindquarters of the cow. The umbilical cord usually breaks during fetal delivery; if not, it should be severed by tearing between two hemostats.

Surgeon attempts to retain the uterus, so that the fetal fluids do not fall back into the peritoneal cavity. The fetal membranes should be removed only if they can be separated from the uterus without undue traction or if they are lying free within the uterus. Antibiotic boluses are inserted into the uterus prior to closure.

Suturing:

- Once the fetus is removed the healthy uterus is closed with metric 7 chromic catgut in a double layer using the cushing's uterine suture pattern, modified pattern so that the suture is turned to a 30 to 45 degree angle away from the incision.
- A double – layer closure is made so that the suture line is less likely to leak uterine fluids during post delivery contraction of the uterus.
- Routinely, a flank laparotomy incision is closed in three layers.
- The peritoneum and transverse abdominal muscle are closed together with a simple continuous suture pattern using No. 0 or 1 synthetic absorbable suture or metric 7 chromic catgut suture placing this suture layer in a ventral to dorsal direction is helpful to maintain the viscera within the incision, particularly on the right side.

- The internal and external abdominal oblique muscle may be closed with a second simple continuous layer using no.1 synthetic absorbable suture or metric 7 chromic catgut suture. This suture line is anchored to the deeper transverse muscle at various intervals to obliterate dead space.
- It is also designed to take even bites on either side with the muscle closures, so the muscles will come together without a defect and without wrinkling
- If the external and internal abdominal oblique muscle layers are substantial in a large cow, closure should be performed in a separate layer with metric 6 PDS (polydioxanone suture) or vicryl suture.
- Generally skin closure is performed with a continuous ford interlocking pattern using heavy polymerized caprolactam (vetafil).
- At the surgeon opinion two or three simple interrupted sutures may be placed in the ventral aspect of the incision .This measure allows easy drainage if infection develops in the incision, such an event is possible in the compromised conditions under which this surgical procedure may have to be performed. If the skin incision has been obvious contamination is by the delivery of an emphysematous fetus, an interrupted suture pattern may be more appropriate. Sutures may be removed 2-3 weeks after surgery
- Some surgeons lavage the abdomen (the uterus and ovary region) with fluids containing various additives such as antibiotics, non steroidal anti-inflammatory drugs and heparin before closure in an attempt to limit postoperative infection and adhesions particularly if abdominal contamination was substantial .

- Oxytocin should be administered at the completion of surgery to assist with contractions of the surgical site.
- Antibiotics are continued for three days after surgery and should be directed against the most common bacteria resident in the normal postpartum uterus for the geographic region.
- NSAID for 48 hrs after surgery to control pain and limit adhesion formation should be considered.

SWINE CAESAREAN SECTION

Sows can farrow up to 25 fetuses with 12-13 in each horn. At the end of pregnancy, the uterine horns may occupy most of the ventral half of the abdomen. In this species, the uterine body is short but may appear longer in vivo because the uterine horns continue cranially a few centimeters before bifurcating. During caesarean section, the surgeon should be aware of the thick layer of adipose tissue encountered before peritoneum; it may confuse the extensive sub peritoneal fat for omentum with adhesions.

The operation is successful if done early in the parturition process, otherwise if it is done on exhausted animal subjected to numerous attempts to remove the piglets manually. Generally, tissue damage to the birth canal is considerable and emphysematous fetuses may be present in such cases. The sows are frequently in a state of endotoxic shock and are poor risks for surgery.

Anesthesia and surgical preparation: The sow is positioned in lateral recumbency, and ropes are tied to its feet if necessary. Adequate restraint is essential, so aseptic technique is not compromised. Once the sow has been placed in left or right – lateral recumbency, the surgical site is prepared. Local or regional anesthesia in the form of a line block, an inverted L block or an epidural block may be administered at this time. Azaperone 1- 8mg/kg Bwt (or Ketamine 10-15mg and Diazepam 2mg per Kg Bwt, i.m.) may be used for chemical restraint of the sow as well . This drug (Azaperone) does cross the placental barrier, resulting in minor sedation of the piglet. However,

respiratory depression in the piglet is usually low and the prognosis for survival is very good. To avoid serious complications, the dose should be kept minimal (max dose 8 mg/ kg i.m.). If additional sedation is needed, thiopental or metomidate may be administered intravenously.

Site of operation: three basic types of incisions are used for caesarean operation in sow.

1. Vertical incision either in the left or right paralumbar fossa and flank region
2. Horizontal incision in the ventral paralumbar area about 6-8 cm above the well developed mammary tissue.
3. Ventral midline incision, which will give access to both uterine horns, but it is awkward to position the sow for this incision.

The surgical site is clipped, but shaving is generally unnecessary. Local anesthetic is administered, depending on which approach is to be used (preferred is vertical incision). The surgical site is given an additional scrub and is prepared for aseptic surgery in a routine manner.

Surgical Technique: The following technique is for the vertical incision. The surgeon makes 20 cm vertical skin incision that commences 6 to 8 cm ventral to the transverse processes of the lumbar vertebra, midway between the last rib and the thigh muscles. The incision is continued through the skin, subcutaneous adipose tissue, muscles of the flank, sub- peritoneal adipose tissue, and peritoneum. The abdominal cavity is explored for bifurcation of the uterus. The surgeon makes a 15 to 20 cm incision through the uterine wall, as close to the body of the uterus as possible, being careful not to cut one of the piglets. If the bifurcation can be located, the entire litter can be brought out through one incision. This leaves only one uterine incision to close and decrease surgery time. If this is not possible, an incision is made in each uterine horn close to the bifurcation and the piglets are removed from each horn separately. If an assistant is present, piglets can be massaged down the uterine lumen toward the incision as the others are removed. But it is generally necessary for the surgeon to reach up into each uterine horn in search of more piglets while pulling the uterine walls up the surgeons' arms as one would pull on the arms of a thick woolen sweater. Great care should be exercised in exposing the ovarian end of each uterine horn. Its attachment is friable in the sow, and if one is not careful, the ovarian artery may be easily torn, possibly resulting in fatal hemorrhage. One should be sure to explore the vaginal canal for remaining piglets, and any loose placentas are removed. The uterus, abdominal muscles and skin are closed in a manner similar to closure of the bovine caesarean operation.

Caesarean section in Mare

Anesthesia: Methohexital sodium as an induction agent is superior to thiopental sodium for obtaining live foals by caesarean section. Induction with Xylazine (0.8mg /kg i.v.) followed by an injection of a Ketamine (2.2mg/kg i.v.)- diazepam (0-04mg/kg i.v.) solution and maintenance with Halothane and oxygen has yielded consistent, satisfactory result. The level of Halothane required for maintenance of anesthesia can be minimized by performing local infiltrations.

Site of operation: Ventral midline laparotomy and abdominal exploration - The incision begins over umbilicus and extends cranial. Its length depends on the procedure, but it is generally 30-40cms long, such an incision is used in patients with acute abdominal disorders but cystotomies and ovariectomies require a more caudal incision. The skin incision extends through a layer of subcutaneous tissue. Which is thin in most animals. When haemorrhage has been controlled the linea alba is incised. Incision of the linea alba reveals the retroperitoneal adipose tissue deeply. The retroperitoneal adipose tissue is cleared with a sponge to reveal the peritoneum, with round ligament of the liver demarcating the midline. The peritoneum is picked up and is incised with scissors and the incision may either extended with scissors or torn by hand.

The uterus enclosing the fetus is located and an incision site over a limb is chosen, just as in the bovine caesarean section. This area is exteriorized as much as possible to minimize the contamination of the peritoneal cavity. A more cranial limb should be chosen, otherwise it may be

difficult to close the hysterotomy incision because of caudal retraction of the uterus once the foal is removed. Unless the allantochorion has already separated or will lift off easily, it should be left in the uterus.

Before closing the uterus when equine caesarean section is performed, any large bleeding vessels should be ligated. The allantochorion is separated for a distance of 2-5 cm from the margin o f the uterine incision, and a continuous suture of rapidly absorbing synthetic suture material (Caprosyn) is placed around the entire margin of the uterine incision for hemostasis. The technique consist of a simple continuous pattern penetrating all layers of the uterus; it is necessary because the uterine endometrium is only loosely attached to the myometrium, and there is little natural hemostasis for the large subendometrial veins. The uterus is closed with a double inverting layer of sutures using no.1 polyglyconate (Maxon) or no.2 lactomer 9 -1(polysorb).

The ventral midline incision is closed in three layers. A separate closure of the peritoneum is not necessary. The linea alba is closed with simple interrupted 1cm apart each or simple continuous pattern with 5-6 throws should be used in each knot. Bites in the linea alba should be placed 0.75-1cm apart. Suture material like polyglyconate (Maxon) or polyglactin (vicryl). The subcutaneous tissue is closed with simple continuous layer of 2-0 synthetic absorbable material. The main purpose of this layer is to close dead space and cover the ends of the suture material, especially when an interrupted pattern is used.

Generally the skin is closed with staples. In most abdominal surgical procedure speed is important, staples offer satisfactory closure as well as speed

CAESAREAN SECTION IN BITCHES

Anesthesia: General anesthesia can be provided by various combinations of drugs. Advantages are complete analgesia and immobilization, where as disadvantages are depression of the fetuses and dam. Premedications are generally omitted to lessen the fetal depression and the dam is oxygenated by facemask to prevent fetal hypoxia. Intravenous fluids are administered and anesthetic depth is maintained at the minimum required for analgesia and immobilization. After delivery of the fetus, routine anesthetic techniques can be used.

Generally the following anesthetic protocols are followed:

1 Induction with Diazepam 0.25 mg/kg and Propofol 2-4mg /kg IV, maintain anesthesia with isoflurane or sevoflurane

2. Induction with Ketamine 5-10mg/ kg and Diazepam 0.25 mg/kg IV, maintain anesthesia with isoflurane or sevoflurane.

3. Induction with Diazepam 0.25 mg/kg and Oxymorphine 0.05 - 0.1mg /kg IV, maintain anesthesia with isoflurane or sevoflurane

Surgical technique :

The animal is moved to the operating room, rapidly anesthetized and placed in dorsal recumbency for final preparation. The urinary bladder is emptied and intravenous prophylactic antibiotics are administered. During induction, the surgeon scrubs, gowns and prepares the instrument table.

The animal is surgically draped and a ventral midline incision is made from umbilicus to pubis. The aim is to incise precisely through the linea alba and to avoid the rectus abdominis muscle on each side. After skin incision, subcutaneous tissue is reflected and the linea alba identified (in dog, a trough between the two rectus abdominis muscle, in cats, abroad semitransparent linea alba or white band). In both species, the linea alba is most easily recognized around the umbilicus.

Pressure can be applied to the scalpel to part the linea alba but not incise the peritoneum and falcifrom ligament beneath it. The peritoneum is punctured with scissors and finger or instrument is inserted to conform the absence of adhesions before the incision is extended with scissors.

Alternatively the linea alba can be grasped with thumb forceps and elevated while the point of scalpel blade held in horizontal inverted manner, is inserted through it. Once the abdominal cavity is entered the incision is extended with the scissors, so care is taken not to incise underlying organs.

The uterus is exteriorized and isolated from the abdomen with moistened laparotomy sponges. A ventral midline incision is made in the uterine body, care is taken not to lacerate a fetus. Alternatively, incision in the linea alba and uterine body may be initiated by careful stab incision with a scalpel and extended with bandage scissors. The hysterotomy incision is made long enough to allow easy, rapid removal of the fetuses. The fetus in the uterine body is removed first followed in order by those in the horns. The surgeon brings each fetus to the incision site by gentle peristaltic motion on the uterine horn with non dominant hand. The surgeon concurrently grasps the fetus intraluminally with dominant hand and exerts gentle traction. Once exteriorized, the amniotic sac is broken and the fetal fluids are wiped or suctioned from the neonate and surgical site. If the placenta is readily separate from the uterus it is removed with neonate, and both are placed in a sterile towel and handed to an attendant. After a few minutes, the umbilicus is clamped 2-3 cm from the body wall, and the placenta is severed free. If the placenta is difficult to separates or bleeds excessively, it is left in place. After removal of all apparent fetuses, thorough palpation of the uterus is performed from ovaries to cervix to ensure that no fetus remains.

The uterine serosa and incisions are wiped clean in preparation for closure. Retained placentas are removed immediately before hysterotomy closure or left to pass naturally. The hysterotomy is closed with (3-0 or 4-0) absorbable suture material on a taper –point needle. Single and double –layer closures have been recommended with first layer a simple continuous suture pattern followed by a second layer continuous cushing pattern. If sutures are carefully placed and knots buried, adhesion formation is minimal. The abdominal contents are inspected for any signs of diseases and then lavaged with 100- 200 ml/kg Bwt. of normal saline or balanced electrolyte solution. The abdominal wall and skin are closed routinely in three layers. Polygalactin 910 (vicryl) or Polyglycolic (Dexon) synthetic absorbable suture material size 2-0 to 1, suture interval 3 to12 mm , suture placement 5- 10mm from incision edge is used for abdominal muscles and subcutaneous in two layers. Third layer for skin suturing by using polypropylene, nylon suture material, size 3-0 to2-0, suture interval 5 to10 mm is used in interrupted mattress suture pattern. A course of antibiotics are used after caesarean operation.

DEMONSTRATION OF FORCEPS DELIVERY IN BITCH

Materials required:
Rampley's Sponge holding forceps, Hobday's forceps, Hobday's Vectis, Roberts snare forceps

Procedure:
Use of Hobday's vectis:
When parts of fetus have already traversed the pelvic inlet and occupy vagina Hobday's vectis is a useful instrument. , Grasp bottom of jaw with one finger and use Hobday's Vectis on top of head at same time and pull.

Use of Roberts snare forceps:
In cases of fetomaternal disproportion in anterior presentation, in which fetus is entirely in the uterus and obstruction is caused by the size of cranium Roberts snare forceps is useful. After fixing fetus at pelvic brim by holding it through abdominal wall, pass the closed forceps carrying the snare into the uterus and over the fetal head until they lie above the neck. Open the jaws of forceps widely and depress downwards until they lie ventral to the neck and then close the jaws. Apply traction on the free ends of the snare so that the noose is drawn tight and it is held in position by the forceps. Traction is applied to the forceps and to the free ends of the snare.

Use of Rampley's Sponge holding forceps:
Useful for application of traction to the live fetus. Using index finger as a guide, the jaws of forceps the forceps are lightly fixed to the upper or lower jaw or the whole snout. In the case of posterior presentation, forceps may be applied to a hindlimb until the fetal pelvis is drawn into maternal inlet and then a more secure hold is obtained.

Use of Hobday's forceps:
Used particularly in the case of dead and emphysematous foetuses. The procedure should be carried out under general anaesthesia. After fixing fetus at pelvic brim by holding it through abdominal wall, pass the closed forceps into vagina directed upwards at first until it reaches the pelvic floor,then horizontally downwards and finally slightly downwards and forwards into uterus. Open the jaws of forceps widely and depress downwards and hold the fetal head or pelvis. Apply steady traction in the upward and backward direction until the secured part has passed through the pelvic inlet.

FETOTOMY

Fetotomy is defined as dismemberment, dissection or cutting the fetal parts inside the uterus to reduce its size and permit per vaginal delivery of a dead fetus.

Indications:
1. To relieve dystocia caused by fetal maldisposition that could not be corrected by manipulation.
2. To relieve dystocia caused by feto-pelvic disproportion with a dead fetus that cannot be removed by traction.
3. To relieve dystocia due to fetus becoming stuck during delivery (hip lock or shoulder lock).
4. During the Cesarean section when the dead fetus is too large to be removed from the uterus, fetus is deformed or in maldisposition, which could not be corrected by manipulation.

Pre requisites of fetotomy:
1. Dead fetus: Occasionally calves are sacrificed in utero in superior dams to avoid complications of surgery.

2. Well dilated vaginal passage should be present to allow the safe passage of the fetus and fetal parts so as to avoid injuries to the genital tract.

3. Lubrication: Parachlor gel (2% sodium salt of carboxy methyl cellulose) is excellent lubricant for handling dystocia cases.

4. Epidural anaesthesia: Alleviation of straining will help in quick and efficient fetotomy while it also controls defecation during fetotomy.

Equipment: It is essential to have all the necessary equipment available before performing fetotomy. The following items are required.
1. Fetotome
2. Standard parturition equipment for the species, including protective clothing for the obstetrician, ample supplies of obstetrical lubricant and epidural anaesthetics.
3. A roll (and a spare) of fetotomy wire.
4. A pair of wire cutting pliers to remove the required length of the wire from the roll.
5. Handles to attach to the ends of the wire saw.
6. A threader to pull the wire through the tubes of the fetotome.
7. A metal introducer to attach to the end of the fetotomy wire while it is passed around the parts of the fetus to be sectioned.

8. One or more fetotomy hooks. The most useful one is the Krey-Scottler's self tightening hook, which grips the fetal tissues more tightly as traction is being applied. A rope or chain is attached to these hooks.

Note: All equipment must be thoroughly cleaned before and after use and should be sterilized if they are to be used during Cesarean section. The perineal area of the animal must be thoroughly washed before fetotomy is performed and effort must be made throughout the procedure to keep contamination at a minimum level.

Assistance required and restraint of the animal: At least two persons are required to restrain the patient and one to assist the obstetrician. Fetotomy is more easily carried out in a standing animal, if the animal is unable to raise the obstetrician must perform fetotomy in the recumbency. An epidural anaesthetic is useful to stop the animal from straining. A large dose of epidural may be helpful in the recumbent patient; sedation may be required in some animals while general anaesthetic may be necessary in some mares, especially in cases which require prolonged fetotomy operation.

PERCUTANEOUS FETOTOMY:

Use of fetotome: The wire must be threaded through one or both tubes of the fetotome before use. If the fetal parts to be sectioned are directly accessible (e.g., The head of calf in normal anterior presentation) both tubes are threaded.The handles are attached to the end of the wire saw and the loop of wire is placed around the part is to be sectioned.

If the fetal part to be sectioned is not directly accessible the wire saw cannot be looped around it (e.g., a fore limb in shoulder flexion) only one tube of fetotome is threaded. The other end of the wire is attached to the threader, which passed around the part to be sectioned and pulled out of the birth canal before being passed through the second tube of the fetotome.

Placement of the wire is always facilitated by generous use of the obstetrical lubricant. Two or more liters of the lubricant should be infused into the uterus. Once in position the wire saw is pulled tight and the obstetrician checks its position carefully. The assistant, taking long strokes, commences sawing. The fetotome is held firmly in position by the obstetrician. Initially the wire saw may take some time to engage in the skin of the part being sectioned and short sawing strokes are used for cutting bony tissue.

Occasionally the wire saw may be break, especially if it is a used one. In such cases the fetotome must be threaded and the process started again. Using a wire saw in good condition reduces the risk of breakage and also avoids development of kinks in the wire by keeping it under slight tension. Progress of sawing may be checked manually at regular intervals by the obstetrician. The obstetrician should ensure that the fetotomy wire does not come in contact with the uterine wall. This can be avoided by holding the head of the fetotome away from the uterine wall.

Once the fetal part has been cut, the movement of the wire will suddenly encounter less resistance. The fetotome is then removed and the sectioned fetal part is retrieved and removed. In most cases bones have to be sectioned and great care must be taken during the removal of such part, to ensure that the sharp bony fragments do not injure the birth canal.

SUBCUTANEOUS FETOTOMY:

Procedure: Apply traction to the limb, carry guarded knife into the birth passage then locate dorsal border of scapula of foetus and make a incision on the skin from top of the scapula to entire the leg. Take a incision on skin over left joint and secure lower end of metacarpal. Apply traction till entire limb with scapula gets detached.

COMPLETE FETOTOMY:

A. FETUS IN ANTERIOR PRESENTATION:

i) Removal of the head: If the head protruding from the vulva, attach a rope to the head and simply cut the head off after application of traction on the rope, with a scalpel by disarticulating the neck as low as possible.

If the head is within the vagina, loop the fetotomy wire over the head and back along to the base of the neck and saw through as close as possible to the shoulders.

ii) Removal of fore limb: A loop of fetotomy wire is passed along the leg to be removed. The loop is guided over the top of the scapula. The threaded fetotome is brought up on the medial aspect of the leg and sawing is commenced with frequent checks that position and progress are satisfactory.

It is sometimes difficult to keep the wire in position over the top of the scapula making small incision in the skin between the scapula and the withers with a scalpel or fetotomy knife may be helpful.

iii) Removal of thorax: The next step is to remove the thorax of the calf by sawing the body across caudal to ribs in the lumbar region. A loop wire threaded through the fetotome is carefully applied over the thorax using plenty of lubrication and pushing it forward little by little. The fetotome is introduced into the vagina and the wire tightened. The point of section must be caudal to the last rib. Once the body has been sectioned the thorax can be gently removed. The fetal abdominal viscera will be exposed and removed manually.

iv) Division of the pelvis: The hind end of the calf remains after removal of the thorax. Several vertebrae are sharp and care must be taken to prevent them from injuring the uterus and birth canal. Occasionally it may be possible to remove the remainder of the calf without further section but it is mostly necessary to divide the pelvis longitudinally so that the caudal part of the calf may removed in two smaller parts.

Procedure: The length of wire is threaded through one tube of fetotome and is attached to an introducer. The introducer is carried into the uterus and is dropped over the dorsal aspect of the rear end of the fetus as nearer to the fetal midline as possible. The obstetrician seeks the introducer from beneath the ventral aspect of the hind end of the calf. Once the introducer is located it is pulled out with its attached wire, which is pulled through the fetotome using the threader. The wire is tightened and the fetotome is placed against the anterior surface of the fetal pelvis. Sawing is commenced after ascertaining and checking at regular intervals whether the wire is cutting between the ischial tuberosities of the pelvis. This will ensure that the pelvis is divided into two equal parts. Once the hind end is divided, one half at a time is removed. Care must be taken to protect the dam from damage due to the exposed cut surfaces of the bone.

B. FETUS IN POSTERIOR PRESENTATION:

i) **Removal of the hind limb**: Fetotome wire loop may be passed up to the limb so that the end of the loop lies anterior and medial to the wing of the fetal ilium. An incision with a scalpel will help the wire saw to become embedded and engaged in the tissue. The head of fetotome is placed between the fetal ischial tuberosities and the loop is arranged so that the cut includes the tail. This procedure will prevent the tendency of the wire to slip down the leg.

If there is a necessity, remove the other hind limb also, the body of the calf can then be divided in the lumbar region, as described for anterior presentation. Forelegs can be removed with the aid of the introducer in placing the wire over the shoulder joint, i.e., between the neck and the fore limb. Alternatively the anterior part of the body can be divided longitudinally.

ii) **Breech Presentation:** (Bilateral hip flexion) the fetotomy wire is passed between the medial aspect of the flexed thigh and the abdominal wall using an introducer. The second tube of fetotome is threaded and the wire is tightened. If possible a skin incision is made in the fetus to ensure that the cut is made on the medial aspect of the fetal tuber coxae. The limb is removed after section. The space now available may allow retrieval of the second limb after its conversion into posterior presentation and fetus is delivered by traction.

If this is not possible the second limb is also removed by fetotomy (same way as the first). The remainder of the fetus is then delivered by traction. Self closing hooks (Krey's) may be attached to the fetus for effective traction.

iii) **Hock Flexion:** Fetotomy wire is passed around the limb using the introducer. The limb is sawn through just below the hock. The prominence of hock joint is preserved and may be a useful point of traction after fixing a rope.

C. FETAL MONOSTER: Fetotomy may be useful if the deformed fetus is accessible. Parts may be removed by directly looping the fetotomy wire round them or by using the introducer to encircle the part to be removed with the wire saw.

PARTIAL FETOTOMY: The technique may be required to facilitate delivery of a dead fetus where manual correction of maldisposition has failed.

a) **Deviation of Head:** The fetotomy wire is passed around the base of the neck with the help of introducer. The base of the neck is sectioned as low down as possible and the head and a part of the neck are removed.

b) **Shoulder Flexion:** The fetotomy wire is passed between fetal thorax and the medial aspect of the retained limb using an introducer. The skin between the thorax and limb is incised to assist in the placement of the fetotomy wire. The aim is to cut through the muscular attachment between the fore limb and the body wall.

AFTER CARE OF THE DAM FOLLOWING FETOTOMY:

- After fetotomy the vaginal wall and uterus of the dam should be manually examined for evidence of possible tissue damage.
- Local and parentral antibiotics should be given to check infection.
- If the placenta is readily detachable from the uterine caruncles it should be removed.
- Careful nursing for a few days is indicated.

PROLAPSE

Objectives: To acquaint about the different skills in handling of genital prolapse.

Clinical management of prolapse of vagina during pregnancy

Vaginal or cervico-vaginal prolapse is an important and common condition requiring careful management. The condition is more frequently observed in the cow, ewe and sow while it is less common in the mare, doe, bitch and queen. If the condition is recovered during the pregnancy, it is termed as antepartum prolapse on the contrary if it occurs after parturition it is termed as postpartum prolapse.

Diagnosis:-

It is based on clinical signs. In mild cases protrusion of the vaginal mucus membrane through the vulval lips is noticed when the cow lies down. The vagina appears as a round bright red ball like structure depressed in the centre. In the early stages of prolapse the appearance may be intermittent. The prolapse may be partial or complete and in latter case, the cervix may also be visible. In chronic cases the colour becomes darker and it may be inflamed, infected and necrotic.

Treatment:

a) **Aim:-** To prevent further damage to the organ, replace it after appropriate cleaning, supervise birth and be prepared for postpartum recurrence.

b) **Considerations:-** Severity of prolapse, species involved, proximity of parturition and extent of damage sustained.

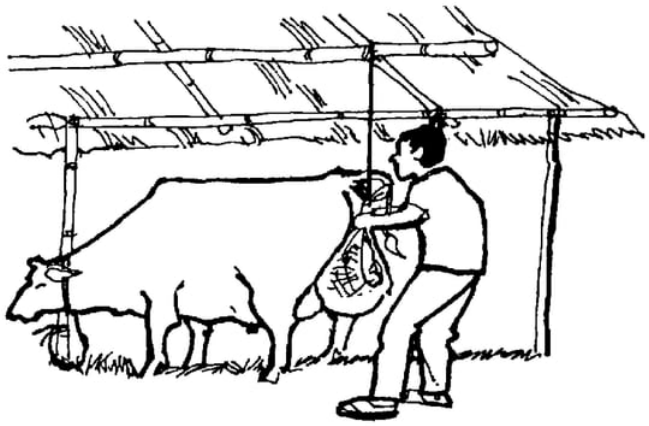
c) **Methods :**

i) ***Conservative*** **Methods:-** If the prolapse is intermittent or slight it may require simply cleaning, lubrication and replace it periodically till the birth occurs, which is carefully supervised to avoid further damage to the prolapsed organ. A cow may be placed in a stall with an elevated rear end. In other cases repeated injections of epidural anaesthesia.

ii) ***Suturing Techniques:-*** Numerous suture patterns are available like Simple mattress, Buhner's purse – string etc. With any suture pattern care must be taken to ensure that the animal is able to pass urine.

iii) ***Surgical Techniques:-*** are used for chronic cases and especially when parturition is a long way ahead. The techniques are as follows

a) Caslick's operation :suturing of upper portion of vulval lips is carried out to prevent vaginal wind sucking in mares;
b) Farquharson's operation – Especially a sub mucosa resection of the prolapsed part of the vagina.
c) Winkler's operation –The cervix is fixed to the pre-pubic tendon to prevent slipping of genital tract backwards. The suture is removed or released as soon as parturition commences.



TREATMENT OF EVERSION AND PROLAPSE OF THE UTERUS:-

Prolapse of the uterus occurs when the pregnant horn together with the non pregnant horn becomes everted and hangs from the vulva after birth of the fetus.

Diagnosis:-

It is based on clinical findings. The cow is in recumbent position in majority of the cases and the prolapsed organ is spread on the ground. If the animal is in standing position, the uterus hangs down to the hocks.

Prognosis: - Depends on the length of time the prolapse existed, degree of trauma to organ, extent of soiling of the prolapse parts and presence or absence of shock or hypocalcaemia.

Treatment :

The uterus is supported on a clean smooth surface (board, tray). Attention is then given to the general condition of the dam. In cases of hypocalcaemia, Calcium bono gluconate is administered by slow intravenous injection. If this is not done prior to correction of the prolapse it may result, regurgitation and aspiration of ruminal contents. When lacerations and hemorrhage are present–ligate the bleeding vessels and suture the lacerations. The animals must be provided with hemostatics. In cases of shock, transfusion of whole citrated blood (about 12 liters) is recommended. Plasma expanders may be of greater value. Oxytocin may be given by intra myometrial injection to contract the uterus and increase the circulating blood volume.

Reduction in the size of prolapsed mass:- when the reduction is hindered by excessive edema, apply topically a hypertonic salt or dextrose solution for beneficial effect. Wrap the prolapsed organ tightly in a big towel and lift it above the level of lower commisure of the vulva. The practice will be quite helpful in reducing the edema.

New Zealand method:- In this method, the cow will be placed on sternal recumbency with her hind legs pulled out behind her. Two or three assistants are required to do this method. If the cow is standing, she must be cast on her side and the uppermost hind limb pulled out behind her. She is then rolled on to her other side so that the second limb may be secured and extended caudally. An assistant sits on the side facing backwards and lifting the cow's tail out of the way.

Repositioning of the prolapsed mass:- This should be performed with utmost care and while straightening the everted mass. Care should be taken that no invigination be left as that will result in recurrence of eversion immediately. Infusing 10 to 15 liters of warm water or normal saline helps in complete reposition up to the tip of the horn. It also stimulates uterine contractions and helps to wash out uterine debris. The remaining fluid should be siphoned out.

Retention of prolapsed mass:- The retention of prolapsed mass after correction is achieved as follows:-

a) ***Rope truss method:-*** Take precaution to prevent the cutting of perineal parts by the rope. Cotton with proper padding either by leather straps or by bandage cloth and proper place for defecation must be left. Care must be taken when there is any difficulty in passing dung or urine it should be corrected. Thorough cleaning of the truss must be done daily and if any wounds are formed they must be dressed with non-irritant antiseptic lotions or creams.

b) ***Shoe lace suture:-*** Double strand umbilical tape is used. 3 to 4 eye holes are made in thick skin lateral to labia through which the umbilical tape is laced and tied.

c) ***Flessa Suture:-*** These are more useful where sutures are required for short period. The complications with these sutures may be the vulvar tear if they are not placed sufficiently deep and the tenesmus is not easily controlled.

d) ***Buhner's Method:-*** Buried or hidden purse string sutures. In this technique a sterile elastic tape is inserted subcutaneously around the labia so as to facilitate four fingers into the vulva. The disadvantages are that the tape needs to be removed at parturition and the knot gets burried under the skin ventrally, it is difficult to open it.

Supportive Therapy:- Heavy doses of broad spectrum antibiotics are to be used intra uterine as well as parentally to control infection. Administration of Calcium Borogluconate solution intravenously. Antihistamines, anti-inflammatory drugs will also relieve pain and reduce straining.

ANESTRUM AND INFERTILITY

INTRODUCTION

Anestrus is one of the most commonly occurring reproductive problems in cattle and buffalo in India.

It is a functional disorder of the reproductive cycle which is characterized by absence of overt signs of estrus manifested either due to lack of expression of estrus or failure of its detection.

Anestrus is a multicausative factors associated problem but its occurrence signals the inadequate nutrition, environmental stress, uterine pathology and improper managemental practices.

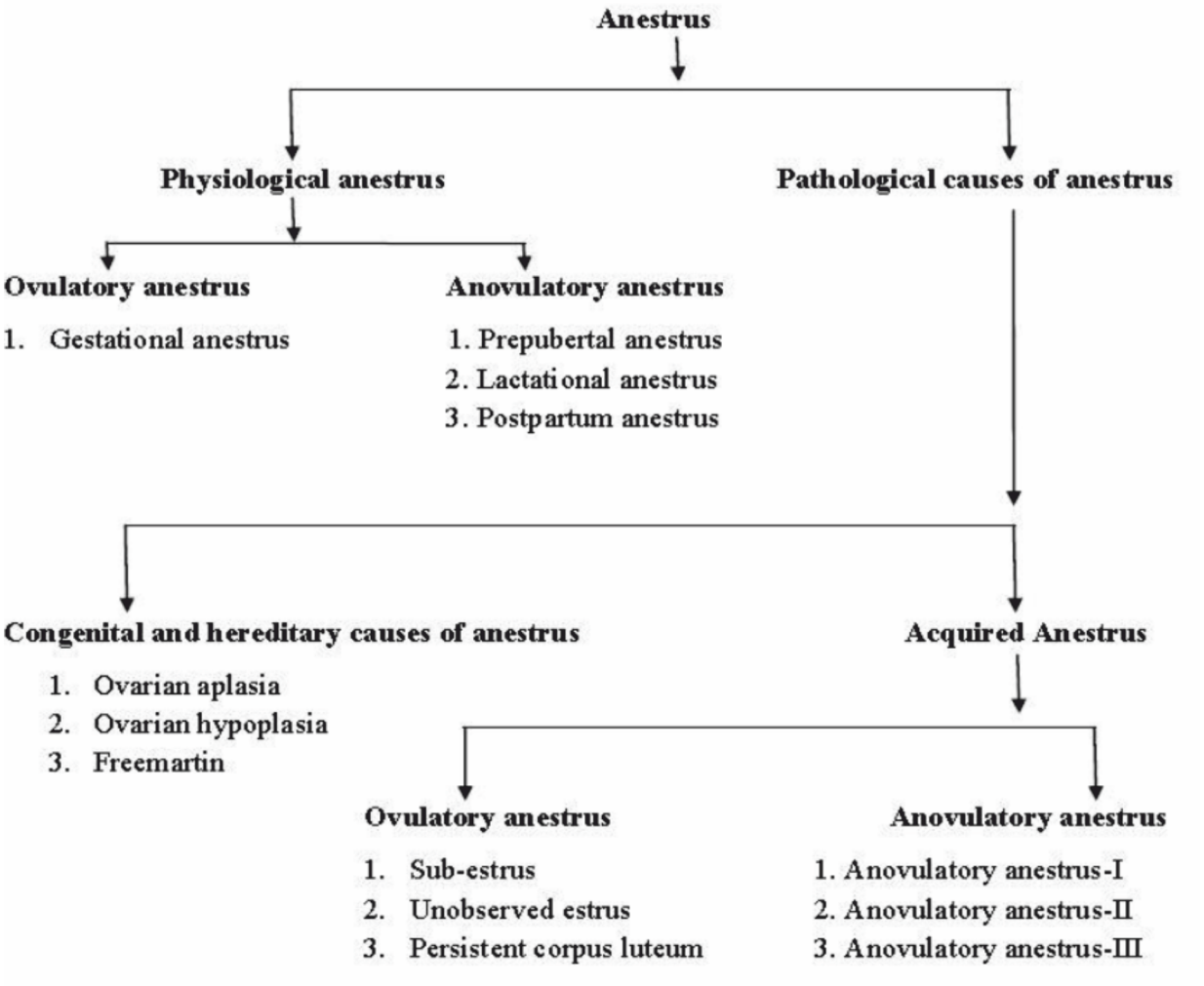
CLASSIFICATION OF ANESTRUS

Based on ovarian activity, anestrus cow has broadly been classified into ovulatory, anovulatory and inactive.

Robert (1971) divided the anestrus cow or heifer into two class viz.,

Class I–cow with a normal functional corpus luteum

Class II–cow with no functional corpus luteum.



MANAGEMENT AND PREVENTION

- Maintaining the healthy status of the animals by adopting efficient farm managemental practices.
- Nutrition is probably most important factor, affecting ovarian activity.
- Special attention must be given to prevent the negative energy balance in high yielders. It can be achieved by providing adequate ration during pre– and postpartum period.
- The supplementation of vitamins, minerals and antioxidants in feed appeared to be promising in restoration of cyclicity.
- As suckling decreases the LH pulsatility and prolongs the postpartum anestrus period.
- Weaning could be one of the effective managemental tools to reduce postpartum anestrus period following restoration of pulsatile secretion of LH in postpartum animals.
- It has been shown that weaning (complete, temporary and partial) is associated with increased GnRH secretion, LH pulse frequency and more LH receptors on follicular cells followed by ovulation within few days.
- Biostimulation (induction of cyclicity through introduction of males into a group of females) activates LH secretion followed by ovulation in females through olfactory and sensory cues.
- Exposure of postpartum cows and buffalo to a bull decreases the postpartum anestrus interval and advances the puberty in heifers.
- In cattle and buffaloes, the satisfactory response to biostimulation is achieved only when females are exposed to bulls immediately and continuously after parturition.

Managemental practices

- Efficient detection of estrus either
- Visually or by bull parading.
- Routine pregnancy diagnosis (40–60 days post breeding).
- Prevention of occurrence of post-partum uterine infections and periparturient diseases (ketosis and mastitis).
- Regular deworming.
- Synchronization of estrus especially in buffaloes where heat detection is more difficult.

TREATMENT

- Anestrus can be treated according to their cause.
- There is no single panacea to correct it.
- Various therapeutic agents including hormonal and non–hormonal compounds have been used extensively for the restoration of cyclicity in anestrus cattle and buffalo by several workers with varying degree of success.
- In order to ensure effective treatment, the health and nutritional status of the animals must be in good conditions.
- Deworming, the supplementation of vitamins, minerals and antioxidants in feed are useful to improve health status of the animals.

NON-HORMONAL TREATMENTS

Plant Based Heat Inducers

- Plants synthesize varieties of phytochemicals such as alkaloids, glycosides, terpenes and tannins (secondary metabolites) as a part of their normal metabolic activity and many of these have therapeutic actions when consumed by animals.
- Many plants are rich source of vitamins and minerals whereas some have estrogenic property which is useful in restoration of cyclicity in anestrus animals.
- Almost all the parts of plant such as seeds, berries, roots, leaves, bark and flowers have been used as therapeutic agents either directly (crude drugs) or their active principles, after separation though various chemical process.
- Murraya koenigii (curry leaves).
- Nigella sativa (kalonji).
- Abroma augusta (Ulatkambal).
- Saraca asoca (Ashoka).
- Trigonella foenum–graecum (Methi).
- Bambusa aruninacea.
- Carica papaya.
- Asparagus recemosus.
- Leptadenia reticulate.
- Courupita guianesis.
- Pergulacia daemia.
- Semecarpus anacardium cucumber.
- Jute plants.
- Either alone or in combinations have been fed to treat the anestrus animals with variable response on induction of estrus.

- 50% estrus induction in anestrus buffaloes using mixture of Abroma augusta (root) and Nigella sativa (seed) in 2:1 ratio.
- Higher success rate in anestrus cattle i.e. 83.33 and 66.66% using Methi seed (@ 200g/day/cow for 20 days) and bark of Ashoka tree (@ 50g/day/cow for 20 days), respectively.

Commercially available herbal heat inducers

- Prajana HS (Indian Herbs).
- Janova (Dabur).
- Sajani (Sarabhai).
- Heat up (Century) Heat raj (Ranjan).
- Fertivet (Ar Ex Labs).
- Aloes compounds (Alarsar).
- These formulations are potent combinations of herbs, formulated to induce ovarian activity.
- Above are good heat inducers.

Utero–Ovarian Massage

- Utero–ovarian massage is the oldest, simplest, cheapest and effective method to induce estrus in anestrus cattle and buffaloes.
- Estrus induction in cattle and buffalo varies between 40 to 80% following utero–ovarian massage daily/on alternate day/weekly for 3–4 weeks.

  The mechanism by which ovarian massage induces cyclicity is not clearly understood, however, probable mechanism includes:

  Activation of intrinsic intra–ovarian factors.
- Enhancement of blood circulation to the ovaries and uterus.
- Increases the availability of hormones and growth factors.
- Stimulation of local oxytocin production by the ovaries which consequently influence local blood circulation and luteolysis if CL is present

Lugol's Iodine

- Lugol's iodine solution (5%) has traditionally been used as a cervical paint. It is presumed that painting of Lugol's iodine on posterior part of the cervix causes local irritation and brings about reflux stimulation at anterior pituitary for secretion of gonadotrophins and consequently cyclicity.
- Lugol's iodine is an irritating solution and intrauterine infusion of Lugol's solution (0.5 to 1.0%) causes hyperemia (enhanced circulation) of uterine mucosa resulting into degree of iodine absorption from uterus.
- The newly formed tissues of endometrium release luteolytic factors (PGF2α) that reaches to the corpus luteum via utero–ovarian pathway and causes luteolysis. Thus, it initiate the estrus cycle, if anestrus is due to PCL.

HORMONAL TREATMENTS

Estrogen Based Treatment

- In presence of dominant follicle, estrogen administration results in expression of estrus and ovulation because of its positive feedback effect over pituitary for LH surge.
- Used to induce ovulation (Saiduddin *et al*., 1968; Peters, 1984; Garcia–Winder *et al*., 1988; McDougall *et al.*, 1994) and to reduce postpartum anestrus period.
- Conversely, estrogen induces anovulatory estrus in absence of dominant follicle.
- One or two doses of intramuscular injections estradiol (3–10mg) or estrone (5–15mg) at three days interval can be used to regresses the retained corpus luteum associated with pyometra, mummification and mucometra.
- But high and prolonged dose of estrogens leads to cystic ovaries, abnormal motility.

Peristalsis of oviduct that may results in introduction of infections to the ovarian bursa through oviduct, causing ovaritis and adhesions.

Progesterone based treatment

- Exogenous administration of progesterone mimics the luteal phase of the estrus cycle by exerting negative feedback effect over hypothalamus and pituitary for LH release.
- Upon withdrawal of progesterone, the normal follicular phase of the cycle is stimulated.
- Such treatment seem to be effective, abrupt decrease in progesterone level is required at the end of treatment.
- Intravaginal progesterone releasing devices such as:
    - PRID (progesterone–releasing intravaginal device).
    - CIDR (controlled internal drug release).
- CueMate are effective in restoration of cyclicity in anestrus animals
- Ear implants (Crestar and Synchromate–B) also produce required abrupt decrease in progesterone concentration at the end of treatment.
- Progesterone therapy alone is not particularly effective for the treatment of anovulatory anestrus; hence other hormones have been incorporated in most of the progesterone based therapy. So, they are used in combination with other hormones.
- Feeding of oral progestational compounds (10–14 days) such as
- MAP (6–methyl–17–acetoxyprogesterone).
- CAP (6– chloro–6–dihydro–17–acetoxyprogesterone).
- MGA (Melengestrol acetate).
- DHPA (16α–17– Dihydroxyprogesterone acetophenide)
- Long term (4–14 days) intramuscular injections of progesterone @ 50–100 mg either alone or in combination with other hormones (Willet *et al*., 1950; Ulberg and Lindlay, 1960; Agarwal., 1983) have been used for induction/synchronization of estrus.
- However, both oral and parenteral routes are impractical for inducing the cyclicity as concentration of progesterone does not decline abruptly at the end of treatment.

Gonadotropic Releasing Hormone (GnRH)

- The single intramuscular injection of GnRH analogue (10 to 20µg Buserelin) has been used effective in induction of estrus and concurrent ovulation with variable response (45.5 to 87.5%) within 4–22 days (Dhoble and Gupta, 1986; Pattabiraman *et al*., 1986; Sonwane *et al*., 1994; Narasimha Rao, 1997; Nautiyal *et al*., 1997; Markandeya and Patil, 2003; Prahalad *et al.*, 2010).
- GnRH has been combined with other drugs such as

  Phosphorus Injections,

  Prostaglandin,

  Estradiol and Progesterone
- The Ovsynch protocol or GPG regimen (GnRH–PG– GnRH), to synchronize ovulations in dairy cows has been widely used to treat anestrus cattle and buffaloes and results are also promising.

Gonadotrophins Based Treatment

- Predominant FSH like activity - Pregnant mare serum gonadotrophin (PMSG) or equine chorionic gonadotrophin (eCG) and analogues of FSH strong stimulator of ovarian activity.
- Extensively for superovulation.
- Single intramuscular injection in low doses either alone or in combinations with others has been used successfully to treat anestrus cattle and buffaloes.

Prostaglandin Based Treatment

- Prostaglandin (PGF2α) is the treatment of choice for persistent corpus luteum and sub estrus.
- Natural or synthetic analogue of PGF2α as a single dose has been used with a reasonable degree of success for management of silent estrus in cattle and buffaloes
- PGF2α is only effective between days 6–16 of the cycle and in the presence of active corpus luteum.
- An intramuscular injection of 25mg (total dose) of natural PGF2α or 250 to 500 micrograms of synthetic ones is required to regress the CL in both cattle and buffaloes.
- A lower dose of PGF2α (5mg) are also effective to regress the CL through intra–vulvo–submucosal (IVSM) (Dhaliwal *et al*., 1988; Narasimha Rao and Venkatramaiah, 1990).
- Alternatively, Ovsynch protocol may be used to treat sub estrus or unobserved estrus.

Insulin Based Treatment

- Use of insulin for induction of estrus in animals either alone or in combination is a fairly recent development and results are very encouraging.
- The recommended dose is 0.25 IU/kg body weight subcutaneously for 3–5 days.
- Use of GnRH or eCG pretreated with insulin has shown promising results for management of anestrus cattle (Shukla *et al*., 2005 a&b) and buffaloes.
- It has also been shown that insulin enhances the follicular growth in true anestrus buffalo which is prerequisite of GnRH to be effective .
- The treatment of true anestrus buffaloes under field condition was reported satisfactory when single intramuscular injection of PMSG (500 IU) was combined with subcutaneous injections of insulin @ 0.25IU/Kg body weight for five consecutive days.

REPEAT BREEDING

Definition : Repeat breeder is a cow that has normal estrous cycle, is free from palpable clinical abnormalities, has no abnormal vaginal discharge, is less than 10 years old, has calved at least once but has failed to conceive after at least three or more consecutive inseminations with proven bull semen.

- Global Problem
- Modern day high producing Holstein cows due to intensive selection for high yields have reduced fertility .
- Incidence : 06 to 35 %
- 2nd most common reproductive disorder. More common in cows & buffaloes.

Etiology:

1. **Fertilization failure** :
   - Fertilization failure accounts for about 40 percent of the repeat breeder cows.
   - It may be due to failure of ovulation, delayed ovulation, defects in the ovum, inflammatory conditions.

   Inability of the gametes to reach one another because of anatomical defects of the genital tract of cow
   - Inability of the sperm to fertilize ovum :
   - Fertility of bull
   - Poor quality of the semen used,
   - High sperm abnormality
   - Low sperm concentration,
   - Low sperm motility,
   - Improper handling of semen and AI,
   - Very early AI

   Anti-sperm antibodies (ASA) have been found in repeat-breeding(RB) cows, and those causing agglutination and/or immobilization of sperm are considered to be closely related to infertility

2. **Early embryonic death**:

   Embryo loss accounts for the major portion (25%) of the reproductive wastage.

Most of the embryonic death occurs between 8 and 19 days after breeding before the critical stage of maternal recognition of pregnancy.

Embryonic death may be due to Cytogenetic abnormalities of the early embryo

- Unfavourable uterine environment due to hormonal insufficiency.
- Specific uterine infections.
- Nutrition .
- Environmental stress.
- Immunological factors.

Cytogenetic abnormalities

- Critical requirement for the embryo survival is the presence of a normal complement of chromosomes.
- Chromosomal aberrations play some unquantified role in early embryo loss.

Unfavourable uterine environment

- Uterine environment enables the spermatozoa to ascend to site of fertilization, provides adequate nutrients for different stages of embryonic development, maintenance.
- Uterine environment can be affected by, hormonal imbalance, infections like endometritis, nutrition and environmental stress.

Hormonal imbalance

- Administration of progesterone in case of luteal deficiency tends to increase the pregnancy rate.
- Administration hCG/GnRH on the sixth day after estrus during the luteal phase to induce steroidogenesis by the corpus luteum.

Non-specific uterine infections

- The presence of non-specific uterine infection or endometritis around the time of service is not an important cause of infertility in the cows.
- The bacteria may interfere with fertility by directly killing the gametes or conceptus, changing the uterine milk, causing endometritis (toxic products, luteolysis) and producing chronic histologic lesions.

Specific uterine infections

- Organisms which cause early embryonic death are Trichomonas fetus, Campylobacter fetus, IBR – IPV.

Nutritional causes

Extremes of nutrition are detrimental to the survival of embryo. .

- Particularly deficiency of selenium and Vitamin E were reported to cause early embryonic death.
- A very high plane of nutrition may also leads to early embryonic death.

Environmental stress

- Sustained elevated body temperature due to persistent fever or high environmental heat and humidity lead to early embryonic death.

Immunologic factors

- Following conception the cow comes into contact with both sperms and embryonic antigens and if the immunosuppressive mechanisms are not functioning properly, the antibodies produced may reduce the fertility

Time of AI

- Improper timing of AI results in ageing of gametes which results in either fertilization failure or early embryonic mortality.

Diagnostic Methods

1. **Record Analysis**
2. **Visual**
   - Proper estrus detection
   - Proper mating events, colour, consistency of cervico-vaginal mucus
   - Vaginoscopic examination to exclude growths, adhesions
3. **Recto-genital palpation**
   - Uterine tone at AI
   - Follicle at AI
   - Ovulation depression
   - Early CL day 5
   - Early embryonic deaths Not possible to be detected as most deaths occur before day 20
4. **Laboratory Tests**
   - Uterine pH
   - Normal pH 7.3
   - 6.9 and 8.0 suggest endometritis
   - White side test :

Procedure:

- 1 mL of estrual cervical mucus was heated with equal volume of 5 to 10% sodium hydroxide (NaOH) up to boiling point and after cooling the intensity of color changes were studied and graded as
- Normal (turbid or no color),
- Mild infection (light yellow color),
- Moderate infection (yellow color)
- Severe infection (dark yellow color).
- Cervical mucus penetrating Assay : a controlled test to see cervical mucus is preventing the sperm penetration
- Metabolic profile tests : Glucose ,Ca, P.
- PMNs>18% suggest endometritis

Tubal patency test:

Evaluation of oviductal patency by PSP dye (Phenol Sulphonpthalene test)

- PSP dye was introduced in to the uterine horns with help of Foleys catheter and Collect the urine sample after infusion of PSP dye at an intervals of 15 mins, 30 mins and 45 mins intervals
- Examine the urine sample for presence of dye in urine sample, if the urine sample not contain dye then oviduct is blocked if it contains dye oviduct is patent.

Hormone Assays

- RIA
- ELISA
- Immunosorbant assay
- Progesterone assay
- LH

Therapy

- Evaluate semen for anatomic defects
- For nutrition and management and advice appropriate measures of correction
- Reproductive hygeine and insemination procedures and adopt corrective measures

Herd

- Correct deficiencies
- Treat Bulls for minor problems Change Bulls or evaluate semen Vaccinate for infectious disease

Individual animal

- Combating Uterine Infection
- Monitoring for Ovulation/Cysts
- Therapy of luteal insufficiency
- Improving AI techniques
- Improving management

Specific corrective measures

- Genital tract infection
- Intrauterine/parentral antibiotics
- Prostaglandins : Cloprostenol Na : 250mcg
- Immunomodulators
- Oyster glycogen 500 mg in 50 mL PBS I/Ut.
- LPS 100 µg in 30 mL PBS I/Ut
- Immunomodulators enhances PMN cell migration into uterine lumen, with peak PMN concentration in 12 hrs after intra uterine administration
- These PMN cells enhances phagocytic activity in uterine lumen and helps to combat infection
- Agents to alter Uterine environment
- Antioxidants: 4mM Taurine + 50 mM fructose in PBS before AI
- Vitamin C Inj Ascovet 20 mL before AI
- Enzymes: Trypsin, Chymotrypsin, papain I/Ut.
- Uterine motility stimulants
- Mifepristone, clitoral massage

Hormonal therapy

Correction of Ovarian dysfunction

- Delayed ovulation : hCG Injection Chorulon 1500-3000 IU at AI
- GnRH 100 mcg IM at AI

Nutritional Management

- Management of dry cows important
- Advice not to feed more than 10% of rumen degradable proteins, produces ammonia and urea
- (ammonia – ovulation ,urea – fertilisation).
- Dry cows should be fed low energy high fibre diet with more of chopped straw
- Feeding of anionic salts with Ca and P
- Injections of vitamin A, E and C important

Timing of AI/ Semen deposition

- Multiple AI in long estrus period
- Training of AI Personnel
- Deep Intrauterine AI

Avoiding periparturient disorders, metabolic diseases: Ketosis/milk fever

Parturient problems:

- Immuno-infertility
- Give vitamin C, E and Dexamethasone
- Change the bull or semen

Other therapies

AI or embryo transfer

- Repeated inseminations
- Mineral vitamin supplements
- Cooling of heat stressed cows/ buffaloes
- Adequate hygeine at parturition & at AI
- Regular and frequent check of semen
- Addition of sperm motility enhancers when liquid semen is used eg. Caffeine
- Prevention of natural mating with scrub bulls

Embryonic losses are reported to be 20%– 30% in ewes, goats and sows

- The major reason for embryonic mortality is likely to be inadequate luteal function
- Consumption of toxic plants
- The injection of GnRH between days 10 and 13 after mating
- Progesterone Day 4 after mating

Management of repeat breeder cow :

- Specific treatments for conditions like endometritis, delayed ovulation may be carried out whenever suspected them as the cause.
- If specific cause was not identified the following guidelines may be followed.
- Bring the animal into positive nutritive balance.
- Use good quality semen having more than 50 percent progressive forward motility.
- Inseminate the cow at right time of the estrum.
- Do AI twice at 12 to 24 hour interval.
- Follow proper AI technique.
- After AI, Clitoral massage or 100 micro grams of GnRH or 1500 IU of luteinizing hormone may be administered to stimulate ovulation.
- Skip the AI; administer 1 million units of penicillin in saline twice at 12 hours interval during estrum.
- Flushing the uterus with normal saline with moderate pressure to remove cellular debris/ mild blocks in oviducts.
- Sexual rest for two consecutive cycles and breeding
- Identify and treat cows with abnormal genital discharge before starting to artificially inseminate them

- Don't start breeding too soon after calving.
- Herds that start breeding early have lower pregnancy rates to service and so more repeat breeder cows
- Minimize stress during artificial insemination.
- Do not inseminate cows previously diagnosed as pregnant. If the cow is pregnant AI may cause embryonic/fetal loss.

General considerations of treatment

Evaluation of oviductal patency:

- Phenol-sulphonphthalein (PSP) test A PSP solution was prepared as follows 0.3 g phenol red and 4.2 g $NaHCO_3$ were dissolved in 100 mL dist.H_2O with the aid of a magnetic stirrer.
- The pH was adjusted to 6.8-7.4 and the solution was filtered through a sterile 0.54 µm-filter
- A fresh solution was prepared for each experimental day. Cows were restrained with the tail tied on one side, and the vulva and perineum areas were thoroughly cleaned.
- By rectal palpation, the cervix was grasped and a sterile Foley catheter passed through the cervix and uterine body into one of the horns, up to 4-5 cm cranial to the uterine bifurcation
- Then, the balloon was filled with air to keep the catheter fixed inside the uterine horn and prevent backflow of the solution.
- The PSP solution (80 mL) was instilled with a syringe attached to the catheter and when instillation was complete, the lumen of the catheter was clamped and the syringe removed.
- Up to 3 urine samples were collected by bladder catheterization. The first sample was drained 15 min post PSP infusion;
- If the dye appeared in urine, the oviduct was considered to be patent
- If the dye did not appear in urine, a second sample was collected at 25 min post PSP infusion.
- If still there was not dye in urine, a third sample was collected at 45 min post-PSP infusion. If the third sample did not contain any dye, the oviduct was considered to be blocked.
- When urine collection had finished, the catheter was unclamped and withdrawn. Cows were tested in 2 different days, at least 24 h apart. Patency of the right oviduct was evaluated on the first day and that of the left one on the second day. Cows were always tested during the luteal phase of the estrous cycle.
- Positive urine samples will dye a very dim red, almost imperceptible, indicating that the oviduct was not completely blocked but it could have stenosis.
- Tubal patency was always evaluated during the luteal phase of the estrous cycle.
- This was because during the follicular phase the muscular tone of the oviduct increases, and the mucosa becomes highly edematous due to the vascular congestion elicited by high estradiol concentrations.
- This in turn causes mucosal ridges and folds to become prominent, reducing the patency of the oviduct, particularly in the region of the isthmus
- In addition, the secretory activity of non-ciliated cells reaches a maximum close to the time of ovulation, which results in fluid accumulation occurring during the follicular phase
- Therefore, oviduct evaluation during estrous could lead to false diagnoses of tubal occlusion.

SEX SORTED SEMEN TECHNOLOGY

Sexed Semen: Sexed semen contains an enriched proportion of either X or Y chromosome-bearing sperm cells. The bovine X chromosome is larger than the Y-chromosome, resulting in X chromosome-bearing sperm cells containing approximately 3.8% more total DNA content. By staining sperm cells with a dye that incorporates proportionally with DNA content, sperm cells can be differentiated as X or Y chromosome-bearing. This difference in DNA content is the basis for generating sexed semen using one of two commercial processes.

Materials required

Albumin, Percoll media, Free Flow Electrophoresis, H - Y Antibodies, Centrifuge tubes, Centrifuge, Immunological antibodies, Proteomics, Flow Cytometry.

Methods of Sperm Sexing:

1. Albumin Gradient/Gradient Swim Down Procedure
2. Percoll Density Gradient Method
3. Swim Up Procedure
4. Free Flow Electrophoresis
5. Identification of H - Y Antigen
6. Sperm Sorting Based on the Volumetric Differences
7. Centrifugal Counter Current Distribution
8. Immunological Approaches
9. Proteomics Approaches
10. Flow Cytometry

1. **Albumin Gradient/Gradient Swim Down Procedure:** This method is based on the differences between the X and Y bearing spermatozoa in the ability to swim down in a gradient solution. Since Y bearing spermatozoa are smaller in size and have high motility, they exhibit a greater downward swimming velocity than X chromosome bearing spermatozoa. Thus, the fractions of semen isolated from specific part of albumin gradient are expected to be either X/Y enriched fractions. Success rate in this method has been reported to be around 75%. The method could successfully separate only spermatozoa of human and not of other mammals . Thus, it was not adopted as a classical method of sexing sperm.

2. **Percoll Density Gradient Method:** This method utilizes the differences in the sedimentation density between X and Y bearing spermatozoa. Due to high sedimentation density of X bearing spermatozoa, it settles in the bottom of column while Y bearing spermatozoa remain at the top of column. Success rate in this method ranged from 86% to 94% The result of Iizuka and co-workers in 1994 was backfired by other findings where the ratio of X- and Y- sperms were almost equal in 80 % fraction of percoll gradient . Due to these types of variation in results the method was found to be ineffective in sperm sexing.

3. **Swim Up procedure** Size mediated difference of spermatozoa was utilized by several researchers for sperm sorting through different methods. Y bearing spermatozoa are reported to swim faster than X bearing spermatozoa due its smaller size. Success rate in this method was reported to be 81%.

4. **Free flow Electrophoresis:** This method is based on the presence of electric charges on the surfaces of spermatozoa. Surface of X spermatozoa are charged negative, while the surface of Y spermatozoa is charged positive. Based on electric field of separation, X and Y spermatozoa were separated using the differences in the surface charges. After subjected to electrophoresis, the motility of sperm is significantly reduced which is alimiting factor in eliminating its use in present.

5. **Identification of H - Y Antigen:** Identification of surface proteins expressed in either X or Y bearing spermatozoa and using immunological methods to identify and separate X and Y bearing spermatozoa could be an option. This method of sorting can be applied in large scale sperm sorting. Using Specific antibodies against H - Y antigen (expressed in Y bearing spermatozoa) sorting of spermatozoa through affinity chromatography or magnetic bead was tried with efficacy of >90% . From various experiment it was confirmed that H-Y antigen is present in the membrane of both the X and Y spermatozoa which makes difficult to sort sperm . Owing to this finding, it can be concluded that it is not an ideal method to differentiate X and Y-sperm prior to fertilization and the method was unsuccessful since then.

6. **Sperm sorting based on the volumetric differences:** This method uses image analysis of spermatozoa using interference microscopy to demonstrate a difference in sperm head volume based on the DNA content between X and Y chromosome bearing spermatozoa. A method based on this principle has been developed for sorting live spermatozoa by using interference microscopy optics with a flow cytometer. Success rate in this method has been reported to be <80% . This method suffered from quality assurance because the purity of spermatozoa of either sex did not exceed 80 % and unfortunately the efforts made to improve it was unsuccessful .

7. **Centrifugal counter current distribution:** This is a chromatographic process that partitions cells into a stationary, lower phase and a mobile, upper phase. Using this method attempts were done to sex ram spermatozoa by centrifugal counter current distribution using an aqueous two - phase system. Centrifugation was used to speed the partitioning process, so a set of 59 partitions was done in about 1 hour. Success rate in this method has been reported to be 75% .

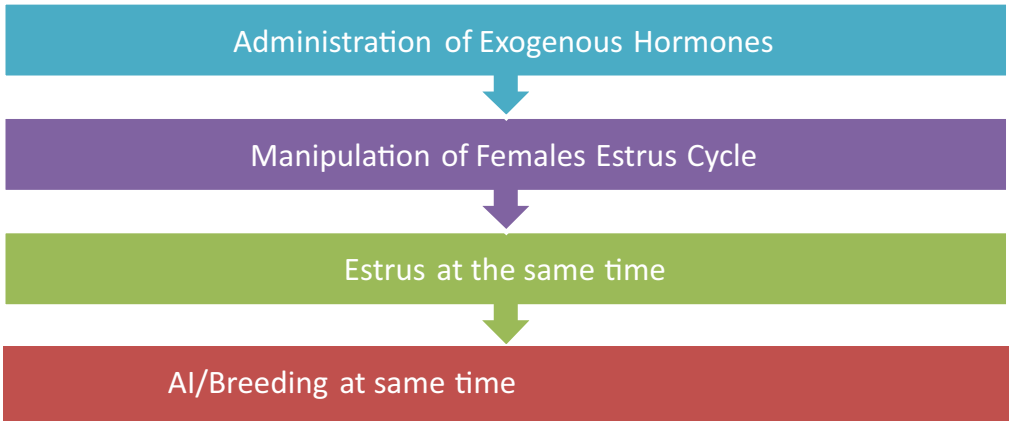
8. **Immunological approaches:** Besides the use of anti-H-Y antibody various other immunological approaches have been tested to separate X- and Y-spermatozoa but the markers so identified are still to be validated. The proposed theory of immunological approaches for sperm sexing is based on the identification of different protein markers present on the surface of X- and Y-sperm. Identification of such a marker(s) could be used to develop antibodies against X- and/or Y-specific surface protein markers that might be subsequently use in bulk separation of two populations of sperms by employing other techniques like chromatography, fluorescence-activated cell sorting (FACS), etc. Blecher et al. successfully purified sex specific proteins (SSP) in X- and Y- sperm and finally developed antibodies against these proteins which bonded specifically to corresponding cell membrane of X- and Y-sperm. In another experiment sexspecific antibodies were raised against bovine sexsorted sperm and SSP were confirmed. Further research is pre-requisite to use these proteins for semen sorting.

9. **Proteomics approaches**: With the advancement in omics, proteomics is getting attention in mining many precious protein markers in all dimensions and especially in cancer biology without the exception of sperm biology. By proteomics approach, identified 17 differentially expressed proteins in sperm cells out of which 15 were upregulated in X-sperm whereas other two in Y-sperm. A few of the differentially expressed proteins are outer dense fiber protein, tubulin, seminal plasma protein PDC 109, sperm acrosome membrane associated protein 1, glyceraldehyde 3 phosphate dehydrogenase test is specific etc. Using proteomics another group of investigators have reported 42 differentially expressed proteins between X and Y sperm population. Although in future these identified proteins may be promising biomarkers to separate X and Y spermatozoa but further validation is still necessary.

10. **Flow cytometry:** Flow cytometers are the advanced cell sorters that use LASER to excite fluorescent dye that binds to the DNA in spermatozoa. The DNA percent and DNA specific dye are the major principle for sperm sexing through flow cytometry. In this method of sorting, the spermatozoa are treated with dye (e.g. Hoechst 33342), which is permeable to live and intact sperm membranes and binds to the DNA. Stained spermatozoa are transported to a point where they are exposed detected and analyzed. Due to more DNA content in X chromosome bearing spermatozoa, it takes more stain than Y sperm. On the basis of this fluorescence, spermatozoa are classified as X or Y chromosome bearing and sorted. Another dye, commonly called “red quencher food colouring dye”, selectively penetrates into the damaged, dead and non - intact sperm membranes giving a red colour. Identification of live and dead sperm should be done before sorting process. Based on the excitation, spermatozoa are separated into discrete populations. In domestic animals the differences in DNA content between X and Y bearing spermatozoa ranges from 3 - 4.5%. Success rate in this method has been reported to be 85 - 95%. One of the major drawbacks of this method is the sperm damage cause by applied electric charge, UV laser, dye and sorting speed and pressure. Furthermore, the involvement of high economic cost, complexity of operation and lower pregnancy rates than the traditional semen are other demerits of this method. Individually to a UV laser beam (wavelength of 351 - 364 nm) and the bright blue fluorescence emitted is detected and analyzed. Due to more DNA content in X chromosome bearing spermatozoa, it takes more stain than Y sperm. On the basis of this fluorescence, spermatozoa are classified as X or Y chromosome bearing and sorted. Another dye, commonly called “red quencher food colouring dye”, selectively penetrates into the damaged, dead and non - intact sperm membranes giving a red colour. Identification of live and dead sperm should be done before sorting process. Based on the excitation, spermatozoa are separated into discrete populations. In domestic animals the differences in DNA content between X and Y bearing spermatozoa ranges from 3 - 4.5%. Success rate in this method has been reported to be 85 - 95% . One of the major drawbacks of this method is the sperm damage cause by applied electric charge, UV laser, dye and sorting speed and pressure. Furthermore, the involvement of high economic cost, complexity of operation and lower pregnancy rates than the traditional semen are other demerits of this method.

ESTRUS SYNCHRONIZATION IN FARM ANIMALS

Estrus Synchronization implies that it is an advanced management technique, which makes use of hormones to control or reschedule the estrous cycle and by which induction of estrus done to bring a large percentage of a group of females into estrus at a short, predetermined time.



Why Synchronize

a) To timely breeding in farm animals is possible with this technique.
b) To scheduling the parturition time at the most favorable season
c) To rear newborns in suitable environment with ample food for enhancing their survivability.
d) To improve the production efficiency in animals.
e) To treat Infertility

Benefits:

1) Saving Labour-Avoiding Estrus Detection -
2) Planned Mating-Timed Insemination
3) Planned Calving
4) Shortening the calving interval
5) Producing a more uniform calf crop with similar age

Structures that Regulate the Estrus

1. Dominant Follicle
2. Corpus Luteum

Criteria for Successful Synchronization

Animal requirement

- Disease free
- Heifer maturity
- Adequate nutrition
- Adequate postpartum interval
- Normal non pregnant reproductive tract
- For PGF2 alpha -animal must be cycling

Management requirement

Proper timing
Good semen quality
Good AI technique
Grouping of Animals:
- Heifers
- Post partum Cows
- Anoestrus
- Non-Pregnant Cows

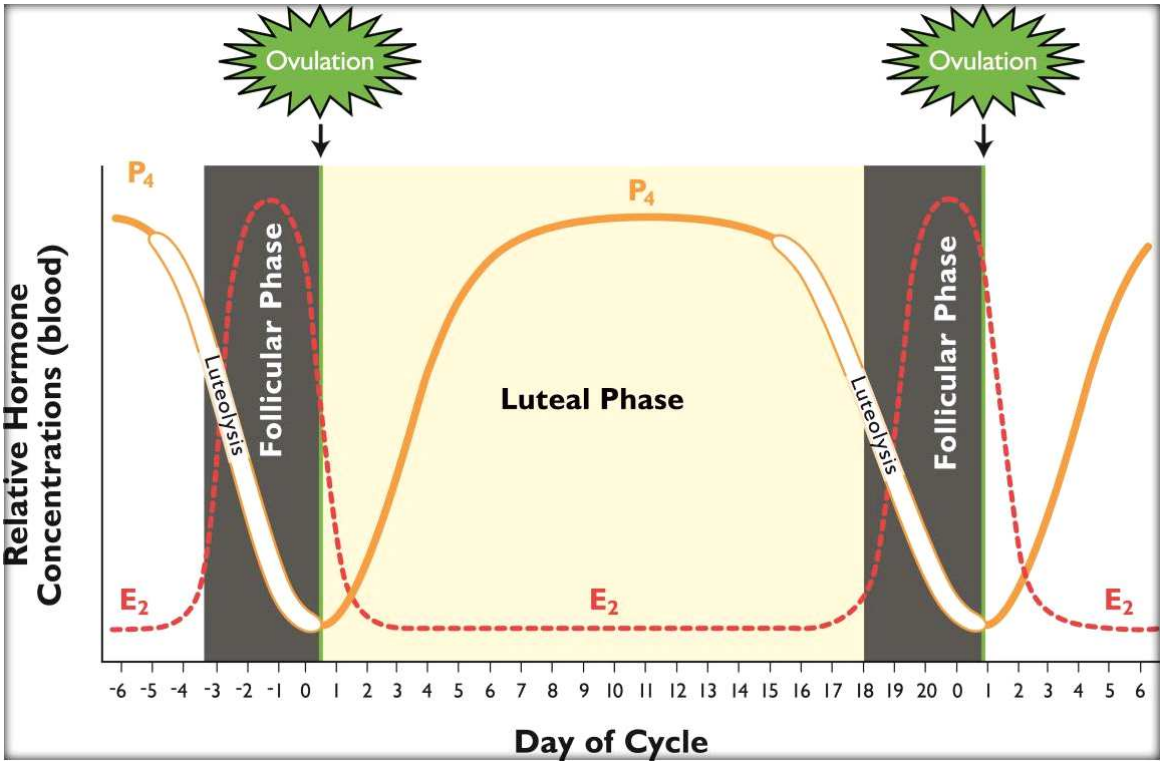
Hormones associated with Estrus Synchronization

S.No	Hormone	Recommend to utilize	Function	Protocol
1	Prostaglandins	Cyclic Females	Naturally occurring hormone that causes regression of the CL and decreases the progesteronesecretion which results in a return to estrus	PGF one shot method PGF two shot method
2	Progesterone	Pre-pubertal heifers Post-partum or Anoestrus Females	Naturally occurring hormone that functions to maintain pregnancy. This hormone also "blocks" estrus and ovulation during the diestrus phase f the estrous cycle.	MGA+ Prostaglandins CIDR
3	GnRH.	Mature Females	Naturally occurring hormone that stimulates the release FSH andLH that stimulates the Follicular development	Ovsynch Cosynch Heat synch Select synch Hybrid synch

Methods of Synchronization

There are two basic methods of synchronization of the estrous cycles in farm species:

1. Extending the Luteal phase
2. Shortening the Luteal phase



1. Extending the Luteal phase:

- This method involves long-term administration of a progestogen, on progestogen withdrawal, CL regresses and animals comes to estrus
- With this approach, the exogenous progestogen continues to exert a negative feedback on LH secretion after regression of the CL.
- On progestogen withdrawal, follicular growth, estrus, and ovulation occur within 2 to 8 days.
- The interval from withdrawal of progestogen to the onset of estrus varies among species and among methods of progestogen treatment within species.
- Generally, long-term progestogen treatment lasts for 14 to 21 days depending on the species.

Ex: Orally active progestogen (Altrenogest), Pessaries, ear implants and Intra Vaginal devices CIDR (Controlled Internal Drug Release) , PRID (Progesterone Releasing Intra-vaginal Device)

2. Shortening the Luteal phase:

- The second method induces the premature regression of a cyclic CL (luteolysis).
- The two primary luteolytic agents are estrogen and prostaglandin F2α (PGF2α) and/or its analogue (Cloprostenol).
- Estrogen is luteolytic in ruminants but not in horse or pig whereas PGF2α is luteolytic in all species, at least during certain phases of CL development.

- A single injection of PGF2α will regress the CL usually within 24 to 72 h and estrus and ovulation occur within 2 to 3 days.
- In all species, the CL is responsive to luteolytic agents only during certain stages of its development.
- Luteolytic agents will not cause regression of the CL during the first 4 to 6 days of the cycle in ruminants and horses, and during the first 12 or 13 days of the cycle in the pig.
- Estrus and ovulation can also be synchronized in cyclic animals through a combination of progestogen and a luteolytic agent. This approach uses a luteolytic agent to regress the CL and the progestogen to mimic the action of progesterone and prevent estrus until its withdrawal.

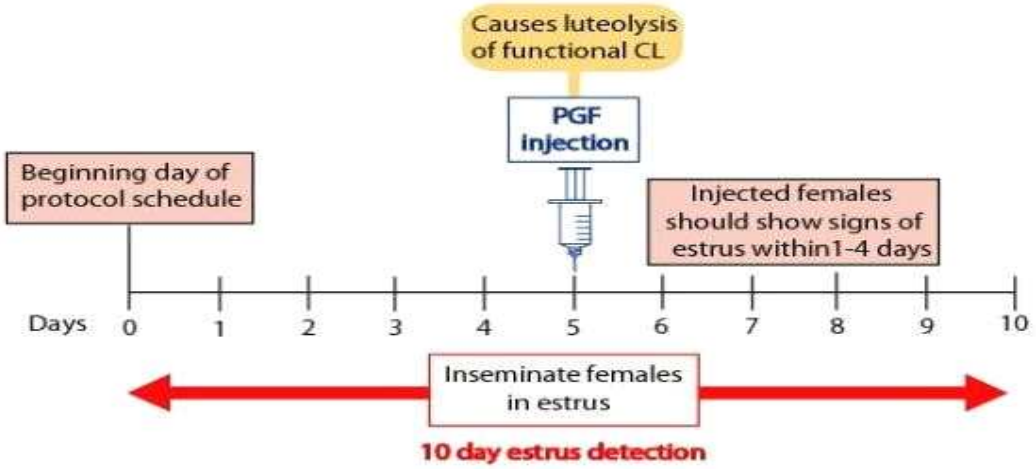
Estrus Synchronization Protocols

I. Prostaglandin based protocols
II. Progesterone based protocols
III. GnRH based protocols

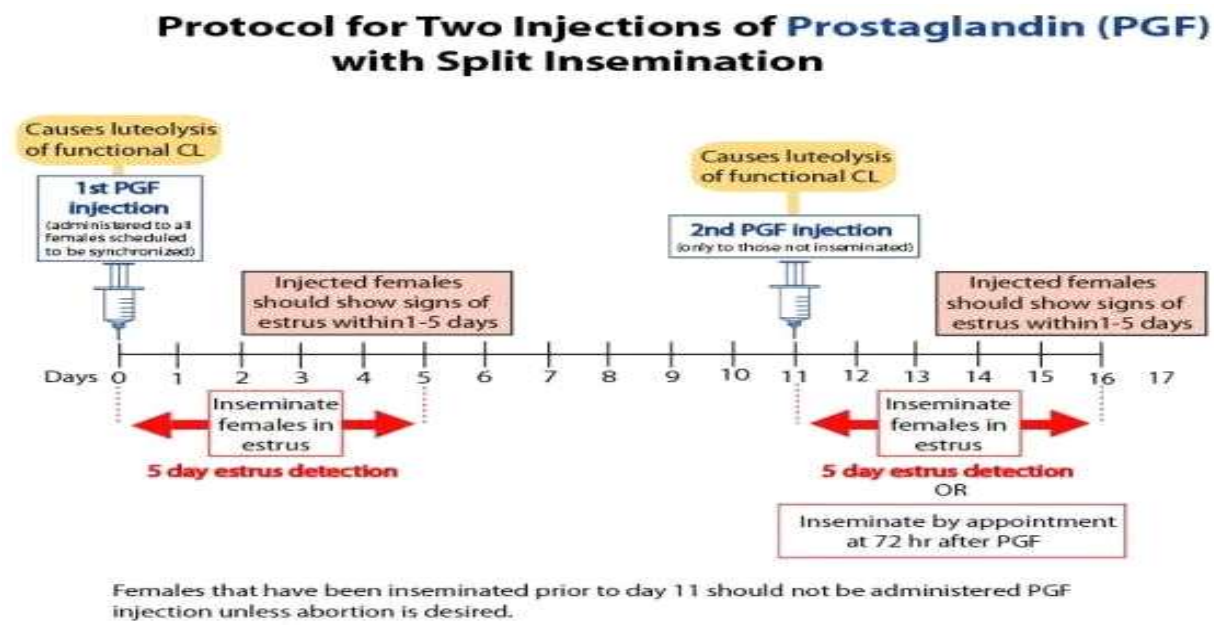
I. PROSTAGLANDIN PROTOCOLS

- **Principle of PGF2α Use**
  - ✓ Regress Active CL
  - ✓ Only effective on Day 5 of the estrus cycle
  - ▪ Not effective on days:
    - ✓ 1-4 (CL not responsive)
    - ✓ 18-21 (CL already regressed)

Protocol for One Injection of Prostaglandin (PGF)

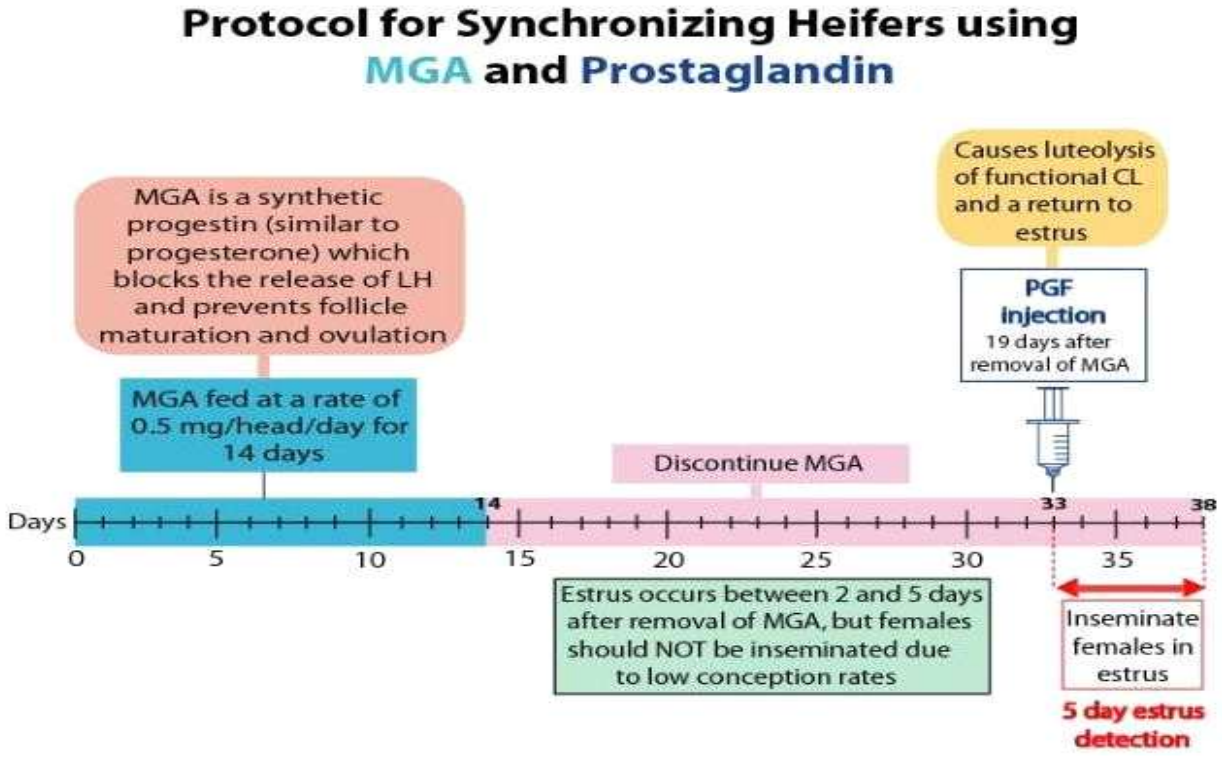


Females that have been inseminated prior to day 5 should not be administered PGF injection unless abortion is desired.



Females that have been inseminated prior to day 11 should not be administered PGF injection unless abortion is desired.

II.PROGESTERONE PROTOCOLS



1. CIDR Protocol

a. **CIDR** - Controlled Internal Drug Release Devices
b. They are T-shaped devices with a silicone-coated nylon core.
c. The silicone coating is impregnated with progesterone.

CIDR + GnRH						$PGF_{2\alpha}$	**Remove CIDR**		**AI**
"0"day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

d. Insert CIDR intra-vaginally by using a specialized applicator and inject with GnRH on day "0". The progesterone is released at a controlled rate into the blood stream after insertion. Progesterone exerts a negative feedback on the Hypothalamus, leading to the suppression of LH, FSH and prevents estrus and ovulation (CIDR act as artificial CL).

e. Day "6" inject with PGF2α.PGF2α cause Luteolysis of functional CL and a returns to estrus

f. Remove CIDR on day "7" and begin heat detection. Removal allows progesterone level decreases and LH pulse frequency to increase, resulting in estrus and ovulation of the dominant follicle.

g. Should breed 48 hrs after removal of CIDR

III. GnRH PROTOCOLS

- Basic GnRH synchronization protocols begin with the same format of an initial GnRH injection followed by a PGF injection 7 days later.
- GnRH causes ovulation of a dominant follicle and starts a new follicular wave whereas PGF cause Luteolysis of Functional CL
- Difference are derived from timing of insemination, estrus detection, parity and hormone administration
  1. Ovsynch Protocol
  2. Cosynch Protocol
  3. Heat synch Protocol
  4. Select synch Protocol
  5. Hybrid Synch Protocol

1. Ovsynch Protocol

- Traditional Method
- Ovsynch occurs in three stages
- Day "0" GnRH injection to create a new follicle, ovulate dominant Follicles and leutinize follicles
- Day "7" PGF2α injection to end the current estrus cycle and regress the CL
- Day "9" second GnRH injection to cause the new follicle to ovulate and release the egg. All cows will ovulate 24-32 hrs after the second GnRH injection
- Day "10" A.I

GnRH							PGF2α 500µg		GnRH	TimedAI
"0"day	1	2	3	4	5	6	7	8	9	10

2. Cosynch Protocol

- Modified Ovsynch Protocol
- AI or breeding done simultaneously with second injection of GnRH
- Reduces the Time spend on Heat Detection.

GnRH 10µg							PGF2α 500µg		GnRH+AI
"0"day	1	2	3	4	5	6	7	8	9

3. Heat synch Protocol

- Uses less expensive Estradiol cypionate (ECP) in place of second GnRH injection of Ovsynch
- AI after 48 hrs after ECP injection or 72 hrs of PGF2α injection

GnRH 10µg							PGF2α 500µg		ECP		TimedAI
"0"day	1	2	3	4	5	6	7	8	9	10	11

4. Select synch Protocol

- Day "0" GnRH injection
- Heat Detection 24-48 hrs before PGF2α injection. Exclude PGF2α injection, if animal in heat on day "6" or "7"
- GnRH and AI of non responders at 72 hrs after PGF2α injection

GnRH 10µg					Heat + AI	Heat + AI	PGF2α 500µg		Heat + AI	GnRH + AI
"0"day	1	2	3	4	5	6	7	8	9	10

5. Hybrid synch Protocol

- Heat Detection and AI after PGF2α injection
- GnRH and AI of non responders at 54-80 hrs after PGF2α injection

GnRH 10µg							PGF2α 500µg		Heat + AI	GnRH + AI
"0"day	1	2	3	4	5	6	7	8	9	10

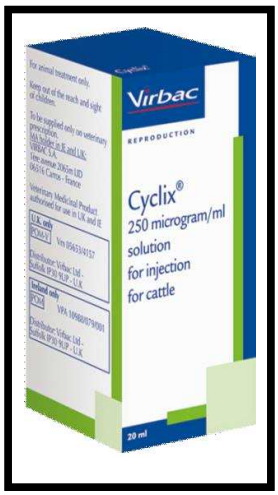
Commercially available Hormones 1. Prostaglandins ($PGF_{2\alpha}$)

- Synthetic – Cloprostenol sodium

Commercially Available Hormones

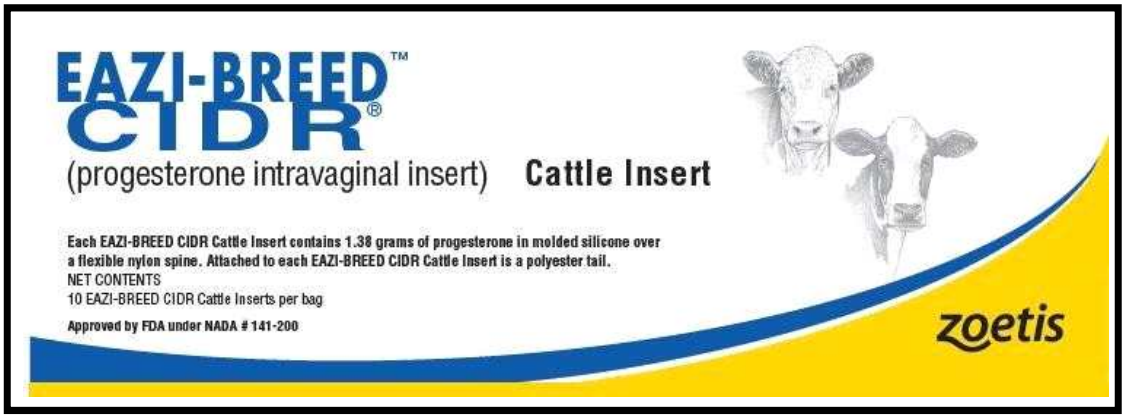
1. Prostaglandins (PGF2α)

Synthetic – Cloprostenol sodium









Natural- Dinoprost tromethamine

2. Progesterone



3. Estrogens





4. GnRH- Buserelin Acetate

Dose -10mcg or 2.5ml in Buffalo or Cow

ESTRUS SYNCHRONIZATION PROTOCOLS IN CATTLE AND BUFFALO

PGF2α and its analogs are the most effective method for estrous cycle control in dairy cattle. Long-term progestogen treatment of cattle is unsatisfactory because of reduced fertility even though estrus is well synchronized. The following treatment protocols are available for cycling cattle and buffalo.

- **Give two PGF2α injections 11 or 12 days apart**. After the second injection, animals may be bred/AI at detected estrus or inseminated at 72 and 96 h.
- **Progestogen and PGF2α:** A progestogen (CIDR, PRID) is administered as a vaginal pessary for 7 days with PGF2α injected on the sixth day. Cows are inseminated at detected estrus or about 84 h after PGF2α.
- **Progestogen and Estrogen:** An estrogen (5-mg estradiol valerate) and progestogen (3 mg Norgestomet) are injected on the first day of treatment. Then a progestogen (Norgestomet) is implanted for 9 days beginning on day

1. Cows are inseminated based on estrus (AIDE) or at a fixed time (TAI; 54 hours) after implant removal.

- **GnRH agonist:** This novel protocol controls follicular development and the life span of the CL. On Day 0, a GnRH agonist is injected and on Day 6 PGF2α is injected. This regimen synchronizes the estrous cycles of 70 to 80% of cyclic cows within a 4 day interval without affecting the fertility rate (65 to 85%). The precision of estrus and high fertility rates are due to the luteinizing or ovulating the mature follicle and initiating

recruitment and selection of a new dominant follicle. The injection of PGF2α causes regression of the spontaneous CL or a potential CL induced by GnRH, or both. An advantage of this regimen is that it can be used at any stage of the cycle and eliminates the use of progestogen. Besides, it promotes the resumption of ovarian activity in acyclic postpartum cows and heifers. For TAl without the need for estrus detection, a protocol of GnRH (DayO), PGFza (Day 7) and GnRH (Day 8) again and AI at predetermined time may be used.

ESTRUS SYNCHRONIZATION PROTOCOLS IN SHEEP AND GOAT

Progestogen and PGF2α are effective for synchronizing estrus in both species, but duration of progestogen treatment varies because of differences in the length of the normal estrous cycle between ewes (16 days) and does (21 days).

- **Progestogen pessary:** A progestogen pessary or implant is given for 12 to 14 days in sheep, and for 18 to 21 days in goats. In both species, eCG (400 to 800 IU) is given at the time of progestogen withdrawal. Ewes should be inseminated at 48 and 60 h after progestogen withdrawal and does at about 30 and 48 h.
- **PGF2α:** PGF2α can be used to synchronize ewes or does, but it is not much beneficial over the combination of progestogen and eCG. In ewes, 2 doses of prostaglandin are given 9 days apart and bred them at estrus or give double AI. In does, 2 injections of prostaglandin are injected 11 to 12 days apart. Natural mating or double AI can be used at the synchronized estrus. Since PGF2α will cause abortion, pregnancy should be eliminated before the PGF2α injection.

ESTRUS SYNCHRONIZATION PROTOCOLS IN SWINE

- **Progestogen (Altrenogest):** fed for 14 to 18 days is effective in synchronizing estrus in cyclic gilts and sows. Normally estrus begins on the fourth or fifth day after progestogen withdrawal and most animals are in estrus during 2 to 4 day period.
- **PGF2α:**is not useful for synchronizing estrus in cyclic swine because the CL do not respond to PGF2α during the first 12 or 13 days of the estrous cycle.

ESTRUS SYNCHRONIZATION PROTOCOLS IN EQUINE

Mares can be synchronized with either progestogen (Altrenogest) or PGF2α.

- **Altrenogest:** Feeding mares Altrenogest for 15 days induces estrus about 3 days after progestogen withdrawal. Satisfactory fertility can be obtained by mating on alternate days during estrus.
- **Prostaglandin:** Diestrous mares will respond to a single injection of prostaglandin by exhibiting estrus within 3 to 5 days. If a group of mares are in diestrus at the same time, their cycles can be synchronized and fertility is normal. Inject PGF2α (Day 1), hCG (Day 7 or 8), again PGF2α (Day 15) and hCG (Day 21 or 22). Estrus is synchronized within a 2 to 4 day period and fertility is normal.

Table 1: Techniques for synchronizing estrus in cyclic farm animals

Species	Method	Treatment regimen	End of treatment to estrus
Cattle and buffalo	PGF2α	Two injections (11-12 days apart)	3-5 days: AIDE/TAI
	GnRH + PGF2α	Inject GnRH (day 0) and PGF2α (day 6)	2-4 days: TAI
	GnRH + PGF2α + GnRH	Inject GnRH (day 0), PGF2α (day 7) and GnRH (day 8 or 9)	2-4 days: TAI
	Progestrogen + estrogen	Estrogen injection (day 1) and CIDR (day 1-9)	3-5 days: AIDE/TAI
	Progestrogen + PGF2α	Progestogen (day 1-7) and PGF2α (day 6)	2-3 days: AIDE/TAI
Sheep	Progestogen (pessary) + eCG	Progestogen (12-14 days) and eCG (day of pessary removal)	2 days: AIDE or double AI
	PGF2α	Two injections (9 days apart)	2-3 days: breedor AIDE
Goat	Progestogen (pessary) + eCG	Progestogen (18-21 days) and eCG (day of pessary removal)	2-3 days: breedor AIDE
	PGF2α	Two injections (11-12 days apart)	2-3 days: breed at estrus or double AI
Swine	Progestogen infeed	Altrenogest (14-18 days)	4-7 days: breedat estrus
Equine	Progestogen infeed	Altrenogest (15 days)	4-7 days: breed at estrus
	PGF2α	One dose to mares in diestrus	3-5 days: breed at estrus
	PGF2α + hCG	PGF2α (day 1), hCG (day7-8), PGF2α (day 15) and hCG (day 21-22)	2-4 days: breedat estrus

MULTIPLE OVULATION AND EMBRYO TRANSFER (MOET)

Objectives: To increase the population of animals with superior genetic constitution through maximum utilization of superior females and to facilitate the shortening of the generation interval.

Materials required: Flushing medium, Y-catheter, petri plates, syringes, stereo zoom microscope, Cassou inseminating gun, Straw, sterile sheath, scissors, chute crate, hair clippers, BP blade with handle, blunt needle, capillary pipette.

Steps to be followed in embryo transfer technique are selection of the donor and recipients, management and treatment of donor for production of optimum number of viable ova,

synchronization of donor and recipients, breeding of the donor with quality semen, embryo collection from the donor, evaluation/ grading of recovered embryos and transfer embryos to suitable recipients.

1. Selection of the donor and recipient: The potential donor should be reproductively sound to produce maximum results. The donor should have regular estrous cycles commencing at an appropriate age with a history of not more than two services per conception and the previous calves should have been born at approximately 365 day intervals. Both donor and recipient should be free from parturition difficulties or reproductive irregularities. Free from conformational or detectable genetic defects. They should be maintained under normal nutritional standard appropriate for their size and level of milk production. Both obese and the thin animals will have reduced fertility, so it is important that the donor be in an appropriate body condition score at the time of embryo transfer. The recipient may not be reproductively sound but must be free from diseases with regular in estrous cycles.

2. Superovulation: Super ovulation can be defined as increased ovulatory response by external hormonal therapy, above a level that would be expected to occur naturally. Gonadotrophins of pituitary origin (FSH) of equine, porcine and caprine or from the serum of pregnant mares (PMSG) are used as super ovulating agents. Best results are obtained if gonadotrophins are injected between days 9 and 12 of the natural estrous cycle.

a. Superovulation using PMSG: As the biological half-life of PMSG is very long it can be administered as a single injection at the start of superovulation programme. The PMSG treatment can be initiated on any day between day 9 and 12 of the estrous cycle after confirming a palpable active CL. A luteolytic dose of prostaglandin is administered at 48 hours in cattle and at 72 hours in buffaloes after the PMSG injection to induce estrus after 36-72 hrs. The dose of PMSG for superovulation varies from 2000 to 3000 IU depending up on the weight of the donor and its past response to superovulation treatment.

b. Superovulation using FSH: Once the normal estrus pattern is established the FSH injections are started on any day between days 9 and 12 of the estrous cycle after confirming the presence of a functional CL. As FSH has a short biological half-life of about 2 to 5 hrs, repeated doses are required at 12 hourly intervals to maintain the required blood level. The total dose of FSH administered varies from 27 to 50 mg NIH in 8 to 10 split doses of equal or tapering quantity, depending upon the weight of the donor and its previous response. Usually in case of cattle the total dose is divided into 8 sub doses and administered over a period of 4 days, where as in case of buffaloes, the total dose is divided in to 10 sub doses and administered over a period of 5 days. A luteolytic dose of prostaglandin is administered after 48 hours in cattle and 72 hours in buffalos after initiation of super ovulatory treatment for induction of estrus after 36 to 48 hrs. The recipients are treated with prostaglandins 12-24 hrs before the donor for the purpose of synchronization between donor and recipient.

3. Insemination/Breeding of the donor: Donors can be bred 2-3 times at 12 hours interval from the onset of estrus by natural service or artificial insemination.

4. Preparation of recipient females: To maximize the embryo survival in recipient females following transfer, the conditions in the recipient reproductive tract should closely resemble those of the donor. This requires synchronization of the estrous cycles between the donor and the recipients, optimally within one day of each others. Synchronization of the recipients can be done in a similar manner and at the same working time as the donor cows preferably 12 hours before the prostaglandin injection of the donor.

5. Synchronization of estrus in recipients: Two alternative approaches are used for manipulation of estrous cycle. The first is by artificially extending the luteal phase by using progestational compounds (Synchromate B ear implant, PRID, CIDR etc.) and second by inducing the lysis of the CL using prostaglandins (Prosolvin, Lutalyse, Dinofertin etc.). It is also possible to combine progestogen and prostaglandin treatment.

6. Non-Surgical collection and transfer of embryos: Successful recovery of embryos from the uterus of super ovulated donor cow is an important step in embryo transfer technology. Buffalo embryos must be collected between day 5 and 6 post estrus and in cattle between 7-8 days post estrus.

7. Collection of embryos from donors: The donor animal should be given epidural anesthesia with 5-6 ml 2% Xylocaine. After making sure that the epidural anesthesia has taken its effect, the animal is gently placed on to a ramp so as to elevate her front feet. After through washing and cleaning of the vulval region, the catheter with a stillet is passed into either of the horns up to the anterior one third part. The catheter is held in position by inflating the balloon. The stylet is removed and inlet and out let tubes through a Y junction are connected to the catheter. Hand operated valves, control the flow of medium in the tubes. The other end of the inlet tube is connected to a bottle containing the flushing medium and hung at a height of 1-1.5 meters. Each time 15-20 ml of the medium is allowed to pass into the horn. By closing the inlet valve and opening the outlet valve, the same medium is collected in a filter which traps the embryos and allows the medium to run out. Each horn is flushed with 400 ml of medium by repeating the above procedure for 10-15 times. A column of 1 cm medium should be held in the filter to avoid exposing the embryos to air and getting dried. Once flushing of both horns is completed, one dose of antibiotic is infused intrauterine as a precaution against spread of any infection and 25 mg of PGF2α is administered by intramuscular route. This helps in luteal regression and also prevents unwanted pregnancies.

8. Transfer of embryos into recipient cows: The embryo is transferred in to the horn ipsilateral to the ovary containing the CL between days 5 and 6 post estrus and between 7- and 8-days post estrus in buffaloes and cattle, respectively. After ascertaining the ovary with CL, epidural anesthesia is induced to prevent straining and defecation during transfer. The perineal region is thoroughly washed and the vulva is blotted dry. The embryo is loaded into a 0.25 ml French mini straw between two air pockets and two columns of holding medium. The straw is kept in ET gun and a sheath with self-locker is fitted over the gun and fixed to it. One plastic sanitary sheath is applied over it to avoid any vaginal contamination the ET gun is forwarded up to the cervix. Near the external os, the sanitary sheath is pulled to allow the ET gun to pass into the cervix. The embryo is deposited in the anterior one third of the ipsilateral horn corresponding to the ovary containing the CL.

In Vitro Fertilization

The term *In vitro* means in glass or in artificial conditions and IVF refers to the fact that fertilization of egg by sperm had occurred not in uterus but outside the uterus at artificially maintained optimum condition. In recent years the IVF technology has revolutionized the field of animal biotechnology because of production of more and more animals as compared to animal production through normal course. Fertilization is a complex process resulting in the union of the spermatozoon and the oocyte; it signals the start of the transition from oocytes to embryo.

The IVF technology is very useful and it involves the procedure of: (i) Collection of oocytes from ovaries of the female donor and semen collection (ii) *In vitro* maturation

(IVM) of egg cultures kept in an incubator, (iii) Fertilization of the eggs in test tubes by semen obtained from superior male, and (iv) Implantation of seven days old embryos into the reproductive tract of recipient female which acts as a foster mother or surrogate mother. These are used only to serve as animal incubator and to deliver offsprings after the completion of normal gestation period. The surrogate mothers do not contribute anything in terms of genetic makeup since the same comes from the egg of donor mother and semen from artificial insemination.

Collection of oocytes: Oocytes can be collected from ovaries obtained from slaughter house genitalia or live animals by adopting the following methods:

I. Abattoir specimens:

1. **Slicing Method:** Ovaries are held firmly with an artery forceps in a 60 mm petri dish containing 8 ml of oocyte collection medium (TCM 199 supplemented with 10 % Fetal Bovine Serum and Dulbecco's Phosphate Buffered saline supplemented with 0.3 % Bovine Serum Albumin (BSA) at 1:1 ratio). Cross hatched incisions are made on the surface of each ovary with a Bard Parker blade (No.11) to release the Cumulus Oocyte Complexus (COC's). Ovaries are rinsed well during and after slicing with oocyte collection medium. At a time 4-5 ovaries are sliced in a petri dish and screened for oocytes.
2. **Follicle isolation:** Follicles are removed after dissecting ovarian tissue with scalpel, scissors, needles and screened for oocytes.
3. **Aspiration Method:** A sterile 18-21 G hypodermic needle attached to a 10 ml disposable syringe containing 0.5 to 1.0 ml of oocyte collection medium is passed into the follicle through the adjacent area of ovarian stroma to reach the follicle from base. The contents are aspirated slowly, pooled in a 60 mm petri dish and screened for oocytes.
4. **Puncture Method:** Ovaries were held firmly with dissecting forceps in a petri dish containing 10 ml oocyte collection medium. The visible follicles on the ovarian surface are punctured as such with 21G hypodermic needle. The contents are expelled into 60 mm petri dish and screened for oocytes.

II. Live animals:

1. **Ovum pick up or Transvaginal follicular aspiration:** This is a non- invasive ultrasound guided procedure which, allows collection from hormonally stimulated or non-stimulated donors. This technique is highly repeatable and donors can be aspirated every two weeks, while *Bos indicus* breeds yield a high number of viable oocytes.
2. **Laparoscopic method:** This is a invasive technique.

Grading of oocytes:

1. GRADE-A: Oocytes have compact multi layered cumulus cells with homogeneously organized translucent ooplasm.
2. GRADE-B: Oocytes have compact cumulus cells with homogeneously organized dark ooplasm.
3. GRADE-C: Oocytes have less compact cumulus cells with irregular and containing dark clusters ooplasm.

4. **GRADE-D:** Oocytes without cumulus cells and jelly like matrix.
5. **Semen collection and evaluation:** Semen was collected from young fertile rams using artificial vagina and was evaluated for sperm concentration and progressive motility immediately.

Preparation of motile sperm: The swim up method was used to separate the motile fraction of sperm. A 0.3 to 0.5ml semen was diluted with 4.5ml of Synthetic oviductal fluid (SOF) and centrifuged at 200g for 5 min. then supernatant was removed and the sperm pellet was resuspended with SOF and recentrifuged. Lymphocyte tubes containing 1 ml of swim up medium were layered with 0.2 ml of sperm pellet at bottom. The top most 0.5 to 0.8 ml of medium containing the motile fraction of sperm was removed from each tube and pooled in a sterile centrifuge tube after 1 hour incubation at 39°C at 5% CO_2 under humidified air. This sample was washed by centrifugation at 200g for 5 min. After washing, sperm concentration was assessed by using Neubeur counting chamber and diluted to a final sperm concentration of 2 x 10^6 sperm/ml.

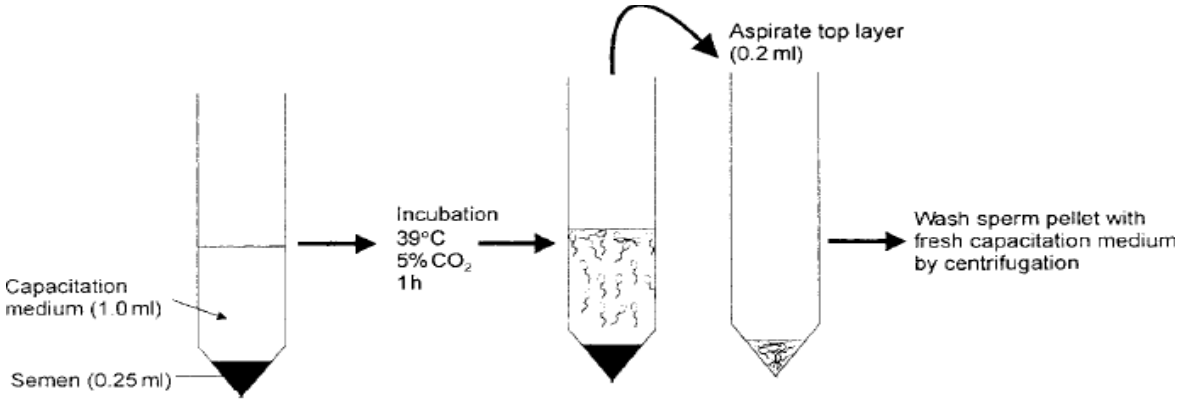


Fig-1: Swim-up technique to obtain hyper motile sperm for IVF

In Vitro Maturation (IVM) of oocytes: Unlike sperm, the oocyte requires no exposure to the reproductive tract following release from the gonad to be fertile. The immature oocytes are incubated *in vitro* so that they can be mature. However, immature oocytes should be taken out from follicles because they cannot mature in it but degenerate. Therefore, full potential of superovulation and all the oocytes can be utilized by IVF technology. Moreover, metabolic and hormonal requirement for oocytes during IVM should be find out so that the present rate of maturation (20%) could be improved. In majority of cases ovarian follicles never reach maturity and degenerate due to unknown causes. Possibly there may be genetic defects associated with them. In most laboratories, oocytes are matured in TCM199 medium (Tissue Cultured medium) with 10% fetal calf serum and gonadotrophins (FSH, LH). Oocytes are transferred into a dish containing this maturation medium. After rupturing follicles to release the cumulus oocyte complexes (COC), four to five or a group of COC are placed in micro droplets of the same medium under paraffin oil in petri dishes and incubated at 39°C in 5% CO_2 and 95% air with high humidity for 24 hours.

In vitro **Fertilization (IVF):** After maturation, oocytes were denuded off cumulus cells by repeated pipetting in SOF medium and were washed thrice with IVF medium. Subsequently, those oocytes with extruded first polar body were selected for IVF and placed in 75µl droplets (10 oocytes/ droplet) of IVF medium in tissue culture dishes. The droplets were overlaid with pre equilibrated light weight mineral oil. 25µl aliquot of sperm suspension was transferred into each 75µl fertilization droplet and incubated for 24 hours at 39°C in 5% CO_2 under humidified atmosphere in air.

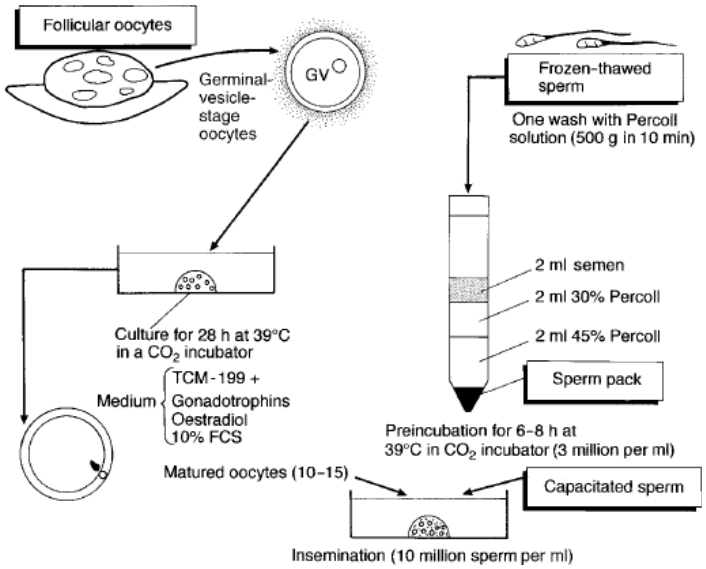


Fig-2: In vitro fertilization system for cattle

Fertilization rate can be assessed by microscopic examination for cleavage but for more accurate analysis, some oocytes 18 to 22 hours after insemination should be fixed, stained, and examined under phase contrast microscopy. High fertilization rates in IVF depend upon optimal number of fertilizable sperm with vigorous motility, and a fertilizable ovum with a first polar body. During coincubation of an IVM oocyte with capacitated sperm, one sperm penetrates the oocyte, triggering a series of events leading to fertilization. The following criteria used as evidence for fertilization.

a) Penetration of sperm into ooplasm,

b) Swelling of sperm head, pronuclear formation,

c) Morphologically normal cleavage, blastocyst formation,

d) Breakdown of cortical granules, and

e) Evidence of a sperm tail in the ooplasm.

None of these alone is sufficient proof of normal fertilization: for example, parthenogenetic embryos also exhibit some of these traits.

***In Vitro* Culture:** Following fertilization (Day 0), oocytes were washed with modified SOF (SOF supplemented with glutamine, essential amino acids and MEM - non essential amino acids) and cultured in mSOF for another 6 days at 39ºC in 5% CO_2 under humidified atmosphere in air. During thecourse of culture, the embryos were transferred to fresh mSOF medium every 48 hours. Finally, seven days old embryos are transferred into reproductive tract of other synchronized recipient female which acts as foster mother for further development.

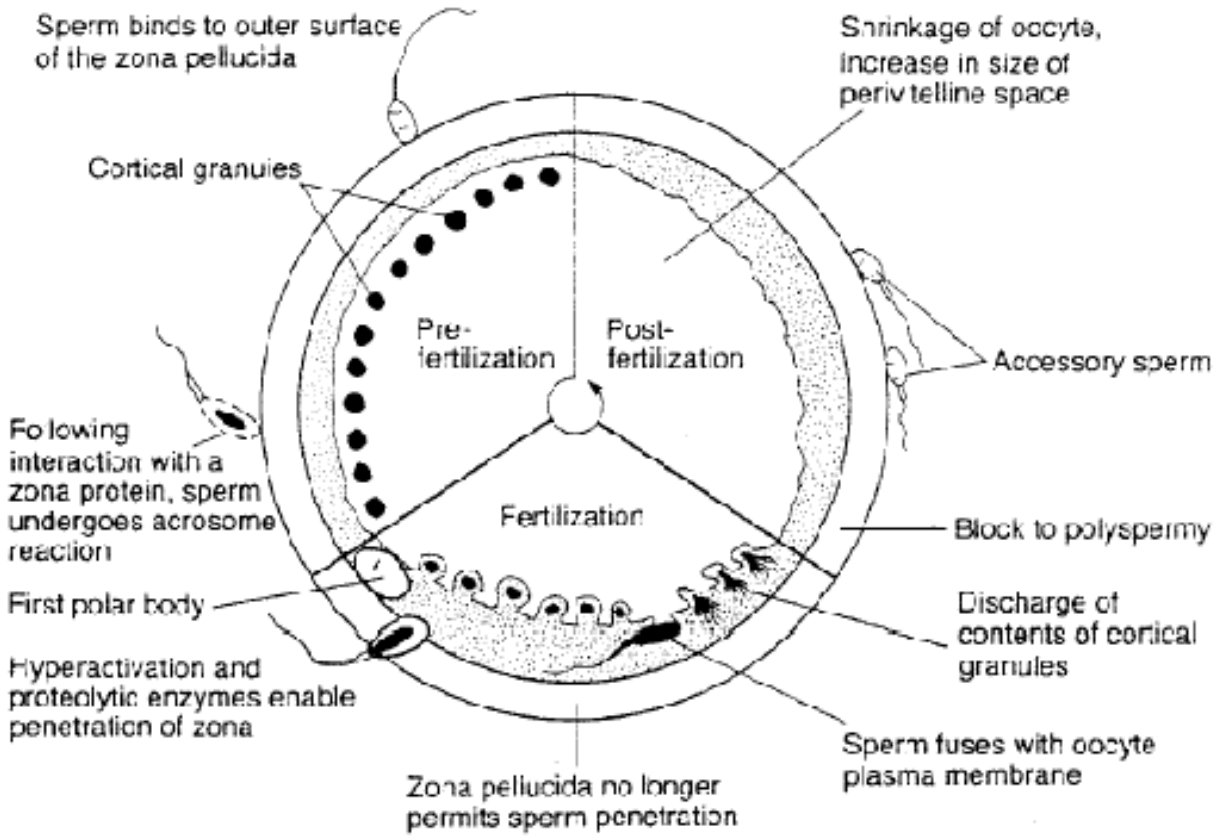


Fig-3: Gamete interactions at fertilization in the cow.

Transfer of embryos into recipient cows: The embryo is transferred in to the horn ipsilateral to the ovary containing the CL. After ascertaining the ovary with CL, epidural anesthesia is induced to prevent straining and defecation during transfer. The perineal region is thoroughly washed and the vulva is blotted dry. The embryo is loaded into a 0.25 ml French mini straw between two air pockets and two columns of holding medium. The straw is kept in ET gun and a sheath with self-locker is fitted over the gun and fixed to it. One plastic sanitary sheath is applied over it to avoid any vaginal contamination the ET gun is forwarded up to the cervix. Near the external os, the sanitary sheath is pulled to allow the ET gun to pass into the cervix. The embryo is deposited in the anterior one third of the ipsilateral horn corresponding to the ovary containing the CL.



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PATHOLOGY

POST MORTEM LESIONS IN POULTRY, CATTLE, BUFFALO, SHEEP, GOAT AND SWINE

NECROPSY PROCEDURES

External examination procedure is common to all species which include abnormalities of natural orifices, skeletal abnormalities, body conditions, external wounds etc.,

1. Place the animal on the left side so that the rumen is away from the prosecutor.
2. Make incision on the midline from between jaws to the perineal region avoiding mammary gland and external genitalia of male.
3. Lift the right leg away from the body.
4. Make incision down on the medial side of each leg connecting the midline.
5. Reflect the skin and cut the muscle to separate the legs. Disarticulate the hip joint to separate hind legs.
6. Open the abdominal cavity by incising the abdominal muscles, the incision extends from the sternum to pelvis.
7. To open the thoracic cavity cut through ribs at the joints junction with sternum, costo-chondral and vertebra. Cut the diaphragm.
8. Examine both cavities for exudate or transudate, adhesions, displacement of organs.
9. Pelvic cavity is opened by cutting the pubis to examine the organs.
10. Remove the omentum.
11. By lifting the left leg tip the carcass. Examine anterior surfaces of reticulum.
12. Remove the spleen and examine (Anthrax, Anaplasmosis, traumatic peritonitis, copper poisoning, tumor).
13. Remove the mammary gland with skin intact. Examine for symmetry, swelling, atrophy; palpate each quarter separately; Examine the mammary lymph nodes. Cut each quarter from teat canal to cistern.
14. Open and examine the nasal cavity for ulcers, granulomas. parasites or tumors.
15. Examine the pericardium by palpation for thickening and fluid accumulation.
16. Open the pericardium from the apex, tip the apex to draw the contents that collect at the bottom of the heart.
17. Examine the thyroid and parathyroid.
18. Remove the tongue, larynx, trachea and oesophagus along with heart and lung by cutting soft tissues and the mandible (cut before premolar and after the molar).
19. Examine mouth and tongue.
20. Arrange thoracic organs in normal position and wash.
21. Open the oesophagus, larynx and trachea and examine.

22. Examine lung by palpation and also after Incision.
23. Examine the heart for dilatation and hypertrophy.
24. Cut open the heart on right side first and then left side Examine the muscle, endocardium, valves and also the vessels.
25. Examine pancreas and mesenteric lymphnodes.
26. Examine the liver surface for fibrinous tufts, adhesion or thickening of the covering.
27. Free the liver from the attachment to the diaphragm. Note the size, weight, borders, and the cut surface.
28. Open the gall bladder and bile duct and examine for worms, gallstones, inflammation etc.
29. Examine the adrenals, kidneys and ureter.
30. Remove the kidney and then remove the capsule after incising the organ longitudinally.
31. Examine the cortex, medulla and pelvis.
32. Open the urinary bladder and examine nature of content
33. Open and examine the uterus, vagina and vulva.
34. Open the skull and examine the meninges and then open and examine the brain.
35. Open and examine the forestomach, abomasum and Intestine. Straighten the intestine and then cut open and examine.

NECROPSY PROCEDURE FOR SWINE

1. The carcass is placed on its back on the necropsy table.
2. The pectoral muscles between scapula and the thorax is cut to loosen the fore limbs.
3. The hind limbs are abducted by making two elliptical incisions from the inguinal region encircling the thigh and opening the coxofemoral articulation, to drop the limbs to the horizontal position.
4. A strip of ventral body wall is removed from the mandibular region to the pubic region to expose the trachea, oesophagus, thoracic and abdominal cavities.
5. The anterior end of sternum is raised with left hand and cut along the costal cartilages.
6. A portion of the ventral abdominal wall is incised towards the pubis to expose the abdominal organs.
7. The strip of ventral abdominal wall is left attached in the pubic region.
8. The thoracic cavity is removed by cutting the ribs.
9. The thoracic and cervical organs are removed together with or without the tongue.
10. The spleen and omentum are removed and examined.
11. The small intestine is pushed to left side to examine rectum.
12. The oesophagus is cut posterior to diaphragm and the rectum well back in the pelvis.
13. The entire viscera are removed by cutting attachments on the dorsal abdominal wall and examined.

14. The adrenal glands should be removed before the kidneys are disturbed.
15. The urinary bladder, ureters, uterus, ovaries, oviducts, in female and the seminal vesicles and other reproductive glands are incised and examined.
16. The nasal passages is examined.
17. The brain and spinal cord must be removed and examined.

NECROPSY PROCEDURE FOR BIRDS

1. Keep the bird on its back with wings and legs extended.
2. Abduct the legs by cutting the skin between the leg and the abdomen on each side and breaking open the hip joints and dislocating the head of each femur from acetabulum.
3. Cut the skin between the keel and the vent transversely and peel off the skin over the abdomen and legs.
4. Free the crop from the clavicular space by blunt dissection.
5. Cut open the abdomen by incising the abdominal wall transversely between the keel and the vent and remove the sternum by cutting through the ribs and clipping the coracoid and clavicles with bone cutter.
6. Examine the muscles of the thigh and sternum.
7. Examine the joints of the limbs.
8. Part the thigh muscles and examine the sciatic nerve with ventral side up.
9. Remove the sternum and expose the internal organs to study them *in situ.*
10. Remove the stomach and intestine in one piece after cutting through the oesophagus just anterior to the proventriculus and at cloaca and examine the organs beneath.
11. Remove the liver separately with gall bladder and then the spleen.
12. In mature females remove the ovary from the base. Cut through the dorsal and ventral attachment of oviduct with mesentery and remove it.
13. Remove the kidneys by blunt dissection and examine the sciatic plexus beneath. Incise the pericardia! sac and observe for increased pericardial fluid.
14. Remove the heart by cutting the large blood vessels arising from the heart.
15. By means of blunt dissection, free the lungs from the thoracic wall and cut through the dorsal attachment. Remove it by cutting through the trachea just anterior to the syrinx.
16. Examine the brachial plexuses on either side near the thoracic inlet along with the vagus nerve.
17. Expose the nasal cavity by cutting the upper beak transversely near its attachment with the skin. With the pointed end of the scissor, incise through the openings on either side to expose the paranasal) sinuses and examine the abnormalities therein.
18. Open the mouth and cut from one angle of the jaw (preferably right side) with the blunt point of scissors inside the oesophagus through the pharynx down the oesophagus and open the crop.

19. Similarly open the trachea along its whole length from the larynx and examine.
20. Examine the condition of the ribs for softness/hardness while cutting and assess the degree of bend and snap in the long bones.
21. Section the proximal tibiotarsal and tarsometatarsal epiphyses with a knife and examine for evidence of richitic changes or abnormal structures.
22. Open and examine major joints.
23. Examine the surface of each visceral organ and incise for examination of cut surfaces.
24. Open hollow organs and examine its contents and inner surface.
25. Examine the brain by cutting and reflecting the skin over the skull and the upper mandible. Carefully cut the skull and lift it to expose the brain.
26. Strip off the skin from the carcass and examine skeleton, bones, Joints and muscles.
27. Record the lesions in the prescribed proforma.
28. After necropsy give a 'Pathological diagnosis' (Tentative/confirmative) based on the lesions encountered. After identifying the etiology, give an etio-pathological diagnosis.

LESIONS OBSERVED IN SOME COMMON DISEASES

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
LARGE ANIMALS		
1.	Foot and mouth disease (Picorna virus)	1. Emaciated carcass, rough coat, erected hairs which are long, dull and brittle. 2. Subcutaneous edema of abdomen and thorax. 3. Vesicles on the dorsum of the tongue (near anterior and lateral aspects), lips, cheeks, gums, dental pads, hard palate, pharynx, and oesophagus. 4. Vesicles on the muzzle, external nares, teats, at the teat orifice, at the cleft of the foot (red sores), on the coronary bands and bulbs of the heels. 5. Vesicles on the ruminal pillars, reticulum, and omasum. 6. Punctiform haemorrhages on the mucosa of duodenum and ulcers in the abomasum. 7. In calves: Focal necrosis on the heart. 8. Heart: Flabby and dilated. Petechiae over pericardium. 9. Lung: Edema and subpleural hemorrhages. 10. In pigs lesions on the snout. 1. Muzzle covered with crusts.

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
LARGE ANIMALS		
2.	Infectious bovine rhinotracheitis -IBRT (Herpes virus type -I)	2. Highly congested and oedematous nasal mucosa covered with mucopurulent exudate. 3. Congestion and exudation in the mucosa of trachea, paranasal sinuses, pharynx, larynx and bronchi. 4. Haemorrhages and suppurative, and diphtheritic inflammation of trachea. 5. Bronchopneumonia. 6. Swollen and edematous lymph nodes of throat and neck region. 7. Pinpoint greyish foci in liver in aborted foetuses.
3.	Theileriosis (Theileria annulata)	1. Emaciation. 2. Icterus. 3. Swollen and haemorrhagic lymph nodes in neck. 4. Swollen edematous and haemorrhagic spleen and payer's patches. 5. Serous fluid in serous cavities. 6. Pulmonary edema 7. Erosions and ulcers in abomasum 8. Acute catarrhal enteritis. 9. Haemorrhages over epi- and endocardium and serous membranes. 10. Infarct like lesions in kidney-greyish white patches. 11. Koch's blue bodies in lymphocytes in blood smear and lymph node impression smears.
4.	Lumpy Skin Disease	1. Circumscribed skin nodules over skin and mucous membranes of oral and nasal cavities. 2. Nodules also seen on genitals, eyelids and conjunctiva.
SMALL RUMINANTS		
5.	Blue tongue (Orbivirus)	1. Emaciation of carcass. Torticollis may be seen. Bloody/Mucous nasal discharge. 2. Mucosa of mouth edematous, hyperaemic and cyanotic. 3. Excoriations covered with grey necrotic material on the lips, dental pads, tongue and cheeks. 4. Subcutaneous edema of neck and abdomen, inter-mandibular space and face.

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
		5. Petechial and ecchymotic haemorrhages in the mucosa of mouth and nose. 6. Swollen cyanotic tongue with ulceration 7. Hyperaemia of ruminal pillars and reticular folds. 8. Congestion, catarrhal inflammation and petechialhaemorrhages in small and large intestines. 9. Haemorrhages, 2-15 mm in diameter in the tunica media at the base of the pulmonary artery. 10. Lymph nodes and spleen enlarged and haemorrhagic. 11. Petechiae and pale areas of necrosis scattered throughout the skeletal muscle and myocardium. Serosanguineous fluid in the pericardium. 12. Edema of Iungs/ pneumonia. 13. Haemorrhages on the mucosa of abomasum and duodenum. 14. Feet: Reddening and petechial hemorrhages on the coronary band.
6.	Pox (Pox virus)	1. Pock lesions on the skin where the wool or hair is shortest such as head, neck, ears, axilla, groin, perineum, under tail and also on the mucous membrane of mouth, nostrils, vulva, pharynx, trachea and abomasum. At these places either pock vesicles or ulcers found. 2. Small grayish white caseous nodules near the pleural surface of the lungs. Nodules are also found on the omentum and kidney. 3. Haemorrhagic inflammation of the mucosa of respiratory and gastrointestinal tract. 4. Petechiae on serous membranes.
7.	Peste des petits ruminants PPR (Morbillivirus)	1. Erosion, necrosis, ulceration on oral mucosa, pharynx, upper oesophagus; abomasum, small intestine 2. Haemorrhage and ulcers in ileo – caecal junction, colon and rectum forming "**Zebra stripes**" 3. Retropharyngeal and mesenteric lymph nodes are enlarged and haemorrhagic

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
		4. Spleen enlarged 5. Mucopurulent exudate from nasal opening to larynx 6. Hyperaemia of trachea and bronchi 7. Congestion and oedema of lungs, pneumonia 8. With secondary bacterial complications, fibrinous bronchopneumonia and pleuritis is common
8.	Enterotoxaemia (Clostridium perfringens type D)	1. Frothy discharges from the nostrils. 2. Haemorrhages in the intestinal mucosa. Ulcers may be noticed on the mucosa. Lesions are prominent in the ileum: 3. Serosanguineous fluid in the peritoneum. 4. Distension of pericardium with straw coloured fluid. 5. Petechiae over epi and endocardium. 6. Pulmonary edema and froth in trachea. 7. Enlarged, soft and pulpy kidney, especially in lambs, than in adults. 8. Spleen and liver congested. 9. Brain: Grey matter edematous.
SWINE		
9.	Clinical Swine fever (Pestivirus) or Hog cholera	1. Carcass dehydrated, emaciated and soiled with diarrhoeal faeces. Swollen eyelids, with mucopurulent exudate (conjunctivitis). 2. Erythematous patches/edema in the skin over abdomen, thorax, ears, internal aspects of thighs, perineum and snout. Haemorrhages on subcutaneous fat and skin. Vesicles on the lips, vulva and edges of ears. Mucous membrane congested. 3. Swollen lymph nodes, congested and haemorrhagic. 4. Petechial haemorrhages on the kidney cortex- Turkey egg appearance. 5. Haemorrhages over bladder, larynx trachea and lungs. 6. Petechial or ecchymotichaemorrhages over serous membranes and in small intestines. 7. Button ulcers in the colon and caecum.

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
		8. Spleen: Congested, swollen and show infarcts. 9. Bronchopneumonia (Fibrinous). 10. Fibrinous pericarditis and pleurisy. 11. Purulent meningoencephalitis.
POULTRY		
10.	Colibacillosis	A. Air Sac Disease 1. Thickened air sacs with caseous exudate 2. Pericarditis and perihepatitis 3. Panophthalmitis and salpingitis, Panophthalmitis - Uncommon. Involves eyes, leads to blindness. Pericarditis - Light yellow fibrinous exudate in pericardial sac. Salpingitis - Large caseous mass in the dilated and thin walled oviduct. B. Acute Septicaemia 1. Green liver with white focal areas 2. Congested pectoral muscles 3. Pericarditis and peritonitis, Synovitis - 1. Emaciated carcass 2. Swollen joints. C. Coligranuloma 1. Typical granulomas over liver, caeca, duodenum and mesentery.
11.	Coccidiosis	A. CaecalCoccidiosis 1. Enlarged caeca with haemorrhages and filled with bloody exudate. 2. Bloody exudate on opening. 3. Mucous membrane necrotic and full of hemorrhages. 4. Examination of scrapings reveals oocysts under microscope. B. Intestinal Coccidiosis 1. Ballooning of the middle intestinal tract almost twice the normal diameter. 2. Petechial or ecchymotichaemorrhages.

S.No.	DISEASE & ITS ETIOLOGY	LESIONS
		3. Red jelly-like bloody exudate on opening. 4. Mucous membrane necrotic and show hemorrhages. C. Duodenal Coccidiosis 1. White patches and typical/ladder-like lesions visible from serosal surface of duodenum and jejunum. On opening lesions appear clearly. 2. Mucous membrane thickened and greyish yellow in colour. 3. Scrapings from white foci reveal oocysts under microscope.
12.	Fowl pox	A. Cutaneous Form Nodules on the wattles, combs, and featherless areas such as legs, feet and vent. B. Diphtheritic Form White opaque or yellowish cheese like material on the mucosa of mouth, tongue, palate and laryngeal orifice. C. Ocular Form 1. Cheesy exudate under the eyelids 2. Conjunctivitis 3. Sticking of eyelid. 4. Swollen infraorbital sinuses.
13.	Newcastle Disease	1. Bran ulcers or button ulcers in intestines visible through serosa. 2. Haemorrhagic necrotic areas in caecal tonsil. 3. Haemorrhages on the tips of proventricular glands. 4. Lungs may show pneumonic foci. 5. Cloudy air sacs with caseous exudate. 6. Enlarged spleen in early stages or shrunken in later stages.

1.Foot and mouth disease



FMD- large animals-Vesicles on the dorsum of the tongue, the muzzle, external nares, teats, at the cleft of the foot (red sores), on the coronary bands





FMD- swine- Vesicles on snout and coronoary band



FMD- Tigroid heart appearance in calves

2. Infectious bovine rhinotracheitis

Respiratory form

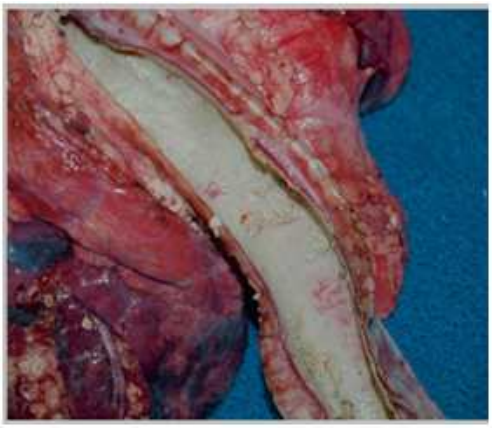




Respiratory form - Red nose

Respiratory form- red nose

Erosive lesions on nose and muco purulent exudate



Trachea- congested, covered with muco purulent exudate



Congested conjunctival Mucous membrane

Genital and abortive form



Infectious pustular balanoposthitis
in a bull infected with infectious bovine rhinotracheitis
inflammation and presence of ruptured pustules on the penis

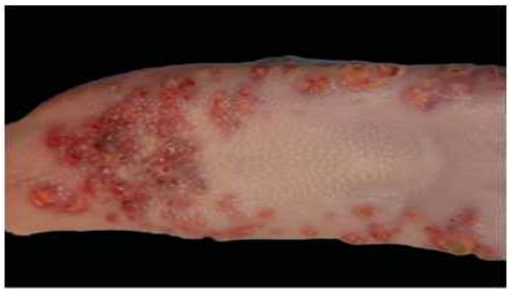


Hyperemia and lightly red granular lesion on vulvar mucous membrane



Pustules on vulva

Neonatal form



Foci of necrosis on mucosa of tongue-neonatal calf



Cheesy necrotic debris in rumen & reticulum-neonatal calf

3. Theileriosis



Swollen lymph node

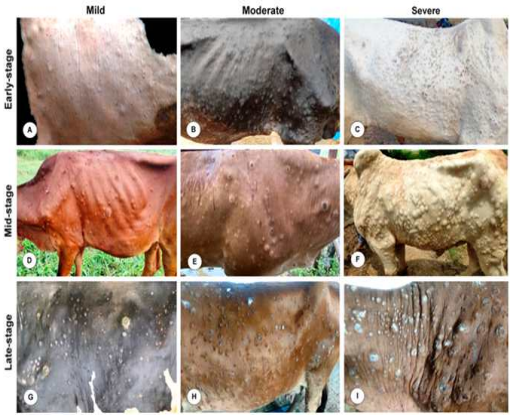


Hemorrhages and ulcers on the mucous membrane of abomasum

4. Lumpy Skin Disease



Circumscribed necrotic tissue 'sit-fasts' and deep ulcers



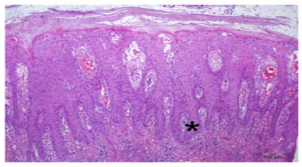


Fig. 2: Acanthosis in the epidermis (*). Bar 100 µm. hematoxylin-eosin stain.

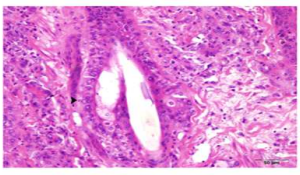


Fig. 3: Intracytoplasmic eosinophilic inclusion bodies in epithelial cells (arrowhead). Bar 50 µm, hematoxylin-eosin stain.



Lacrimation and corneal opacity

5. Blue tongue



Haemorrhage of the coronary band



Swollen cyanotic tongue



Haemorrhage at the base of the aorta



Edema of the muzzle and excessive salivation

6. sheep pox



Sheep pox- Erythematous papules, nodules and plaques around mouth , nose and eyes



Sheep pox in sheep – vesicle on teat





Goat pox – pock lesions at the base of the tail

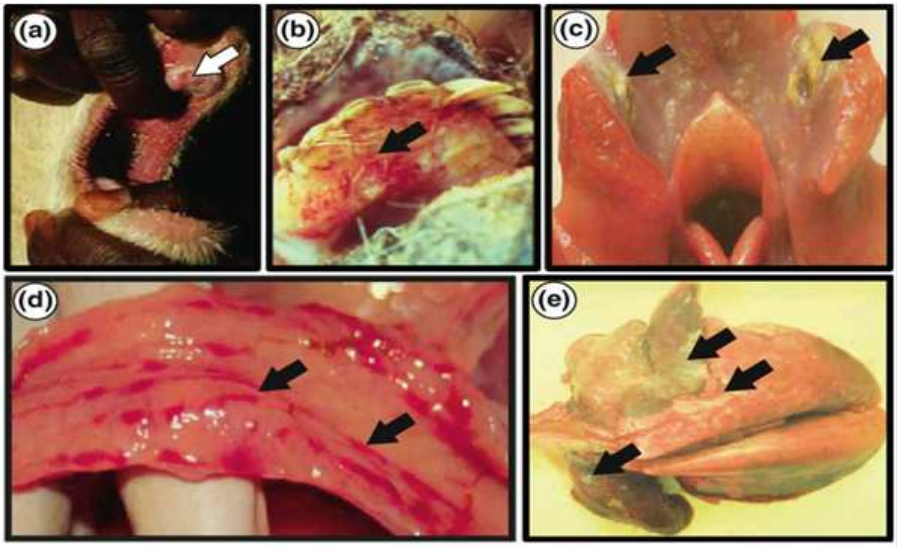


Goat pox

7. PPR



a) Oculonasal discharges and matting of eyelids
b) Diarrhea soiling the perineum
c) Submandibular edema
d) Sores and nodules on the gums and tongue



a. Necrotic lesions on dental pad;

b. Lesions on gum and oral cavity;

c . Oro-pharyngeal sections showing necrotic lesions on palatine tonsils and small fibrin deposits on the base of tongue;

d. Zebra striping in large intestine and

e. Consolidated lungs

8. Enterotoxemia



Enterotoxaemia- Dilated intestine showing a patchy congestion



Pulpy kidney appearance

9. Classical Swine fever / Hog chalera



Petechia and Cyanosis of ears



Turkey egg kidney due to petechial haemorrhages

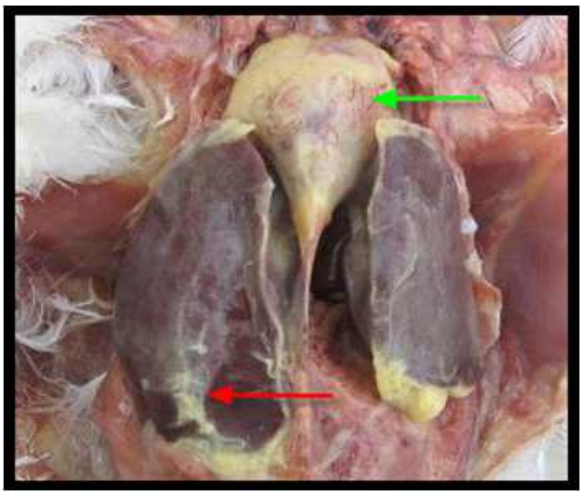


Splenic infarcts

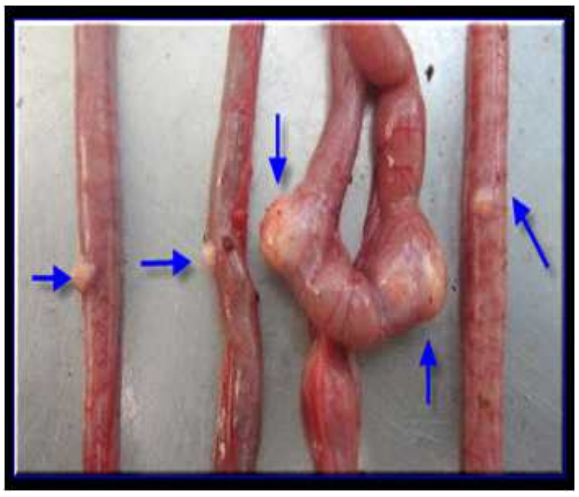


Button ulcers in caecum and colon

10. Poultry : Colibacillosis



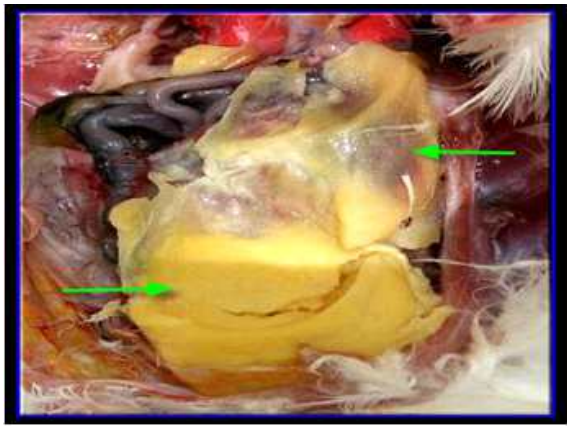
Pericarditis and perihepatitis



Coligranuloma- granuloma or nodules on intestine



Mushy chick disease- “unabsorbed" yolk sac

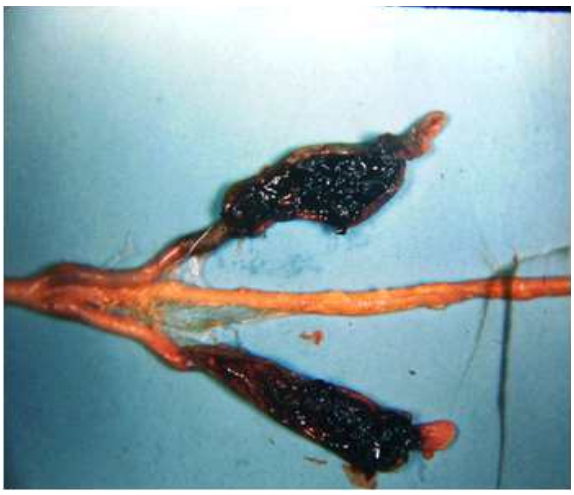


Egg peritonitis- yellowish, caked yolk material

11. Poultry : Coccidiosis



Eimeria tenella- caecal cocciodiosis- haemorrhagic contents in caeca



haemorrhagic contents in caeca

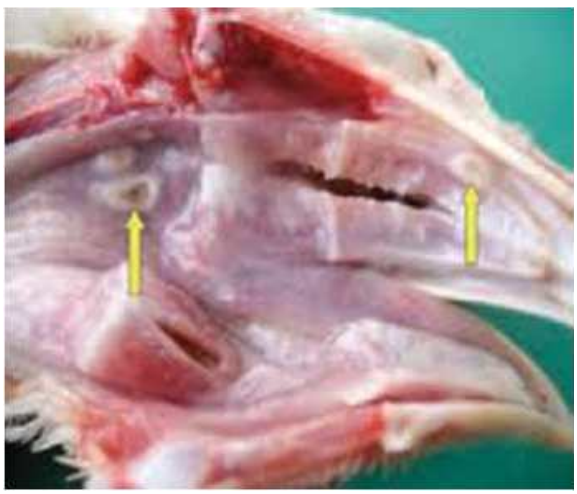


Eimeria necatrix- mid-small intestine- bloody diarrhea

12. Fowl Fox

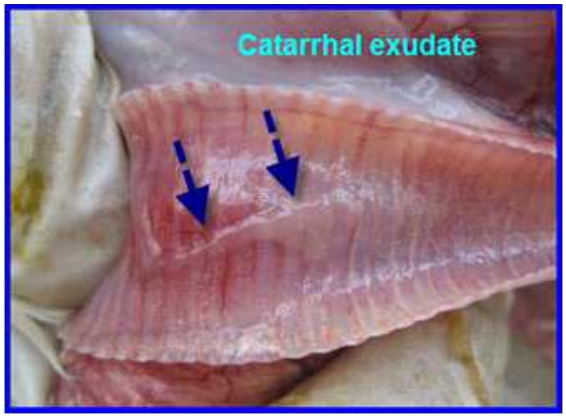


Cutaneous Form
Nodules on the wattles, combs



Diphtheritic Form or wet form- pock lesions on palate

13. Poultry: Ranikhet Disease/Newcastle Disease



RD- trachea



RD- Proventricular Haemorrhages



RD- Haemorrhagic ulcers in intestine



RD- Caecal tonsil Haemorrhages

BLOOD, URINE AND MILK EXAMINATION

BLOOD EXAMINATION

INDICATIONS FOR BLOOD EXAMINATION

- The blood examination is performed as an adjuvant to patient's evaluation. It is done to:
- To assess the general health of the individual.
- To assess the body's ability to fight infection.
- To evaluate the progress of certain diseases
- To know the hereditary diseases
- The blood smear examination is carried out to:
- Diagnose leukaemia's
- Know the relative status of red blood corpuscles and associated anemias
- Demonstrate the blood parasites.
- As an aid in the diagnosis of acute generalized and localized infections.

COLLECTION OF BLOOD

There are several factors to consider when determining the appropriate blood collection volume and technique. These include:

- The species to be sampled
- The size of the animal to be sample
- The age and health of the animal to be sampled
- The minimum volume required for analysis
- The frequency of sampling necessary
- The training and experience of the personnel performing the collection
- The suitability of sedation and/or anaesthesia

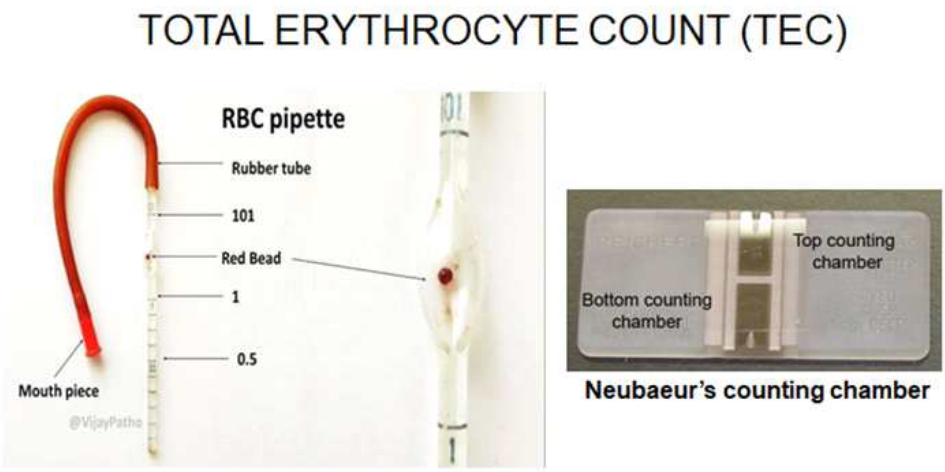
PROCEDURE FOR COLLECTION OF BLOOD:

- Clip the area from where the blood is to be drawn
- Apply 70% alcohol and allow it to dry
- Raise the vein by pressure
- Use a dry, sterile large bore needle
- Insert the needle into the vein, draw into the syringe the required quantity of blood
- Disengage the needle, insert the syringe into specific collection tubes to near its bottom and allow the blood to flow out without exerting any pressure on the piston. Immediately place the rubber stopper. Place the vial on the palm, and with the other make rotary movement so that the blood mixes with an anticoagulant. Never shake the blood vigorously. Otherwise, froth will form, red blood cells may rupture, and erroneous results may be obtained.

ESTIMATION OF TOTAL ERYTHROCYTE COUNT (TEC):

Equipment and Reagents required :

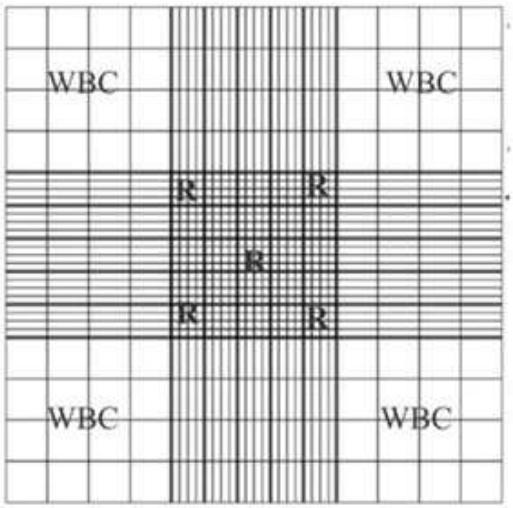
1. Counting chamber with cover glass. Improved Neubaeur's counting chamber (Mercury coated)
2. A diluting pipette.
3. A diluting fluid.
4. A hand tally counter if available.



Diluting fluid: The number of erythrocytes is usually > 4.5 million/c.mm and they are too crowded in the counting chamber to make a correct count. So, the blood has to be diluted sufficiently so that the red cells may lie singly in the counting chamber for correct counting. For this a diluting fluid is necessary.

Counting of RBCs :

1. Mix the oxalated blood by rotating the specimen tube for few minutes
2. Draw the blood up to 0.5 mark in the RBC diluting pipette
3. Wipe the end of the pipette with cotton or cloth
4. If the blood is drawn above the mark 0.5 bring it up to the mark by touching the end of the pipette on the finger. The absorbent material should not be used to make the volume up to 0.5 mark
5. Draw the diluting fluid up to 101 mark
6. Close the tip of the pipette with fore finger and shake the pipette
7. Discard 2-3 drops by twisting the rubber tube attached to the pipette.
8. Load the counting chamber by applying the end of pipette at the junction of the cover slip and counting chamber.
9. While loading care should be taken that the chamber is filled completely without air bubbles and also fluid should be taken not overflow into the moats.
10. Wait for a minute for the cells to settle
11. Bring the counting area at the center and count all the cells in 16 small squares of a square and those lying on two borders while leaving those lying on the other two borders.
12. Count the cells in four more large squares at the corner of the counting area under high power.
13. Add all the cells in five large squares and multiply the sum by 10000 to obtain the number of cells in 1 cubic mm.



Calculation :

1 sq.mm divided into 400 small squares. Cells in 80 of these are counted i.e., 1/5 of 1 sq.mm.

Dilution factor is 1:200

Depth of fluid column between cover slip and chamber is 1/10 mm therefore the number of cells are xX 5 X 10 X 200= xX 10000/µ1 where x is the number of cells in 5 large squares

Source of error is ± 20 %. Result The erythrocyte count is = ---------- million/cmm

Interpretation:

Increase in TEC occurs in polycythaemia which may be relative or absolute.

Decreased TEC seen in oligocythemia which may be relative or absolute. Absolute oligocythemia is anaemia. Observed in Vit. B12, Iron, Cobalt, Copper deficiencies and also in babesiosis, theileriosis.

Significance :

It is required for the calculations of MCV and MCH

ESTIMATION OF HEMOGLOBIN (Hb)

There are different methods for determination of Hb concentration.

1. Oxyhaemoglobin method.
2. Cyanmethemoglobin method.
3. Acid hematin method.
4. Direct matching.

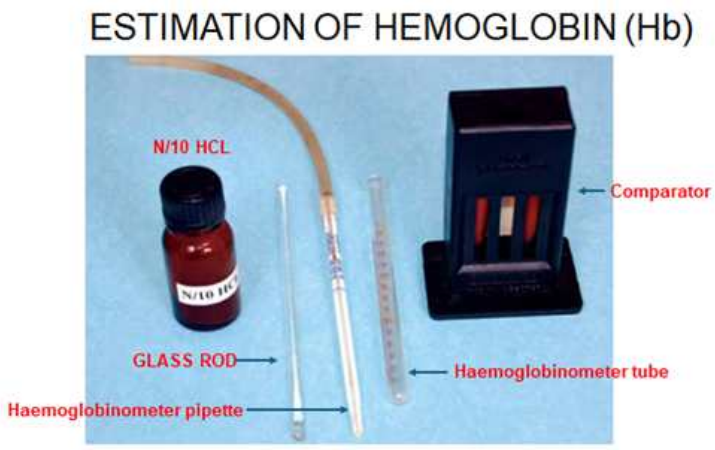
But none is satisfactory. The cheapest and easiest method used for clinical purposes is Sahli's acid haematin method. This is a commonly used method.

Principle:

Hb in erythrocytes combines with acid and form acid haematin which is brown in colour and match the colour standards.

Requirements:

Sahli's apparatus consisting of haemoglobinometer pipette, haemoglobinometer tube, comparator, glass rod or stirrer.



Procedure:

- Mix the oxalated blood in the specimen tube by rotation.
- Place the N/10 Hcl in the haemoglobinometer tube upto'10' mark on % side.
- Draw the blood upto mark 20 cμ in the haemoglobinometer pipette.
- Wipe the tip and if blood is overshot, make the volume upto the mark by tapping on the finger.
- Insert the pipette into tube in which acid is taken and immerse the pipette in acid. Allow the blood to flow out by keeping the pipette in a vertical position. After the blood has flown, raise the pipette slowly, suck the acid and blow it gently without causing any air bubbles and repeat this for 2-3 times.
- Shake the tube gently to mix the blood and acid.
- Keep the tube in a dark place (to form acid-hematin) for 30 minutes.
- At the end of this period, keep the tube in comparator and then add distilled water drop by drop stirring with the glass stirrer after each addition. This procedure is repeated till the colour in the tube matches the colour standard in the comparator. While matching, the stirrer should be raised. A better result can be obtained by placing the comparator against palm or a white paper.
- When the colours match, then remove the tube from the comparator and read the level of fluid in gm/100 ml of blood.
- Error is = 15%

Sources of error:

1. Chipped end of pipette.
2. Not taking correct quantity of blood.
3. Too much acid in tube.
4. Errors in matching.
5. Not keeping the blood and acid mixture for sufficient time to form acid hematin.

Interpretation:

Haemoglobin is increased in polycythaemia, dehydration, haemoconcentration, poorly compensated heart diseases with cyanosis and in high altitudes and is decreased in anaemia.

ESTIMATION OF HEMATOCRIT OR PACKED CELL VOLUME (PCV)

PCV is the percentage of total volume occupied by packed erythrocytes when a given known volume of whole blood is centrifuged at a constant speed for a constant period of time. PCV gives an approximate idea about number and size (volume) of the cells as these are altered in anaemias. From PCV – MCV, MCH and MCHC are calculated.

Methods of estimation of PCV :

1. Macrohaematocrit method (or) Wintrobe haematocrit method.
2. Microhaematocrit method (or) capillary tube method.

1. Wintrobe haematocrit method :

Wintrobe tube is used. A tube having a 3mm bore 10 cm length and calibrated in centimetres and further into mms.

PCV - on right side 0 from the bottom to 10 on top ESR – left side 0 at the top to 10 at bottom

Mix the oxalated blood by rotating the specimen tube on the table.

With a long pasture pipette fill the blood by inserting the nozzle into the tube so that it touches the bottom.

While squeezing the teat, slowly and gradually raise the pipette so that the Wintrobe tube gets completely filled up to the top 10 mark on right side without trapping of air bubbles.

Put the tube into a clinical centrifuge and rotate it at 3000 RPM for half an hour.

Red cells will be packed at the bottom and plasma on top, leucocytes in between i.e. buffy coat.

PCV = Height of red cells in mm x 100 Total height of column in mm PCV expressed as a percentage. (%)

HEMATOCRIT OR PACKED CELL VOLUME (PCV)



WINTROBE TUBE



PCV READER

2. Microhaematocrit method / capillary tube method

- Capillary tubes measuring 7cm x 1mm are used i.e., 7cm length and 1mm bore.
- Apply the one end of the capillary tube to the mixed oxalated blood. The blood rises into the capillary tube by capillary action and surface tension.
- Fill the capillary up to 2/3rd full, remove it and seal the end of it which is free of blood by using flame or plasticine.
- Fasten then cover of the centrifuge.
- Spin the centrifuge for 2 minutes at 120000G
- Read the PCV with the help of a special reader provided along with the instrument.

Significance:

The PCV value is required for calculating erythrocytic indices

o A fall in the PCV indicates bone marrow depression and anaemia.

o PCV is increased in haemoconcentration and polycythaemia.

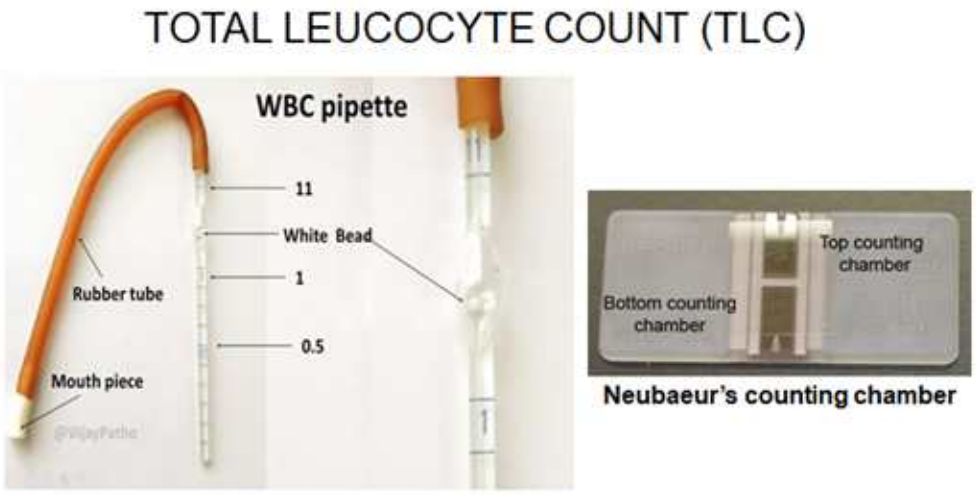
- Even in anaemic status with extreme cases of haemoconcentration due to dehydration, PCV will be normal. So interpretation of PCV should be made taking into consideration, factors like dehydration
- The colour of the plasma layer should also be noted to find out certain clinical problem.
- Plasma is icteric in haemolytic anaemia and liver diseases. It is colourless to pale in bone marrow depression and it is cream-like in lipaemic condition.

ESTIMATION OF TOTAL LEUCOCYTE COUNT (TLC)

Requirements:

WBC pipette containing 0.5, 1, and 11 marks with a white bead in the bulb, Haemocytometer with special cover slip, diluting fluid, tally counter, pipette shaker and sample of blood.

Diluting fluid: Thomas fluid Composition: glacial acetic acid – 2 ml 1% aqueous solution of gentian violet – 1 ml Distilled water – 100ml. The glacial acetic acid lyse the RBCs and gentian violet stains nuclei of WBCs



Procedure:

- Draw the oxalated blood up to 0.5 mark in WBC diluting pipette. Wipe the end of the pipette with cotton.
- Mark the column of the blood exactly up to 0.5 mark as done for RBC count. Draw the diluting fluid up to 11 mark.
- Shake well & discard 2-3 drops.
- Load the counting chamber as done for RBC count.
- Count the cells in 4 large squares on four corners of counting area each having 1sq.mm area under low power.

Calculation:

Total WBC count = total number of cells in 4 large squares x 50/µl.

= X/4 * 20* 10 /µl

= X * 50 / µl

Where X is the total number of cells in 4 large squares, 20 is the dilution factor. Source of error is ± 10 %. Total WBC count is expressed as thousands / µl

Interpretation:

1. Increase in leucocyte count is leucocytosis, seen in fear, exercise, excitement, parturition, stress, trauma, neoplasia, pyometra and TRP.
2. Decrease in leucocyte count is leucopenia, seen in viral diseases like RP, CD, ICH.

DIFFERENTIAL LEUCOCYTE COUNT (DLC):

Preparation of blood smear:

- Blood smear should be prepared on clean and grease free slides immediately after collection of blood preferably without adding an anticoagulant.
- The blood smear should be even and fairly thick, but not too thick.
- If an anticoagulant is added mix the blood sample by gentle agitation.
- With the applicator stick, place a small drop of blood near one end of the slide.
- Place the end of spreader slide against the surface of the first holding it an angle of 30 .
- Draw the spreader slide gently into the drop of blood and allow it to spread to the width of slide and push forward the spreader slide. Dry rapidly by weaving in air.

Staining of blood smear:

- The staining should be done within 1hour for best results. If delay is anticipated, preserve the slide by fixing in absolute alcohol or methyl alcohol for 15 minutes. For routine examination of blood smear Leishman's stain is used.

Method of staining:

- Cover the blood film with Leishman's stain and keep it for 1-2 minutes.
- Add double the quantity of buffered distilled water (pH 6.6 - 6.8) and mix by blowing air and keep for 10-15 minutes.
- Wash the slide with distilled water until the film has a pinkish tinge (½ to 2 minutes). Wipe the back of the slide to remove excess stain and allow it to dry.

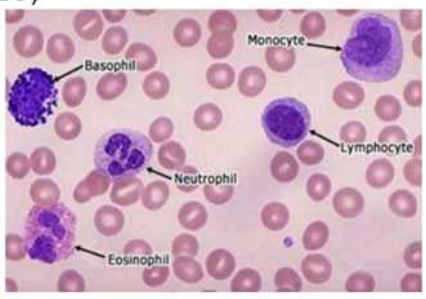
Precautions to be taken while staining the film:

- Do not allow the stain to dry before the distilled water is added. Do not wash too long period as the stain is washed.
- The washing water should not be too acidic as it will not stain the nuclei of leucocytes and also should not be too alkaline as it will not stain the cytoplasm of leucocytes.

Examination and counting of cells:

- The slide should be examined under oil immersion. While counting the cells avoid the tail end of the smear. Examine the smear at the edges for intracellular parasites.
- Count the 100 leukocytes and tabulate as neutrophils, lymphocytes, basophils, eosinophils and monocytes and express as percentage of each cell type.

DIFFERENTIAL LEUCOCYTE COUNT (DLC)



Methods for counting cells:

a. Straight edge method. b. Cross-sectional method. c. Battlement method

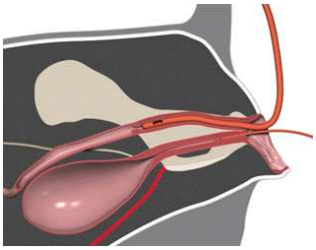
Interpretations:

Usually interpretation should be based on absolute number of various cell types because the interpretation solely based on DLC does not reflect the true alteration in cell distribution. Absolute numbers = % of cell type in DLC x Total leukocyte count.

URINALYSIS

COLLECTION OF URINE SAMPLE:

Collected in a clean glass or plastic container at the time of voiding. Alternately urine is collected by catheterization or by cystocentesis into a sterile container to be used for bacterial cultures and sensitivity testing. An early morning mid stream sample is preferred, as it is most likely to contain constituents of diagnostic significance without any cellular debris.





Urinary catheter insertion



Cystocentesis

Preservation:

Always a fresh sample is preferred. Urine can be preserved by refrigeration for 2-3 hrs. When immediate analysis or refrigeration is not possible preservatives may be used. Some commonly used urine preservatives are:

a) Toluene- antimicrobial preserves a 24 hr urine specimen.

b) Thymol- antimicrobial, preserves a 24 hr urine specimen.

c) Formalin-Prevents bacterial growth (1 drop of formalin in 30 ml urine) but interferes with glucose testing.

d) Chloroform-Antimicrobial preserves a 24-hr urine collection.

PHYSICAL EXAMINATION:

Colour

The colour of the urine may be any one of the following colorless, pale yellow, yellow, and dark yellow, yellowish brown, greenish yellow, red, reddish brown, brown green, blue or milky.

- Yellow color - due to urochromes.
- Pus in urine - thick colour.
- Dark yellow colour - due to dehydration as occurs in vomiting, diarrhea, serous exudations and fever and in deficient intake of water.
- Pale urine - diabetes mellitus, diabetes insipidus, when too much for water is ingested, in pyometra(when there is increased water consumption) and in chronic interstitial nephritis in dogs.

- In jaundice- yellow, brown or greenish yellow.
- Presence of hemoglobin and blood given the urine a red color.
- In congenital porphyria - faint pink.
- In phenothiazine medications - red color.
- Greenish color - medicated with methylene blue or diazan.

CHEMICAL EXAMINATION:

PROTEINS

Normal urine does not contain any proteins.

Tests for detection of albumin in urine are:

1. Robert's test:

Reagent: Conc.nitric acid -1 part Saturated Magnesium sulphate -5 parts (Prepared by dissolving 770 g of magnesium sulphate to 1 litre of water).

Procedure:
1. Take 2 ml of reagent in a test tube.

2. With a pipette, layer 2 ml of urine down the sides of the test tube held slantingly.

3. At the junction of two fluids, a white ring forms if albumin is present.

2. Heller's test:

This is a very commonly used test though not as sensitive as Robert's.

1. Take 2 ml of Conc.nitric acid in a test tube.
2. With a dropper or pipette, layer on top 2ml of urine.
3. At the junction of two fluids, a white ring forms if albumin is present.



Heller's test

3. **Sulfosalicylic test:**
   To 2ml of urine add few drops of 20% Sulfosalicylic acid. Cloudiness is a positive test.

4. **Heat & acid test:**
   Boil 2ml of urine add 2drops of 5% acetic acid and a drop of conc nitric acid. Cloudiness is a positive test.



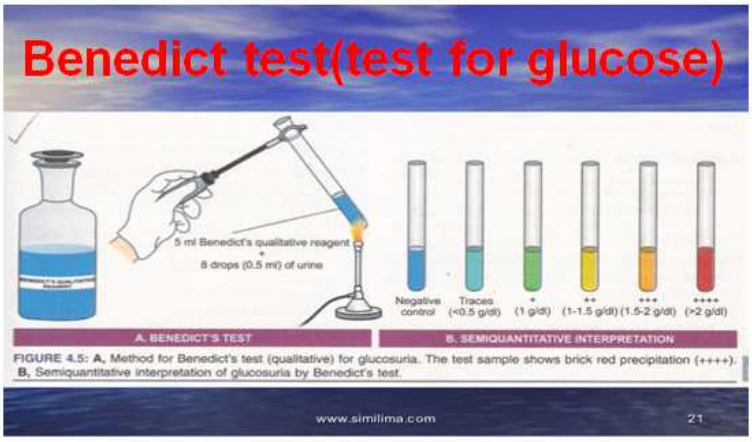
Sulfosalylic acid test

GLUCOSE

Normally urine does not contains any glucose. All of that is found in the glomerular filtrate is reabsorbed by the tubular epithelium since glucose is a threshold substance. Glucose in urine is called glycosuria. It is detected by **Benedict's test**. This contains copper sulphate. Glucose is reducing agent, which converts the cupric ions in the copper sulphate to cuprous ions – cuprous oxide.

Procedure:

1. Take 5ml of the reagent in a test tube and heat it. If it has not changed color (usually it should not).
2. Add 8 drops of the urine to it and boil it carefully. See that it does not spurt while boiling. Cool it. Then if glucose is present a greenish or yellow precipitate forms.



KETONE BODIES

These are acetoacetic acid, beta hydroxy butric acid and acetone. These are not normally present in the urine. But when fat metabolism is impaired due to deficient carbohydrates, ketone bodies accumulate in the body giving rise to ketonemia and then ketonuria results. Ketones in the urine are detected by **Rothera's test**.

Procedure:

Saturate 5ml of urine with ammonium sulphate. Add 2 or 3 drops of 5% sodium nitroprusside solution and then add strong ammonium hydroxide. A permanganate color is indicative of ketones.

BLOOD

Hemoglobin contains a peroxide which can liberate oxygen from hydrogen peroxide. This oxygen gives a blue color in the presence of benzedine. It is detected by **Benzidine test.**

Procedure:

1. In a test tube dissolve a small quantity of benzedine in glacial acetic acid.
2. Add 2 ml of urine to this.
3. Add 1 ml of fresh hydrogen peroxide and mix. If blood is present a blue color or green color develops.

Hematuria is the presence of whole blood in the urine. Hemoglobinuria is the presence of hemoglobin in the urine. Centrifuging a specimen of urine can differentiate these. In hematuria, the red blood cells will be layered at the bottom while the supernatant liquid is colorless. In haemoglobinuria in which the erythrocytes are leaked , the whole fluid will be red.

BILE PIGMENT

Gmelin's test:

1. In a test tube take 2 ml of concentrated nitric acid.
2. Carefully on top layer 2 ml of urine with pipette.
3. At the junction of the two fluids a play of colors – green, violet etc. will be observed if bile pigment is present.

MILK EXAMINATION

Physical Examination

1. **Colour:** Normally the colour of milk is white or creamy white

   In acute mastitis - reddish due to presence of blood.

   In chronic mastitis or sub-acute mastitis - watery.

   During the colostral period, feeding of carrots, tetracycline therapy and therapy of acridine dyes - yellowish.

   Phenothiazine treatment - pink to brown colour.

2. **Specific gravity:** The specific gravity of normal milk is 1.015 to 1.037 which may get altered due to mastitis.
3. **Reaction:** The pH of normal milk is 6.4 to 6.6. But in mastitis it becomes alkaline upto7.4 due to presence of sodium bicarbonate in the milk. The reaction can be determined by using pH strips.
4. **Odour:** Normally the odour of milk is pleasant, but it may turn obnoxious due to mastitis caused by *Actinomyces pyogenes*. In ketosis, the odour of milk becomes sweet, stable, and fruity.
5. **Consistency:** The colostrum or first milk of the animal just after parturition is viscous.

   The watery consistency - is due to poor feeding and chronic mastitis.

   During mastitis (acute and subacute), the milk contains fine as well as large flakes.

   The consistency of milk is determined by using strip cups even under field conditions.

Strip cup test:

In this test, enamel plate divided in four strip cups is used. The bottom of the plate is black coloured so that it gives a good contrast to easily observe the milk flakes. The comparison of milk from all 4 quarters can be carried out simultaneously. The milk flakes can be seen by tilting the cups at an angle. This test can be carried out by laymen at farm itself. If clots or flakes are observed in the milk, the animal is isolated from the herd for confirmatory diagnosis and treatment. This test is very useful in primary screening of animals for mastitis.

Chemical Examination

1. pH

Bromothymol blue (BTB) test:

The reaction of milk is detected by this test. In this test, 1 ml of 0.2% bromothymol blue solution is taken and to this 5 ml of freshly collected milk sample is added. If sample is alkaline due to mastitis, it becomes blue to green. However, the test may give false positive reaction in later stage of lactation.

Bromocresol purple (BCP) test:

BCP is deeper yellow at pH 5.2. This can detect abnormal milk with high acidic pH. In this test, 0.5 ml of BCP solution (0.9g BCP in 100mL DW) is mixed with 9.5 ml of freshly collected milk sample. Normal milk is pale greenish purple in color. Abnormal milk is deep purple in colour due to increased alkalinity. These pH tests are of limited value. Hence other tests should be performed.

2. Chloride test:

The presence of more than 0.14% chloride content in milk is considered abnormal. For this test, take 5 ml of 0.1341% silver nitrate solution in a test tube and add 2 drops of 10% potassium dichromate solution as indicator. To this add 1 ml of milk sample and mix it properly. If the chloride is less than 0.14% then it will remain brownish red while in positive case it will become yellow indicating more than 0.14% chloride content in milk. However, this test may give false positive reaction during early and late lactation.

3. White slide test:

In this test, 4-5 drops of test milk sample are placed on a clean dry glass slide. To this add a drop of 4% sodium hydroxide and mix with a glass rod. If the milk is from animal having mastitis, it becomes thickened and flakes appear. While the negative milk sample remains the same. This test is based on the increased number of leukocytes in mastitic milk.

4. California mastitis test:

This test is based on increased number of leukocytes and increased alkalinity in milk due to mastitis. Take 0.5 ml milk from each quarter in plastic peddle cups and add equal quantity of mastoid solution and mix well by circular movement of peddle on a horizontal plane.

Liquid milk with no streaks or precipitation: Negative for mastitis.

Streaky fluid: + (weak positive cell count 500,000/ml).

Slimy: ++

Gelatinous: +++

5. Hotis test:

Take 0.5 ml of 0.5% bromocresol purple and sterilize it by autoclaving. Mix 9.5 ml milk sample after cooling and incubate it at 37°C for 24 hours. The appearance of yellow colonies along the sides of tubes or on bottom indicates the infection due to *Streptococcus agalactiae.*

Cytological Examination:

Leukocyte count:

Mix the milk sample thoroughly and take out 0.1 ml of mixed milk and place it on a clean, dry glass slide. Mark the area on central portion of slide (1 sq cm) and spread the milk sample with bacteriological loop in this area. Dry the smear and dissolve the fat by rinsing it in xylene for 2-5 minute. Fix the smear with alcohol for 5 minute and stain with methylene blue for 1 minute. Remove the excess stain by immersing the slides in alcohol. Count the leukocytes under oil immersion of the microscope. The cells of 10 fields are counted and averaged and multiplied by 500,000 to get the total number of leukocytes per ml of milk.

The milk is collected in sterilized vials and stored in refrigerator. The milk sample is inoculated on bacteriological media (nutrient agar, blood agar or tryptose soya agar) for isolation of organisms and antibiotic sensitivity test.

PARASITOLOGY

FAECAL EXAMINATION

FAECAL EXAMINATION METHODS:

I. Qualitative method.

II. Quantitative method.

I. Qualitative faecal examination

i) Direct smear method:

A pin head size of the faecal sample is placed on a slide, mixed with 2 to 3 drops of water and a cover slip is placed on it to form a thin translucent faecal smear. It is then examined for parasitic eggs under 10x.

Advantages:

1. It is a simple and rapid technique and can be performed at field level to screen large number of faecal samples in a limited period of time.
2. It does not require any specialized equipment like centrifuge.

Disadvantage:

1. It is useful only if the parasitic ova are in high concentration in the sample.

ii) Concentration techniques:

1. Sedimentation technique
2. Floatation techniques
    a. Direct centrifugal floatation (DCF)/ Lane's centrifugal floatation technique.
    b. Willi's method/ Lanes technique.

1. Sedimentation technique

Principle: Helminth eggs are sedimented by virtue of their weight and by the application of centrifugal force.

Procedure:

1. 1 g of faecal sample is mixed with 10 ml tap water to form a suspension.
2. The suspension is then poured through a wire mesh or tea strainer to remove the course debris which interfere while examination.
3. The suspension is transferred to centrifuge tubes and centrifuged at 1000 rpm for 5 -10 min.
4. Supernatant is discarded and sediment is examined with small quantity of water at 10x.

Advantages:

1. It is useful in concentrating the sample to contain helminth eggs.
2. It is useful for the examination of large trematode eggs.

Disadvantages:

1. It involves the usage of specialized equipment like centrifuge.
2. The sample will have more debris as compared to floatation technique.

2. Floatation technique:

Principle: When helminth eggs are suspended in floatation fluids of high specific gravity, the eggs float on the top of the floatation fluid.

Table-1

Common floatation fluids

Floatation fluids	**Specific Gravity**
Saturated Sodium chloride	1.18-1.19
Sugar solution (Sucrose)	1.12-1.30
Zinc sulphate solution (33%)	1.18
Magnesium sulphate (35%)	1.28
Sodium nitrate	1.36
Potassium mercury iodide (111 g Potassium iodide, 150 g mercury iodide, water- 399 ml)	1.44

a. Direct centrifugal floatation (DCF)/ Lane's centrifugal floatation technique.

Procedure:

1. Take 5 g of faecal sample into a bowl.
2. Add 15 ml of water.
3. Prepare thick emulsion with the help of a glass rod.
4. Sieve it through a strainer.
5. Centrifuge at 1000 rpm for 5-10 min.
6. Pour off the supernatant.
7. Add 15 ml of floatation fluid (Table-1) to the sediment and mix thoroughly.
8. Centrifuge at 1000 rpm for 10 min.
9. Touch the topmost layer with a loop or glass rod and transfer it on to a glass slide.
10. Cover it a cover slip and examine it under 10x.

Advantages:

1. It is useful in concentrating the sample to contain helminth eggs, oocysts and cysts.
2. The samples processed by this technique will be free from debris showing only eggs suitable for photography.

Disadvantages:

1. It involves the usage of specialized equipment like centrifuge.
2. The sample should be examined immediately as the floatation solution will crystallize and alter the shape, size and contour of the eggs, sometimes leading to breakage of the shell.

b. Willi's method/ Lanes technique:

Procedure:

1. Prepare thick emulsion of faeces in water.
2. Fill one third of Willi's tube (tube with flat bottom) with the above emulsion.
3. Fill rest of the tube with saturated salt solution.

4. Add the saturated salt solution drop by drop to the Willi's tube to form a convex surface.
5. Leave the tube undisturbed for 30 min.
6. Touch the convex surface with a cover slip.
7. Place the cover slip on a glass slide and examine under 10X of microscope immediately.

Advantages:

1. It is useful in concentrating the sample to contain helminth eggs, oocysts and cysts.
2. The samples processed by this technique will be free from debris showing only eggs suitable for photography.
3. It does not involve the usage of specialized equipment like centrifuge.

Disadvantages:

1. The sample should be examined immediately as the floatation solution will crystallize and alter the shape, size and contour of the eggs, sometimes leading to breakage of the shell.
2. It is a time consuming process.
3. Trematode and cestode eggs cannot be floated due to their more specific gravity.

II. Quantitative faecal examination

1. Stoll's egg counting technique.
2. Mc Master counting technique.

1. Stoll's egg counting technique.

Procedure:

1. Weigh 1 g of faecal sample and suspend it in water to make upto 15 ml suspension.
2. Draw 0.15 ml (150 µl) of the suspension using a pipette onto a slide and place a cover slip on it.
3. Count all the parasitic eggs and oocysts present in 0.15 ml and calculate the EPG (Egg per gram of faeces) or OPG (Oocyst per gram of faeces) as below.

EPG/OPG = Egg count in 0.15 ml x 100

2. Mc Master egg-counting technique.

Principle: Area under the grid line of a Mc Master slide holds exactly 0.15 ml of faecal suspension which is used for calculation of EPG/OPG.

Procedure:

1. Weigh 1 g of faeces and add upto 15 ml of tap water.
2. Homogenise and pour suspension through a 250 µm aperture sieve, collecting the filtrate.
3. Collect the filtrate, agitate and fill a test tube of 15 ml volume.
4. Centrifuge at 1000 rpm for 5-10 min.
5. Pour off the supernatant, agitate sediment and fill the tube upto 15 ml with floatation fluid.

6. Invert tube six times and remove fluid with pipette to fill both chambers of Mc Master slide quickly.
7. Examine one chamber and multiply number of eggs or larvae under one etched area by 100 or two chambers and multiply by 50 to arrive at the number of eggs per gram (EPG) of faeces.

EPG/OPG = Egg count in 0.15 ml X 100	**[Single chamber]**
EPG/OPG = Egg count in 0.15 ml X 50	**[Both chambers]**

SKIN SCRAPINGS EXAMINATION

Skin scrappings are collected for diagnosis of mite infestations in domestic animals.

Principle: Mites in skin scrappings are heated in 10% KOH/NaOH to digest their hard cuticle to make them clear and to help in identification.

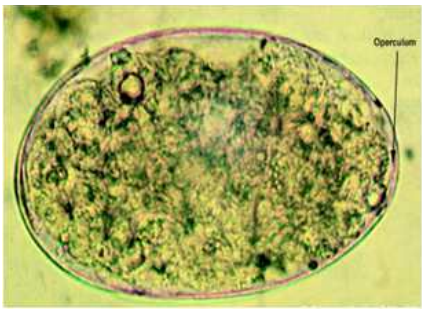
Procedure:

1. A clean blunt scalpel is taken.
2. Hold the fold of the skin containing the lesion between the thumb and the index finger and scrape at the periphery of the lesion until slight blood oozes out.
3. Collect the scrapping powder below in a paper and pack it tight and place it a air tight vial.
4. Transfer the scrapping powder into a glass test tube and add 10 % KOH or NaOH and boil it for about 10 min till the hair strands are completely digested.
5. Cool the test tube under water.
6. Transfer the content into a centrifuge tube and spin @ 1000 rpm for 5-10 min.
7. Discard the supernatant and examine the sediment under 10x for parasitic mites.

PICTURES OF PARASITIC EGGS

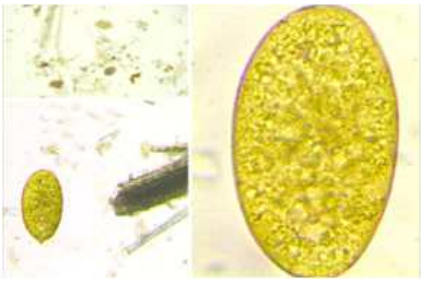
Amphistome egg

- Composite and transparent eggs
- Thin shelled, oval shape
- Distinct operculum with a small knob at the opposite end



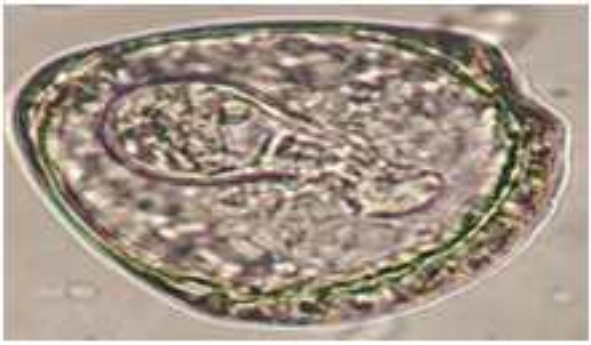
Fasciola egg

- The eggs are large yellowish and operculated with thin shell.
- Each egg contains one cell stage embryo surrounded by a group of oval body yolk cells.
- It has a distinct, inner concaved operculum and an umbilicus-like invagination at the posterior end of the shell.



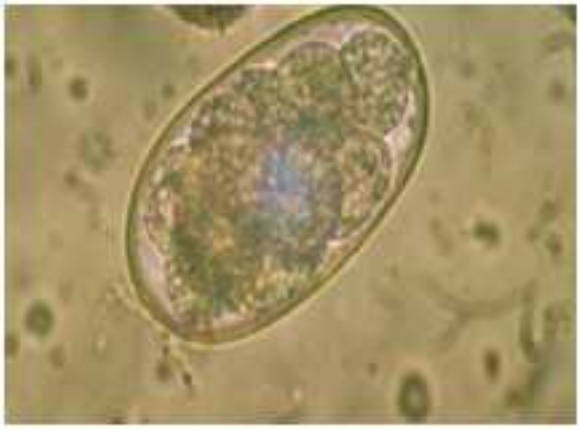
Monezia egg

- Each egg contains a hexacanth larva enclosed in a pyriform apparatus. It resembles triangular to rectangular shape depending on the species.



Strongyle egg

- "strongyle" eggs, oval, with a thin, smooth shell .
- In fresh feces each egg contains a small clump of segmented cells.



Ascarid egg

- Fertilized eggs are are rounded and have a thick shell with an external mammillated layer. In some cases, the outer layer is absent (known as decorticated eggs)..
- Unfertilized eggs are elongated and larger than fertile eggs .
- Their shell is thinner and their mammillated layer is more variable, either with large protuberances or practically none. Unfertile eggs contain mainly a mass of refractile granules.



Balantidium coli Cyst

- The shape of the parasitic cyst is round, has a two-layer cyst wall.
- The cyst has a granular cytoplasm containing a macronucleus, a micronucleus and a retractile body



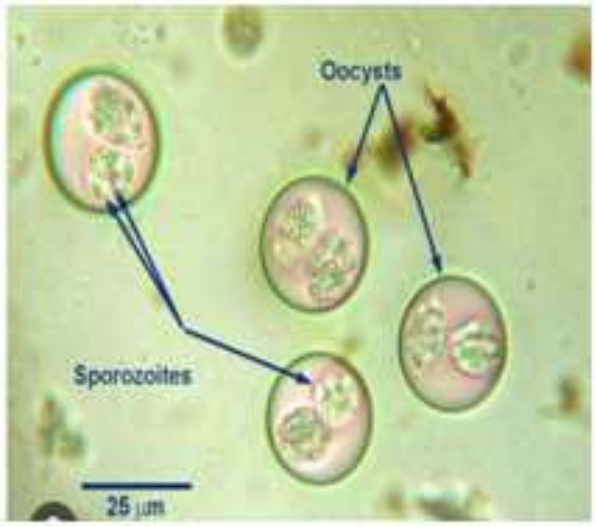
Eimeria oocyst

- Sporulated oocysts had an ellipsoidal shape with four sporocysts, and each sporocyst had two sporozoites.



Isospora oocyst

- Isospora is a spindle-shaped body that has two sporocysts that contain four sporozoites each.



BLOOD EXAMINATION

Wet film examination:

A drop blood is mixed with a drop of normal saline and place a cover slip to view live parasites like microfilaria and Trypanosomes.

Preparation of thin blood smear

A small drop of blood is placed on the slide at one end. A spreader (or another clean slide) is placed on the slide at an angle of 20-30° and drawn back to make contact with the blood. The blood is allowed to run to each end of the spreader. The blood is spread along the slide in a fairly rapid but smooth motion. The blood should be pulled behind the slide and not pushed ahead of it: A thin and even blood smear should result. Wave the slide in the air until it dries (a matter of few seconds if the smear isthin enough), If the smear is to be stained in Giemsa's stain, fix it by dipping in absolute methyl alcohol. If the smear is to be stained in Leishman's stain, fixation is not necessary since it will take place during the staining process. If the smear is to be stored for more than a day or so before staining, it should he fixed.

Parasites detected by thin smears: Microfilaria, Trypanosoma sp., Theileria, Babesia, Anaplasma, Ehrlichia, Hemoproteus, Leucocytozoon & Plasmodium etc.

Preparation of Thick Blood Smears:

Clean slide as for thin smears. Place a medium sized drop of blood or several tiny ones on the slide, and mix with a toothpick or the edge of another slide. Allow to air dry. Thick smears must be laked (i.e. the hemoglobin must be extracted) before staining. This can be done by placing them in water until their red color has disappeared. If Giemsa's stain is used and the smears are fresh, laking will take place during the staining process. If the smears are to be stored for more than a day or so before staining, they should be laked and then fixed with absolute methyl alcohol before storage, since it is often extremely difficult to remove the hemoglobin from smears that have been stored for some time.

Parasites detected by thin smears: All intracellular protozoa like Theileria, Babesia, Anaplasma, Ehrlichia, Hemoproteus, Leucocytozoon, Plasmodium etc.

Staining of Blood Smears

Staining methods

1. Leishman staining
2. Geimsa staining

1. Leishman's staining technique

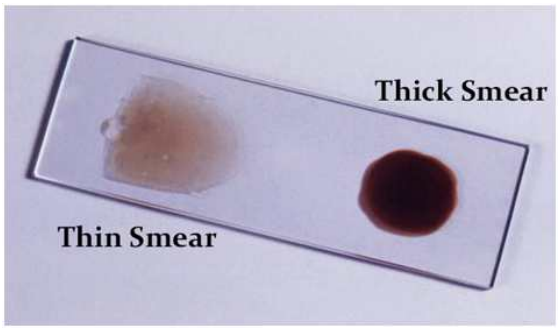
Procedure:

1. Place the prepared blood smear on a staining rack.
2. Add a known quantity of stain and allow for 1 min.
3. After 1 min double dilute the stain with distilled water and mix it by blowing over it.
4. Allow it for 15-20 min.
5. Wash the stain under water, blot dry and examine it under 100x magnification

2. Geimsa's staining technique

Procedure:

1. First fix the blood smear in methanol for about 30 sec.
2. Place the prepared blood smear on a staining rack.
3. Flood the blood smear with freshly prepared geimsa stain (1:20 dil or 1:30 dil)
4. Allow it for about 30-45 min.
5. Wash the stain under water, blot dry and examine it under 100x magnification.



DIAGNOSIS OF MICROFILARIOSIS :

Microfilaria, the pre larval stages of *Dirofilaria*, *Dipetalonema* and *Brugia* species is commonly reported among canines worldwide. Dirofilaria immitis is found to be highly pathogenic. *D. repens* is moderately pathogenic where as *Dipetalonema reconditum* is considered as non-pathogenic. All the three species have been reported from India. It is essential to correctly identify the three species for diagnostic and epidemiological purposes. Several techniques were adopted to detect microfilariae in blood of Human beings and animals. But concentration techniques appeared to be the best in detection of low- level of infections.

MODIFIED KNOTT'S METHOD:

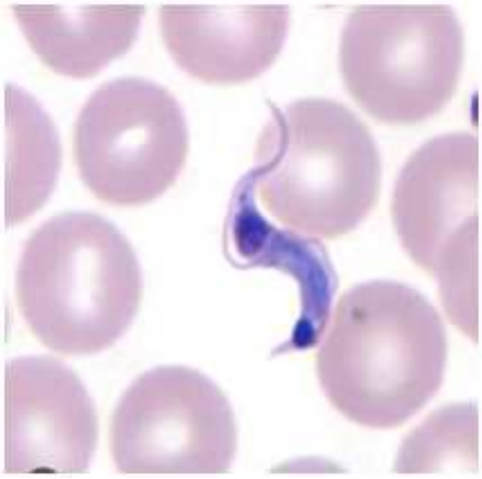
This method is fairly rapid and allows differentiation of Microfilaria and Dipetalonema species it concentrates the microfilaria from an adequate volume of blood and haemolyses the RBCs, so that the microfilaria can be seen more clearly.

Mix two ml of sample with 10 ml of two percent freshly prepared formalin solution. Then gently invert the tube three to four times and allow it to stand for four to five minutes so that the blood gets haemolysed. Centrifuge the haemolysed blood at 1500 rpm for five minutes . Discard the supernatant carefully and transfer a drop of the sediment onto a clean grease free slide and mix with an equal quantity of 0.1 percent Methylene blue or 0.2 percent Methyl green stain. Place a cover glass over it and examine under the microscope

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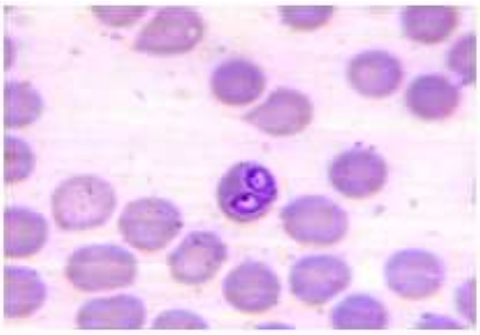
Trypanosomes

- A typical trypomastigote has a large, subterminal or terminal kinetoplast, a centrally located vesicular nucleus, an undulating membrane, and a flagellum running along the undulating membrane, leaving the body at the anterior end.



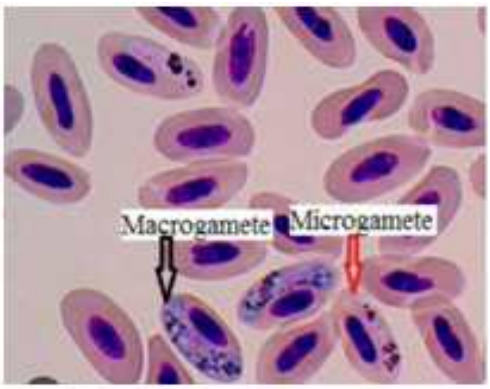
Babesia

- Round to pyriform in shape either acute/obtuse angle
- Arranged in pairs inside the RBC.



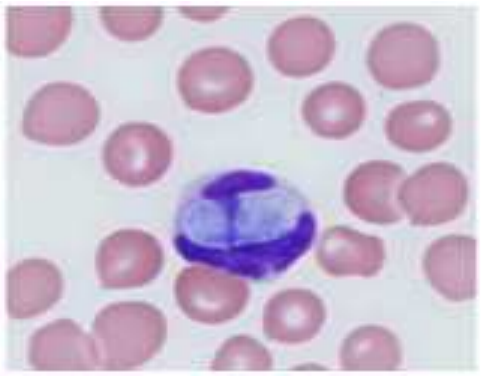
Haemoproteus columbae

- Gametocyte partially surrounds the cell's nucleus like cap
- Multiple, refractile, golden-brown particles of hemozoin pigment.



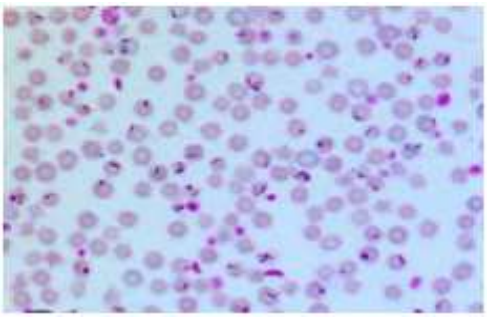
Hepatozoon canis

- A characteristic "wheel spoke" appearance with a central eosinophilic nucleus and peripheral, basophilic merozoites; they are more commonly found in peripheral blood, spleen, and bone marrow.



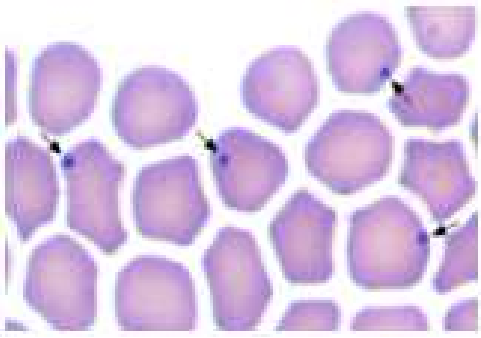
Theileria

- Small, appear in comma, round, ovoid shapes.



Anaplasma

- Small spherical bodies red to dark red in colour when stained with Romanowsky stain.



PACKAGE OF PRACTICES

India has huge livestock population with huge potential to support growth of Indian economy. Among many limiting factors in development of this sector is the fact that majority of livestock farmers are unaware about the package and practices to be implemented for maintaining good health to their animals. A good package and practices for maintaining health and productivity of livestock is required and awareness among animal farmers can bring revolutionary change in this sector. With this as objective, package and practices for different strategies for maintaining health and productivity of animals has been attempted and advised to be implemented under strict supervision of a veterinarian.

Vaccination

1. Animal diseases cause huge losses to livestock industry. Prevention of the sediseasesis possible by protecting the animals by prophylactic and strategic vaccination.
2. "*Prevention is better than Cure*" is age old proverb which proves its worth by routine vaccinating
3. Vaccination is done at specific age and at definite time interval against specific disease(s) using 'vaccine' to give optimal protection to the animals.
4. Preferably de worming should be ensured at least one week in advance before vaccinating.
5. Vaccination schedule may vary depending on the prevalence of disease



What to Do:

- Deworm must be done at least one week before vaccination and follow schedule.
- Use Only sterilized disposable syringes and needle; administer either SCorIMonly.
- Always follow the instruction given by the vaccine manufacturer
- Ensure vaccine is not expired and cold chain (2 -8Â°C)isnot broken.

What to Avoid:

- Avoid vaccinating sick and weak animals.
- Avoid stressing the animals until 2 weeks post-vaccination.
- Avoid administering antibiotics & immunosuppressant until 2 weeks post vaccination.

Routine Pro phylactic schedule for Domestic animals

Disease and animal	Vaccine	Dose and Method	Age and time of vaccination
FMD: Cattle, Buffalo, Sheep, Goat, Swine	FMD inactivated polyvalent vaccine	Cattle, Buffalo and Sheep: 2 ml Goat and Swine :1ml Method:IMroute	First dose at 4 month of age. Booster: at 6 month of age repeated every 6 month interval. Appropriate time : March- April and Sept- October
PPR: Goat and sheep	Live attenuated PPR vaccine	Sheep and Goat : 1ml Method:S/Croute	First Dose at 4 months of age Revaccinate once in 3 years. Avoid vaccination in advance pregnancy
Rabies In all species of domestic animal	Inactivated cell culture vaccine	In all species:1ml Method: IM route	Rabies vaccine in domestic animals is given only after bite from suspected rabid dog. **Schedule**: day 0 of the dog bite,3rd day,7th day, 14th day, 28th day, 90th day
Sheep and Goat Pox: Sheep and Goat	Sheep and Goat pox vaccine	Goat & Sheep: 0.3 gm triturated vaccine mixed with 30ml Glycerine for100 animals. Method : S/C or IM route	First dose at 3 months of age Booster repeated every year
Swinefever: Swine	Lapinized swinefever vaccine	Swine: 1ml Method: IM route	First Dose at 2 months interval Booster every year
Haemorrhagic speticemia: Cattle, Buffalo, Sheep, Goatand Swine	H. Soilad juvant vaccine	Cattle and Buffalo:3ml Sheep, Goat, Swine and calves: 2ml Method: IMor S/C route	First dose at 4-6 months of age. Booster repeated every year preferably before rainy season (May -June)
Anthrax: All domestic animals	Anthrax live spore vaccine	Cattle, buffalo and horse:1ml Swine, sheep and Goat: 0.5ml Method: IM route	First dose at 6 months of age Booster repeated every year preferably in the month of May to June
Black Quarter: Cattle, buffalo, sheep and goat	Polyvalent BQ vaccine	Cattle and Buffalo:5ml Sheep and Goat:2-3ml Method:S/C route	First Dose at 6 month of age. Booster repeated every year, preferably before monsoon season

Brucellosis: Cattle and buffalo	*Brucella abortus* Strain -19 live vaccine	Cattle and Buffalo: 2ml Method: S/C route; Do not vaccinate male calves and pregnant animals	Single Dose at 4-8 months of age
Tetanus: All domestic animals	Tetanus toxoid vaccine	Cattle, buffalo and horse:Â 1500-3000 units Swine, sheep and goat: 500-1500 units Method:IM route	First Dose: First dose at 1 month of age Booster at month interval. Pregnant cattle, buffalo and horse: 6-7 months of gestation Swine at 2-3 months of age Pregnant Sheep, goat, swine at 3-4 months of gestation
Enterotoxemia: Sheep and Goat	Entertoxemia vaccine	Sheep and Goat: 3-5 ml Method:S/C route	2 doses of vaccine at 21 days interval and repeat annually with two doses of vaccine at 21 days interval
Equine Abortion: Horse	*Salmonella abortusequi* vaccine	Horse: first two doses 10 ml and third dose 20ml and to be repeated at 10 days interval Method:IM route	Booster every year

DEWORMING

Package and practices for control of endoparasite:

1. Endoparasites in general are responsible for poor weight gain, depraved appetite, reduced fertility and stress to the animals.
2. Control of endoparasite is possible by regular prophylactic deworming of animal using potent anthelmintic.
3. Anthelmintic should be used based on age, gestational status and species of the animal.
4. Preferably, anthelmintic should be changed at frequent interval, to avoid resistance in animals.
5. Therapeutic deworming should be done based on faecal examination and eggs per gram.
6. Maintaining good hygiene and sanitation of animal houses and feeders is very important to control parasitic load in stall-fed animals
7. Rotational grazing is important in control of parasite in pasture grazed animals.
8. Vector and intermediate host control is also important aspect for control of endoparasite.

Deworming Schedule for livestock

S No	Endoparasite	Name of parasite	Anthelmentic	Dose	Route	Remarks
1	Round worms	*Ascaris*	Piperazine (220mg/1kg body wt.)	30ml for cattle, buffalo, horse, calves, sheep & goats	Oral	First dose to be given within 5 to 6 days of birth Repeat at 45 days intervals intervals.
			Tetramisole	15mg/kg body weight	Oral Single dose	
			Morantel Citrate	10mg/kg body weight	Oral	
			Levamisole	7.5 mg/kg body weight	Oral, once	
2	Flat (Fluke)	Liver fluke	Oxyclozanide	10-15 mg/Kg body weight	Oral, once	Deworm at 4-6 month interval
	Worms	Amphiostome				
			Fenbendazole	5-7.5 mg/Kg body weight	Oral, once	
			Albendazole	5-10 mg/kg body weight	Oral, once	
			Tricalbebdazole	10-12 mg/kg body weight	Oral, once	
			Rafoxanide	7.5mg/kg body weight	Oral	
3	Tape Worms	Cestodes	Dichlorophen	0.5 mg/kg body weight	Oral	Deworm at 4- 6 month interval
			Albendazole	5-10 mg/kg body weight	Oral, once	
			Fenbendazole	5-7.5 mg/kg body weight	Oral, once	

Package and practices for control of ectoparasite:

1. Ectoparasites are responsible for economic losses to livestock producers
2. Direct losses are as a result of distress and damage to hides and fleeces caused by the parasite
3. Distress results in decrease in milk production and poor growth rate
4. They can also cause direct damage to hides and wool
5. Indirect losses are from diseases transmitted by the ecto-parasites
6. Annually in a farm pesticide application should be carried out at 4 month interval.
7. The pesticides used of ectoparasite control are poisonous and should be kept away from reach of children and farm animals.
8. Avoid application in adverse weather
9. Provide plenty of drinking water before application to prevent animals from licking after application

List of important diseases transmitted by ectoparasite

S No.	Ectoparasite	Important disease Transmitted
1	Ticks	Babesiosis, Anaplasmosis, Theileriosis
2	Flies	Mastitis, Keratoconjunctivitis, Trypanosomiasis
3	Midges	Bluetongue, African Horse Sickness

Common pesticides used for control of ectoparasite in animals:

Pesticides	Uses	Doses
Cypermethrin 10% w/v	Ticks, lice, flies, mites, midges and keds	Dilute 1 ml to 2ml in 1 litre of water and apply on whole body as spray or bath Repeat after 15 days to kill the newly emerged larva and Adults from egg
		**For Animal Houses: Dilution rate is 20ml/lit of water
Deltamethrin 12.5mg/ml	Tick, lice, mite, flies, keds, etc.	For Tick: Dilution rate 2 -3 ml/Lit of water For Mites: 4-6ml/lit of water For Lice: 1-2ml/lit of water For Fly: 2 -3ml/lit of water
Amitraz 12.5% w/v	Tick, Fleas, Mange, lice	Dilute 2-4ml per lit of water and spray or wash all over the body. Repeat the application 3 times at 15 days interval
Ivermectin 1% w/v 200 mcg/Kg body weight	Sarcoptic Mange	Dog: 0.2ml/33 Kg body weight Pig: 1ml/33 Kg body weight the Animals: 1ml/50 Kg body weight by s/c route

Package and practices for Coccidiosis:

- Coccidiosis is very common protozoal disease, caused by Eimeria spp.
- Commonly a disease of young cattle (1-2 month to 1 year) and poultry birds
- Usually occurs during the rainy and winter seasons of the year and stress acts as pre - disposing factor.

Drug dose schedule for treatment and prevention:

Drug	Treatment	Prophylactic dose
Amprolium Sulfaquinoxaline	10 mg/kg/day for 5 days 13.2mg/kg/day(3 -5days)	5 mg/kg/day for 21 days

COMMONLY USED ANTIBIOTICS IN NEONATES

1. Young ones of cow, horse, sheep, goat and pigs are susceptible to contagious bacterial infections as well as opportunistic bacteria present in the environment.
2. Neonates are more prone to bacterial infection during early age due to immature immune system, so antimicrobial therapy is a cornerstone of treatment of neonatal infections.
3. The most common infections occurring in neonates include diarrhoea, pneumonia, septicaemia, endotoxemia, omphalophlebitis, osteomyelitis, meningitis, septic arthritis etc.
4. As sepsis progresses very rapidly in neonates, it is of utmost importance to start antibiotic therapy as early as possible upon anticipation of sepsis.
5. Generally broad spectrum antibiotic coverage should be started pending the results of culture and sensitivity.
6. Bactericidal drugs are mostly preferred to treat neonatal infections taking into consideration the immature immune system of neonates.
7. In cases of neonates generally large doses with longer dosage interval are administered to achieve optimum pharmacokinetic parameters to increase efficacy of antibiotic treatment.

Commonly used antibiotics in neonatal calves

S No.	Drugs	Dose regime
1	Ampicillin Sodium	5-10 mg/kg PO or IV every 12 hrs.
2	Ceftiofur Sodium	10 mg/kg PO or IV every 12 hrs.
3	Enrofloxacin	2.5-5 mg/kg PO or IV every 12-24 hrs.
4	Erythromycin	2.2-4.4 mg/kg PO
5	Gentamicin	4 mg/kg IM or IV every 12 hrs.
6	Trimethoprim-Sulfonamide	15-30 mg/kg IV every 12 hrs.

Commonly used antibiotics in neonatal foals

S No.	Drugs	Dose regime
1	Amoxicillin trihydrate	25 mg/kg PO every 6-8 hrs.
2	Amoxicillin-Clavulanate	15-25 mg/kg IV every 6-8 hrs.
3	Ampicillin sodium	10-20 mg/kg IV or IM every 6-8 hrs
4	Ceftiofur sodium	10 mg/kg IV every 6-8 hrs.
5	Enrofloxacin	5-7.5 mg/kg PO or IV every 12-24 hrs
6	Trimethoprim-Sulfonamide	15-30 mg/kg IV every 12 hrs.

Package and practice for Fumigation of animal houses

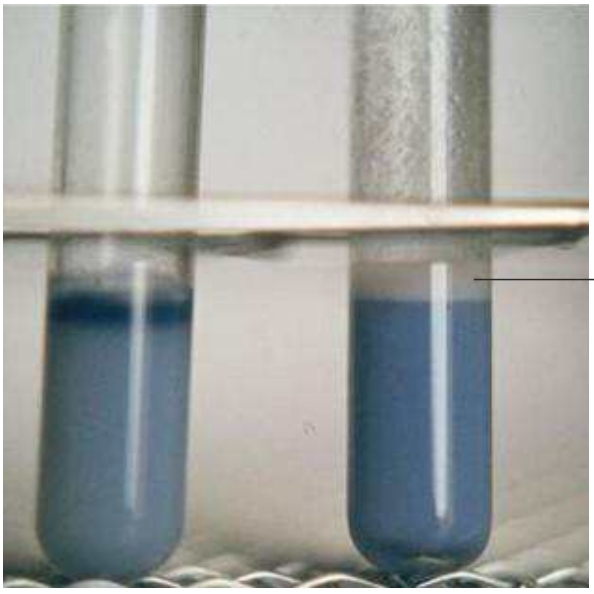
1. Prevention is the best strategy ever.
2. Fumigation practice is most commonly followed in animal houses where houses are generally fumigated before stocking of new batch.
3. Fumigation is a technique for the disinfection of a shed so that fresh batch of birds/animals will get the disease free environment and to check the vermin population in the animal houses.
4. Fumigation is generally done with mixture of potassium permanganate and formalin (3:5). Flaming is another suitable technique with minimal cost input. Gluteraldehyde is also effective disinfectant for animal houses.
5. Fumigation is generally done in the evening

MICROBIOLOGY

MILK EXAMINATION

I.Milk Ring Test:

This is a simple and sensitive method of detecting Brucella infection in milk, known as milk ring test. In this test, a Brucella antigen stained with hematoxylin is added to milk. Any agglutinins in the milk, which are carried by the cream as it rises to the surface, react with the antigen



Positive test:

The Milk Ring Test (MRT) can be used to detect Brucella antibodies in tank milk if the following points are considered:

(1) Before testing, the milk must be stored at least 72 hours at 6^{0} C.

(2) To obtain a reliable reaction one must use 8 ml milk and 0.8 ml antigen, instead of 1 ml milk and 0.05 ml antigen.

(3) The 4 vol.% antigen appears to be more sensitive than the 5 vol.% antigen.

(4) A standard negative milk sample should be included in a batch to be examined. It can help to determine doubtful results.

(5) For further determination of a doubtful result obtained from the 1 ml milk reaction, 3 ml milk and 0.05 ml antigen can be used.

II. Antibiotic Sensitivity Test

What is an antibiotic sensitivity test?

Antibiotics are medicines used to fight bacterial infections. There are different types of antibiotics. Each type is only effective against certain bacteria. An antibiotic sensitivity test can help find out which antibiotic will be most effective in treating the infection.

The test can also be helpful in finding a treatment for antibiotic-resistant infections. Antibiotic resistance happens when standard antibiotics become less effective or ineffective against certain bacteria. Antibiotic resistance can turn once easily treatable diseases into serious, even life-threatening illnesses.

Other names: antibiotic susceptibility test, sensitivity testing, antimicrobial susceptibility test

What is it used for?

An antibiotic sensitivity test is used to help find the best treatment for a bacterial infection. It may also be used to find out which treatment will work best on certain. Bacterial infections.

Why do I need an antibiotic sensitivity test?

This test may need if an infection that has been shown to have antibiotic resistance or is otherwise hard to treat. These include tuberculosis, Mithicillin Resistant Staphyloccus Aureus and C. diff. You may also need this test if you have a bacterial infection that is not responding to standard treatments.

What happens during an antibiotic sensitivity test?

The test is done by taking a sample from the infected site. The most common types of tests are listed below.

Blood culture

- Blood sample may be collected from the vein using a suitable needle. After the needle is inserted, a small amount of blood will be collected into a test tube or vial.

Urine culture

- You will provide a sterile sample of urine in a cup.

Wound culture

- Special swab to collect a sample from the site of wound or site of infection

Sputum culture

- You may be collected the sputum into a special sterile cup, or a special swab may be used to take a sample from mouth.

Will I need to do anything to prepare for the test?

There are no special preparations needed for an antibiotic sensitivity test.

Are there any risks to the test?

There is little risk to having a blood culture test to restrain the animal and locate the vein. Animal may have slight pain or bruising at the spot where the needle was put in, but most symptoms go away quickly.

There is no risk to having a urine, sputum, or wound culture.

What do the results mean?

Results are usually described in one of the following ways:

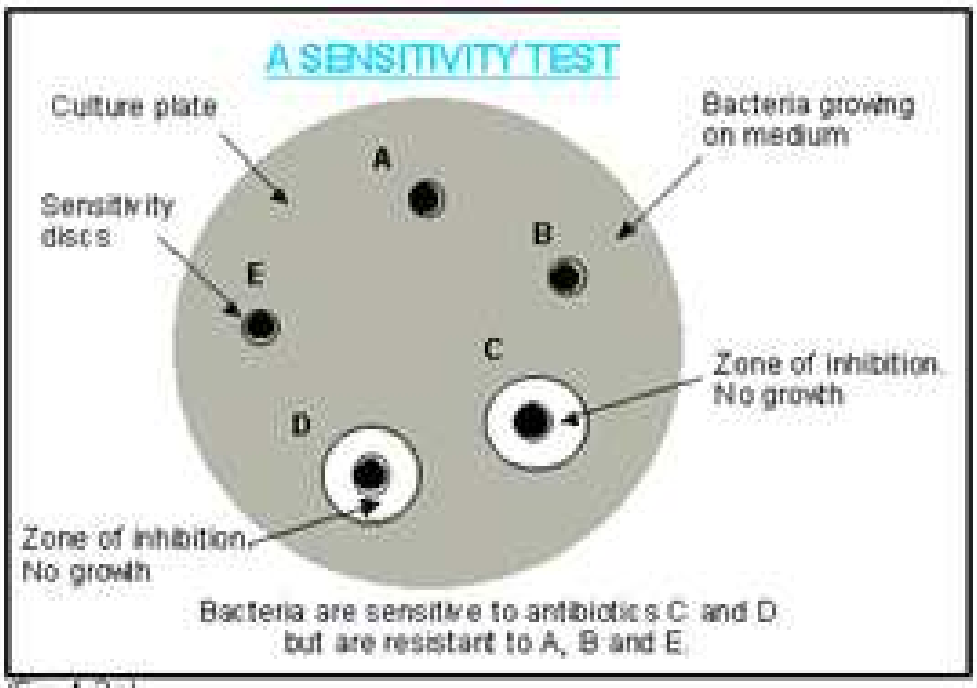
- **Susceptible.** The tested medicine stopped the growth or killed the bacteria or fungus causing your infection. The medicine may be a good choice for treatment.
- **Intermediate.** The medicine may work at a higher dose for longer period.
- **Resistant.** The medicine did not stop the growth or kill the bacteria causing the infection. It would not be a good choice for treatment.

If you have questions about your results, talk to your veterinary doctor.

Is there anything else I need to know about an antibiotic sensitivity test?

Incorrect use of antibiotics has played a big role in the rise in antibiotic resistance. Make sure you use antibiotics the right way by:

- Taking all doses as prescribed by your veterinary doctor.
- Only taking antibiotics for bacterial infections. They don't work on viruses, like colds and flu.



(Fig.4-3a)

III. Catalase Test

This test is used to identify organisms that produce the enzyme, catalase. This enzyme detoxifies hydrogen peroxide by breaking it down into water and oxygen gas.



The bubbles resulting from production of oxygen gas clearly indicate a catalase positive result.
The sample on the right below is catalase positive.
The *Staphylococcus* spp. and the *Micrococcus* spp. are catalase positive.
The *Streptococcus* and *Enterococcus spp. are* catalase negative.



COLLECTION AND PRESERVATION OF CLINICAL SAMPLES

The most common sample analyzed in a clinical biochemistry laboratory is blood (plasma/serum) sample. Other samples which are analyzed are urine, CSF, dialysate fluid, pleural fluid, peritoneal fluid, pericardial fluid, sinovial fluid, amniotic fluid and spinal fluid etc.

COLLECTION OF BLOOD

Capillary or venous blood is mostly used for almost all analytes

Capillary blood - For small quantity (like blood grouping), collect blood by pricking ear tip of animals with due aseptic precautions.

- Arterial blood - collect from carotid artery
  - for arterial blood pHand gas analysis
- Venous blood - For large quantity:
- Serological examination - collect blood without anticoagulant
- Plasma and whole blood - collect blood in anticoagulant added vial

Venous blood:

Materials required: Scissors, Cotton, Spirit, Needle/ Lancet, Syringe, Blood collection vials and Tourniquet.

Procedure :

- Locate the vein, clip hair and sterile the area with alcohol, ether or tincture of iodine.
- Apply tourniquet above the collecting site to raise the vein.
- Insert the needle in to the raised vein and draw requisite amount of blood directly into the collection vial/ vacutainer or in to the dry syringe and disengage the needle, insert the syringe into the vial very near to its bottom and allow the blood to flow out without exerting any pressure on the piston. Avoid injection of air bubbles.
- After collecting blood apply sterile swab with gentle pressure over the punctured site and withdraw the needle.
- Close the vial and gently mix the blood and anti coagulant by repeated inversion or circular movements of vial without causing rupture of R.B.C (haemolysis) or froth formation. Don't shake vigorously to avoid haemolysis.



BLOOD COLLECTION SITES OF DIFFERENT ANIMALS

Animal	Site	Needle gauge	Needle length (inches)
Cattle, large wild animals	Jugular vein, ear vein, tail vein	16-19	1.5-2
Horse	Jugular vein, cephalic vein	16-19	1.5-2
Sheep & Goat	Jugular vein/ tail	18-20	1.5-2
Dog	Cephalic/ Saphenous/ Jugular vein	20-22	1.5
Pig	Ear vein/ Ant.venacava/ tail	20	1.5-4
Cat	Ear/Cephalic/femoral/saphenous vein	20-22	1
Rabbit & Guinea pig	Ear vein / Cardiac puncture	19-21	3
Birds	Wing vein/ Cutaneous vein/comb	18	3
Rat & Mouse	Orbital sinus/ cardiac puncture/ tip of the tail	19 - 21 or Micro blood collecting tubes	

Suggestions for collection of blood:

1. Collect blood when the animal is at rest. Overexcitement can alter blood chemistry
2. Fast the animal before collection of blood, otherwise lipemia may interfere in assays.
3. Use dry syringe and remove needle before filling the collecting vial to avoid hemolysis.
4. Serum is preferred than plasma because of possible interference by anticoagulants.
5. Inadequate amount and improper mixing of anticoagulant may clot the blood.
6. Do not collect blood more than 0.5 ml/kg body weight.

Anticoagulants which can be used:
EDTA, Heparin, Sodium Citrate, Sodium fluoride, Acid- citrate – dextrose solution (ACD), Oxalates

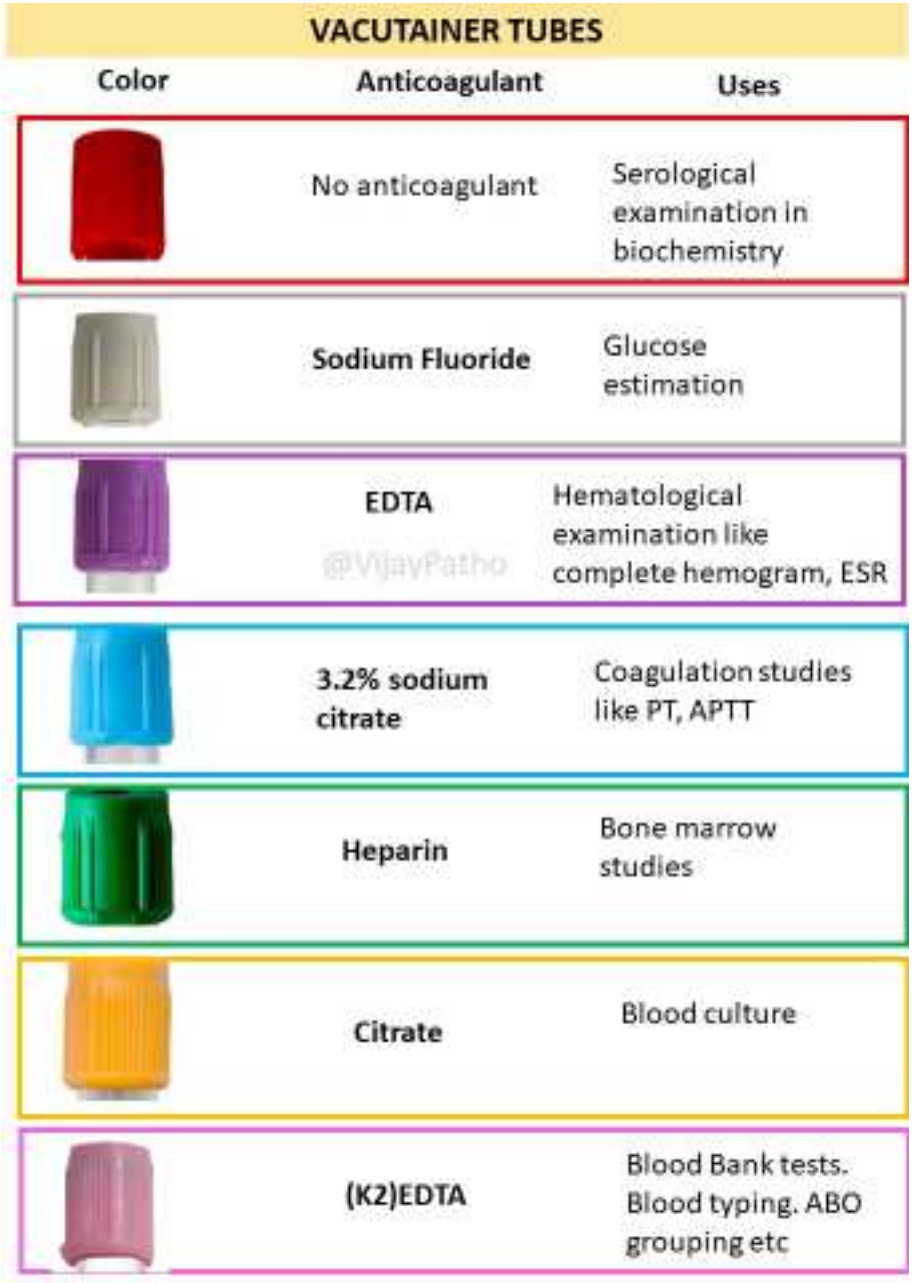


flashback needle for collecting blood in vacutainers

Effect of Anticoagulants on Laboratory Results

Anticoagulants	Test affected	Alteration
EDTA / Oxalate / Citrate	Alkaline Phosphatase , Creatine Kinase, Lipase, Amylase, Sorbitol dehydrogenase, Calcium	Decrease
Sodium Fluoride	Glucose	Decrease if GOD method
	Amylase	Increase
Heparin	Potassium	Increase
Oxalate	LDH	Decrease
Ammonium Oxalate / Heparin	Urea nitrogen	Increase

Types of blood collection tubes/ vacutainers



Collection of plasma:

Centrifuge whole blood (after adding anticoagulant) within 1 hour after collection, at 2000-3000 rpm for 10 minutes. Transfer the supernatant (plasma) into another container for further analysis.

Collection of serum: Collect whole blood (without anticoagulant) and allow it to clot for 20-30 minutes at room temperature by keeping it in maximum possible slant position, so that most surface area is exposed. Separate the serum from clot and preserve the serum for analysis.

Volume of sample:

In dehydrated animal, 10 ml of blood yields 3 ml of serum

In hydrated animal, 10 ml of blood yields 5 ml of serum.

Minimum Serum/Plasma volumes required for various tests

S.No.	Name of the test	Volume of Serum/Plasma (ml)
1	ACTH	0.5
2	Alanine amino transferase (ALT)	0.3
3	Albumin	0.3
4	Aldosterone	0.8
5	Alkaline phoshatase	0.3
6	Amylase	0.3
7	Aspartate amino transferase (AST)	0.3
8	Bilirubin (total)	0.3
9	Bilirubin (direct)	0.3
10	Cholesterol	0.3
11	Creatine kinase	0.3
12	Creatinine	0.3
13	Electrolytes	0.3
14	Electrophoresis (SPE)	0.3
15	Estradiol	0.8
16	Gastrin	1.2
17	GGT	0.3
18	Glucose	0.3
19	Growth hormone	1.2
20	Hepatitis screen	0.75
21	Hb A1C	0.1
22	Ketone bodies	0.2
23	LDL cholesterol Total Cholesterol	0.3 0.3
24	Insulin	0.8
25	Phosphate	0.3
26	Potassium	0.3
27	Progesterone	0.4
28	Prolactin	0.6
29	PTH	0.3
30	Renin	0.9
31	T_3 (total)	0.3
32	T_3 (free)	0.3
33	T_4 (free)	0.3
34	Testosterone	0.4

S.No.	Name of the test	Volume of blood (ml)
35	Thyroglobulin	0.3
36	Total protein	0.3
37	Triglyceride	0.3
38	TSH	0.5
39	Urea	0.3

Serum samples expiration time for Blood Chemistry (Santos, 2006).

Parameter	Type of Sample	Expiration of the Sample
Glucose	serum	immediate use only *
Total Protein, Albumin	serum	3 days, at 2 - 8°C, 1 week at 10°C
Triglycerides	serum or plasma (EDTA or heparin)	3 days, at 2 - 8°C, 1 month at 10°C
Cholesterol	serum or plasma (EDTA)	1 week, at 2 - 8°C, 3 months at 10°C
Creatinine	serum or plasma (EDTA or heparin) or urine	1 week at 2 - 8°C
Na, K, P	serum or plasma (EDTA or heparin)	1 week at 2 - 8°C
Ca, Cl, Mg	serum or plasma (EDTA or heparin) or urine	1 week at 2 - 8°C
Amylase	serum or plasma (EDTA or heparin) or urine	24 hours at 15 - 25°C, 2 months at 2- 8°C
ALP	serum or plasma (heparin)	6 hours at 2 - 8°C, several months at 10°C
AST	serum or plasma (EDTA or heparin)	4 days at 2 - 8°C, 1 week, at 10°C
Cholinesterase	serum or plasma (EDTA or heparin)	1 week at 2 - 8°C
CK	serum or plas ma (EDTA or heparin)	24 hours at 15 - 25°C, 1 week at 2- 8°C
GGT	serum or plasma (EDTA or heparin)	2 weeks at 2 - 8°C, 1 week at 10°C
Lipase	serum or plasma (EDTA or heparin)	24 hours at 15 - 25°C, 1 week at 2- 8°C
SDH	serum or plasma (EDTA or heparin)	4 days at 2 - 8°C, 1 week at 10°C

Serum samples expiration time for Blood Chemistry (Santos 2006).

Parameter	Type of Sample	Expiration of the Sample
Total Lipids	serum or plasma (EDTA)	10 days at 2 - 8°C
Total Bilirubin	serum	4 days at 2 - 8°C safe from light, 3 months at 10°C
Uric Acid	serum or plasma (EDTA or heparin) or urine	3 days at 2 - 8°C, 1 week at 10°C, 6 months at 20°C
BUN	serum or plasma (EDTA or hepar in) or urine	12 hours at 15 - 25°C, 1 week at 2 - 8°C, 3 months at 10°C

* Addition of sodium fluoride anticoagulant in blood will preserve the sample for atleast 3 days

BASIC TESTS PROFILES

Basic Metabolic Panel	Sodium, potassium, calcium, chloride, carbon dioxide, glucose, blood urea nitrogen and creatinine
Compton metabolic profile test	13 parameters – PCV, hemoglobin, blood glucose, BUN, total protein, calcium, inorganic phosphorus, magnesium, potassium, sodium, copper, iron
Mini metabolic profile test	Glucose, albumin, urea nitrogen
Polydipsic patients profile	calcium, glucose, and cholesterol for differential diagnosis Calcium allows recognition of hyperparathyroidism and other causes of hypercalcemia (which causes polydipsia and renal insufficiency) Glucose picks up diabetes mellitus and contributes to the pattern characteristic of Cushing's disease Cholesterol also adds to the appreciation of the "Cushing's pattern."
Collapsing patients Profile	Calcium and glucose to screen for hypocalcemia or hypoglycemia
Large animal Kidney Profile (KFT)	Creatinine, Blood urea nitrogen, Phosphorus, Calcium, Protein
Small animal kidney profile (KFT)	Total Protein, Albumin, Globulin, A:G Ratio, Urea, Creatinine, Glucose, Calcium, Phosphorus, Sodium, Potassium, Chloride, Na:K Ratio.
Hepatocellular leakage enzymes Profile (LFT)	ALT, AST, SDH, LDH
Cholestatic enzymes profile	Alkaline phosphatase (ALP), Gamma glutamyl transferase (GGT)
Acute hepatitis Profile	ALT, AST, GGT, total bilirubin, direct bilirubin, indirect bilirubin, bile acids, ammonia, glucose, total protein, albumin, globulin, cholesterol
Addison's disease or hypokalemia Profile	Sodium, Potassium, Na:K ratio, ACTH stimulation test, Aldosterone pre and post value

BASIC TESTS PROFILES

Cushing disease profile	ACTH Stimulation Test, ALT, ALP, Total Protein, Albumin, Globulin, A:G Ratio, Urea, Creatinine, Glucose, Calcium, Phosphorus, Cholesterol.
Pancreatic Profile	Amylase, Lipase, Calcium, Albumin, trypsin like immunoreactivity
Carbohydrate Profile	Glucose, Fructosamine, glycosylated hemoglobin
Lipid Profile	Cholesterol, HDL cholesterol, LDL cholesterol, triglycerides Total cholesterol =HDL +LDL +1/5th of Triglycerides
Muscle Profile	Creatine kinase (CK), AST, ALT, LDH
Cardiac Profile	Creatinine Kinase-MB, AST, LDH, Troponin
Acid-base Profile	Bicarbonate, anion gap
Thyroid profile	Total T_4, Free T_4, TgAA, TSH, ALT, ALP, Total Protein, Urea, Creatinine, Phosphorus, Cholesterol
Food Animal Maxi Profile	Albumin, Anion Gap, AST, Total Bilirubin, Direct Bilirubin,

ESTIMATION PROCEDURE OF THE PARAMETERS

ESTIMATION OF TOTAL PROTEIN (BIURET METHOD)

Principle: Proteins are made up of aminoacids joined by peptide bonds. CO-NH group of protein reacts with cupric ions in alkaline medium forming a purple complex, whose intensity is measured at 540nm. The reaction is so named since biuret (NH_2-CO-NH- CO-NH_2) also gives this test. The intensity of the colour produced is proportional to the no. of peptide bonds and hence to the conc. of protein.

Reagents:

1. Biuret reagent: 3g of copper sulphate is dissolved in 500ml of water. 9g of sodium potassium tartarate and 5g of potassium iodide are added and dissolved. 24g of sodium hydroxide dissolved separately in 100ml of water is added. The volume is made upto 1L with water. The reagent is stored in a well-stoppered polythene bottle.
2. Biuret blank: prepared in the same way, as the biuret reagent with the difference that copper sulphate is not added.
3. Standard protein solution: 6.5g/dl of BSA (bovine serum albumin can be prepared and used as a standard)

Procedure:

1. Take 3 clean and dry test tubes. Label 3 test tubes : blank as (B), standard as (S) and Test as (T).

S.No.	Reagents	Blank	Standard	Test
1	Biuret reagent	3ml	3ml	3ml
2	Biuret blank	0.05ml	-	-
3	Protein standard	-	0.05ml	-
4	Serum sample	-	-	0.05ml

2. Mix the contents thoroughly

3. Leave the test tubes undisturbed for 15 minutes.

4. Measure the optical densities of test and standard against blank at 540nm using a photo colorimeter.

Calculations: Conc of serum total proteins (gm/dl) = $\frac{\text{absorbance of unknown}}{\text{absorbance of standard}}$ x conc. of standard

Note: The above procedure gives reliable result with clear and unhemolysed specimens. If the serum specimen is lipemic, icteric or hemolysed an additional tube (serum blank) should be prepared. 0.1ml of serum should be mixed with 5ml of biuret blank in this tube and read after 30 min. against blank. Absorbance of serum blank should be subtracted from that of unknown before calculation.

ESTIMATION OF SERUM ALBUMIN (BCG dye binding METHOD)

Principle:

Albumin in a buffered medium binds with bromocresol green and produces green color whose absorbance is proportional to albumin concentration and is measured colorimetrically at 6.30 am.

Reagents:

1. Succinate buffer-11.8 gm of succinic acid is dissolved in about 800ml of water. The p^H is adjusted to 4.0 with 0.1N sodium hydroxide. The volume is made up to 1 litre with water.
2. BCG solution-419mg of bromocresol green is dissolved in 10ml of 0.1N NaOH solution. The volume is made to 1litre with water. The solution is stored in refrigerator.
3. Buffered BCG solution 250 ml of BCG solution is mixed with 750ml of succinate buffer. The p^H is adjusted to 4.2 with 0.1N NaOH solution.4ml of Brij-35 solution (30%) is added.
4. Standard albumin solution – an aqueous solution of human albumin with concentration of 3-4 gm /100ml can be prepared and used as standard. Sodium azide should be included in this solution (50gm /100ml) as a preservative.

Procedure:

Take three clean dry test tubes and label them with symbols B, S and T for blank, standard and test respectively. Then add the reagents as per the following tables:

Contents	Blank	Standard	Test/sample
Buffered BCG solution	4.0ml	4.0ml	4.0ml
Distilled water	0.02ml	---	
Albumin standard	---	0.02ml	---
Serum/plasma	---	---	0.02ml

After adding the solutions as shown in the table mix them well and read the absorbance of the standard and the test sample after 5min. against blank solution at a wave length of 630nm using spectrophotometer.

Calculations:

Albumin (gm/100ml) = O.D of test sample x conc. of stand(gm/100ml)
O.D of standard

Globulin gm% = total protein – albumin

ESTIMATION OF TOTAL SERUM CHOLESTEROL (FERRIC CHLORIDE METHOD)

Principle: Cholesterol reacts with ferric chloride in acidic medium to produce a red coloured complex. The intensity of the colour developed is proportional to the cholesterol concentration in the given serum sample. It is measured colorimetrically at 520 nm using a photo colorimeter

Reagents:

1. Ferric chloride reagent: Dissolve 2.5g of ferric chloride in 50ml of o- phosphoric acid taken in a 100ml volumetric flask. Make up the volume to 100ml with o- phosphoric acid
2. Acetic acid
3. Standard cholesterol solution(100mg%) : Dissolve 100mg of cholesterol taken in 50ml glacial acetic acid taken in a 100ml volumetric flask. Then make up the volume to 100ml with glacial acetic acid.
4. Serum sample

Procedure:

1. Label 3 test tubes Test (T), standard (S) and blank (B).
2. Add the reagents in the three test tubes as shown in the following table.

S.No	Reagents	Blank	Standard	Test
1	$FeCl_3$ reagent	3ml	3ml	3ml
2	Acetic acid	0.1ml	-	-
3	Cholesterol standard	-	0.1ml	-
4	Serum sample	-	-	0.1ml

3. Mix the contents thoroughly.
4. Boil the contents in the test tubes for 2 minutes in a water bath at 100^0 C.
5. Measure the optical densities of test and standard against blank at 520nm using a photo colorimeter.

Calculations:

Serum total cholesterol (mg/100ml) = Absorbance of test x concentration of standard
Absorbance of standard

ESTIMATION OF SERUM GLUCOSE (O-TOLUIDINE METHOD)

Principle: The terminal aldehyde group of glucose reacts with O- toluidine in the presence of hot glacial acetic acid to form a blue green coloured complex. The intensity of the colour developed is proportional to glucose concentration in the serum sample. It is measured colorimetrically at 630nm using a photo colorimeter. One of the advantages of this method is that it can be directly applied to plasma without the precipitation of proteins. It is specific for aldose sugars, galactose and

mannose. Because blood contains no significant amounts of aldoses other than glucose, the values are taken as true glucose.

Reagents:

1. O- toluidine reagent: About 300ml of glacial acetic acid is taken in a liter volumetric flask. 1.5gm of thiourea and 9.5g of sodium borate are added successively and dissolved. 80ml of o-toluidine is added. The volume is made up with glacial acetic acid.
2. Glucose standard (100mg%): 100mg of glucose is dissolved in some saturated benzoic acid solution and volume is made up to 100ml with standard benzoic acid solution. Benzoic acid acts as preservative..
3. Trichloroacetic acid (3%): 3gm of TCA is dissolved in distilled water and diluted to 100ml.
4. Serum sample
5. Distilled water.

Procedure: Direct method:

1. Take 3 clean & dry test tubes and label them as B(for blank), S(for standard),and T(for test).
2. Add the reagents in the three test tubes as shown in the following table.

S.No	Reagents	Blank	Standard	Test
1	O-toluidine reagent	4ml	4ml	4ml
2	Distilled water	0.02ml	-	-
3	Glucose standard	-	0.02ml	-
4	Serum sample	-	-	0.02ml

1. Mix the contents thoroughly.
2. Boil the contents in the tubes for 10 minutes in a water bath at 100^0C.
3. Measure the optical densities of test and standard against blank at 630nm using a photo colorimeter.

Indirect method:

Take 0.9 ml of 3% TCA in 3 test tubes labeled as unknown, standard and blank. Add 0.1ml of blood (plasma or serum) to unknown, standard glucose solution to standard and water to the blank. Mix well and centrifuge or filter unknown. Transfer 0.2ml from each tube into correspondingly labeled test tubes containing 4ml of O- toulidine reagent. Proceed as in the direct procedure.

Calculation:

$$\text{Serum glucose concentration (mg/dl)} = \frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times \text{Concentration of standard}$$

ESTIMATION OF BLOOD UREA NITROGEN (DIACETYL MONOXIME METHOD)

Principle:

When urea is treated with substances such as diacetyl monoxime (containing two adjacent carbonyl groups) in hot acid solution, will give colored product that is read colorimetrically at 480 nm

Reagents:

1. 10% Sodium tungstate
2. $^{2}/_{3}$ N H_2SO_4
3. 2% DAM solution in 2% acetic acid: 2g of solid DAM is added to about 60 ml of water and then 2ml of glacial acetic acid is added. Shake the contents to dissolve with slight warming if necessary. Make upto the mark 100ml with distilled water.
4. H_2SO_4 - H_3PO_4 reagent: 150 ml of 85% phosphoric acid is added to 140 ml of distilled water. Mix well and then add 50 ml of conc H_2SO_4 slowly by mixing.
5. Stock standard: 250 mg of urea dissolved in 100ml of distilled water.
6. Working urea standard: 2ml of stock standard is made upto 100 ml with distilled water.

Procedure:

1. Take 0.1 ml of blood. Add 3.3ml of distilled water followed by 0.3ml of sodium tungstate and 0.3 ml of 2/3 N H_2SO_4. The tube is centrifuged and 0.5ml of supernatant is taken (or the contents are filtered and the filtrate is taken) in the sample test tube.
2. 0.5 ml of urea standard in standard tube and 0.5ml of distilled water should be taken in blank
3. Then add 0.4 ml of DAM reagent followed by 1.6 ml of H_2SO_4 - H_3PO_4 reagent to all the tubes. Then keep all the tubes in boiling water bath for 20 mins.
4. After cooling the colour developed in test and standard tubes is read against blank at 480nm colorimetrically.

Calculation:

$$\text{Conc of Blood urea (mg/dl)} = \frac{\text{absorbance of test}}{\text{absorbance of standard}} \times \text{onc. of standard} \times \frac{\text{vol of filtrate prepared}}{\text{vol of filtrate taken}} \times \frac{100}{\text{vol of blood taken}}$$

Blood urea nitrogen = Blood urea conc. (mg/dl) x 0.467

ESTIMATION OF SERUM CREATININE (ALKALINE PICRATE METHOD)

Principle: Creatinine develops an orange red colour when treated with the picric acid in the presence of strong alkali, forming creatinine picrate.

Reagents:

1. 1% picric acid or 0.04 M picric acid solution
2. 0.75 N NaOH : 30g of NaOH dissolved in 1lit. of distilled water.
3. Creatinine standard: 1mg of creatinine dissolved in 100ml of distilled water.

Preparation of samples:

Urine sample: It is diluted 20 times with distilled water.

Blood sample: for blood or serum for the analysis of creatinine in blood or serum protein free filtrate is prepared.

Preparation of protein free filtrate:

a. Sodium tungstate 10%
b. $^{2}/_{3}$ N H_2SO_4

Take 1 ml of whole blood or serum in a boiling /wide bore test tube. Add 7 ml of distilled water, 1ml of 10% sodium tungstate and 1 ml of $^{2}/_{3}$ N H_2SO_4. Mix the contents of the tube and allow it to stand for a while. Filter the contents of the tube by using whatman No.1 filter paper.

Procedure:

1. Take 3 clean & dry test tubes and label them as B (for blank), S (for standard) and T(for test).
2. Take 3ml of distilled water in B, 3 ml of working standard in S and 3ml of protein free filtrate or dilute urine in T.
3. To all the tubes add 1ml of picric acid solution and mix.
4. Add 1 ml of 0.75 N NaOH reagent to all the tubes and mix.
5. Keep all the test tubes in a dark place for 15 minutes.
6. Read the tubes at 520 nm against blank.

Calculation:

In serum

$$\text{Conc. of creatinine(mg/dl)} : \frac{\text{absorbance of test}}{\text{absorbance of standard}} \times \text{conc. of standard} \times \frac{\text{vol of filtrate prepared}}{\text{Vol. of filtrate taken}} \times \frac{100\ (\text{mg/dl})}{\text{vol. of blood}}$$

In Urine

$$\text{Conc. of creatinine (mg/dl)} = \frac{\text{absorbance of test}}{\text{absorbance of standard}} \times \text{conc. of standard} \times \text{dilution factor in Urine}$$

ESTIMATION OF SERUM CALCIUM (O-CRESOLPHTHALEIN COMPLEXONE METHOD)

Principle: Calcium forms a purple-coloured complex with ortho-cresolphthalein complexone in an alkaline medium. The inclusion of HCl helps to release calcium bound to proteins and 8 hydroxy-quinoline eliminates the interference by magnesium. 2-amino, 2-methyl, 1- propanol (AMP) provides the proper alkaline medium for the colour reaction. The intensity of the colour is measured at 540nm.

Reagents:

(a) AMP Buffer pH 10. 7: Measure 37.8 ml of AMP reagent and add 150 ml of distilled water and mix. Adjust the pH to 10.7 with 6N HCl and make up to 250 ml with distilled water. The buffer is stable for 3 weeks under refrigeration in brown coloured bottle.

(b) Colour reagent: Add 15 ml conc. HCl to a 250 ml volumetric flask containing about 25ml of distilled water. Transfer with washing 25 mg O-Cresolphthalein complexone powder into it, mix to dissolve. Then add 250 mg of 8 hydroxy-quinoline and dissolve and then make up to 250 ml with distilled water. The reagent is stable for a month in brown coloured glass bottle at room temperature.

(c) Stock calcium standard solution (50 mg/dl): Before weighing, dry calcium carbonate at 100^0C for 2 hours. Allow to cool in a desiccator. Dissolve 625 mg of dried calcium carbonate in 50 ml of distilled water taken in a 500 ml volumetric flask and add 3.5ml Conc. HCl. Mix to dissolve and make up to 500 ml with distilled water. The solution is stable for 6 months in a brown bottle at room temperature.

(d) Working standard solution (10 mg /100ml): Take 20 ml of stock calcium standard in a standard flask and dilute to 100 ml with benzoic acid. The solution is stable for two months.

Precautions:

1. Use of plastic tubes for assay is recommended.
2. Contamination of glassware with calcium, usually from detergents, is a problem of this assay. Therefore glassware should be washed with dilute hydrochloric acid and rinsed with high purity deionised water before use.
3. Serum should be separated without adding EDTA.

Procedure:

1. Take three test tubes and label them as B, S and T.
2. Add 0.1 ml of distilled water, standard and sample solution into B, S and T test tubes respectively.
3. Add 2 ml of colour reagent and 2 ml of buffer to all the test tubes. Shake thoroughly and incubate at room temparature for 15 min.
4. Measure the absorbance of standard, test against the blank at 540 nm using spectrophotometer.

	Blank	Standard	Test
Distilled water (ml)	0.1	-	-
Standard (ml)	-	0.1	-
Test sample (ml)	-	-	0.1
Colour reagent (ml)	2.0	2.0	2.0
Buffer (ml)	2.0	2.0	2.0

Calculations:

$$\text{Concentration of Calcium in mg \%} = \frac{\text{OD of test}}{\text{OD of std}} \times \text{conc of standard}$$

ESTIMATION OF SERUM INORGANIC PHOSPHORUS (PHOSPHOMOLYBDATE METHOD)

Principle:

Phosphorous present in protein free filtrate react with ammonium molybdate in acidic medium to form phosphomolybdic acid which is reduced to molybdenum blue by 1, 2, 4- aminonaphthol sulfonic acid (ANSA) which is measured at 680 nm.

Reagents:

1. 2.5% Ammonium molybdate solution in 5 N Sulfuric acid.
2. 10% Trichloro acetic acid solution.
3. ANSA reagent: Add 0.5 g of ANSA to 195 ml of 15% sodium bisulfite solution and add 5ml of 20% sodium sulfite solution, Mix and filter. Store in brown color bottle in a refrigerator. (the reagent is stable for 4 weeks)
4. Stock Standard phosphorous solution (0.08 mg/ ml): dissolve 0.3514g of pure dry potassium dihydrogen Phosphate (KH_2Po_4) in about 200 ml of water. Add 10ml of sulfuric acid and make up the volume to one litre.

5. Working standard solution (0.008 mg/ml): dilute 10ml of stock phosphorous standard up to 100ml with 10% trichloroacetic acid.

Procedure:

1. Take 1.0ml of serum in a test tube and add 9ml of 10% TCA and mix. Filter and use the filtrate for color development.
2. Take 5 ml of working standard solution in standard tube labeled as S
3. Take 5ml of protein free filtrate in test labeled as T.
4. Prepare a blank by taking 5ml of 10% TCA in a test tube labeled as B.
5. Add 1ml of Ammonium molybdate to all tubes, and then mix.
6. Add 0.4ml of ANSA reagent to all tubes and keep for 10 minutes.
7. Make up the volume up to 10ml (all tubes) with distilled water and mix thoroughly.
8. Read the absorbance of standard and test at 680 nm against the blank.

Calculation:

$$\text{Phosphorous (mg \%) in blood / serum} = \frac{\text{OD of test}}{\text{OD of std}} \times \text{conc. of std.} \times \frac{\text{vol. of filtrate Prepared}}{\text{vol of filtrate taken}} \times \frac{100}{\text{vol of serum taken}}$$

COLLECTION OF URINE

Urine is collected in a clean glass or plastic container at the time of voiding. Alternately urine is collected by catheterization or by cystocentesis into a sterile container/ vacutainer to be used for bacterial cultures and sensitivity testing .An early morning mid stream sample is preferred, as it is most likely to contain constituents of diagnostic significance without any cellular debris.

Preservation:

Always a fresh sample is preferred. Urine can be preserved by refrigeration for 2-3 hrs. When immediate analysis or refrigeration is not possible preservatives may be used. Some commonly used urine preservatives are:

a) Toluene, thymol, chloroform - antimicrobial preserves a 24 hr urine specimen.
b) Formalin-Prevents bacterial growth (1 drop of formalin in 30 ml urine) but interferes with glucose testing.

ESTIMATION OF CHLORIDE IN URINE (MOHR'S METHOD)

Reagents:

1. 0.05N silver nitrate: Dissolve 8.5g of silver nitrate in chloride free distilled water and makeup the volume to 1 litre.
2. Potassium chromate indicator (5%): dissolve 5g of potassium chromate in distilled water and add saturated solution of silver nitrate until permanent red precipitate is formed. Filter and make up the volume with distilled water.

Method:

1. Pipette out exactly 5ml of urine into a conical flask.
2. Add six drops of potassium chromate indicator to turn the contents yellow.
3. Fill the burette with 0.05N silver nitrate and titrate the contents till the yellow color turns to reddish brown.
4. Note down the reading and repeat the titration taking fresh urine sample until concurrent values are obtained.

Calculations:

Volume of 0.05N silver nitrate run down = Xml

1ml of 0.05N silver nitrate = 2.925x Xmg of NaCl

5ml of urine contains = 2.925x X mg of NaCl

100ml of urine contains (mg%) = $\frac{2.925 \times X \times 100}{5}$

mEq of chloride/1L of urine = $\frac{2.925 \times X \times 100}{5 \times 58.5}$

NORMAL VALUES OF DIFFERENT PARAMETERS IN SERUM OF DIFFERENT SPECIES

Constituent	Unit	Cow	Sheep	Goat	Pig	Horse	Dog	Cat
ALT	U/L	11-40	-	6-19	31-58	3-23	21-102	6-83
AST	U/L	78-132	60-280	167-513	32-84	226-366	23-66	26-43
ALP	IU/L	90-170	68-387	93-387	118-395	143-395	20-156	25-93
Bilirubin (total)	mg/dl	**0.01–0.5**	0.1-0.5	0-0.1	0-1.0	0.-0.4	0.1-0.5	0.150.5
Bile acids (total)	**µmol/L**	20-80	-	-	-	5-28	0-5.0	0-5.0
Bilirubin (un conj)	mg/dl	0.03	0-0.12	---	0-0.3	0.2-2.0	0.01-0.49	---
Calcium	mg/dl	9.7-12.4	11.5-12.8	8.9-11.7	7.1-11.6	11.2-13.6	9.0-11.3	6.2-10.2
Chloride	mmol/L	97-111	95-103	99-110	94-106	99-109	105-115	117-123
Cholesterol(T)	mg/dl	80-120	52-76	80-130	36-54	75-150	135-270	95-130
Cholesterol(free form)	mg/dl	22-52	40-60	---	5.7-11	--	31 - 71	20-40
Creatinine	mg/dl	1-2	1.2-1.9	1.0-1.8	1.0-2.7	1.2-1.9	0.5-1.5	0.8-1.8
Glucose	mg/dl	45-75	50-80	50-75	85-150	75-115	65-118	73-134
LDH	U/L	692-1445	238-440	123-392	380-634	162-412	45-233	63-273
Total protein	g/dl	6.74– 7.46	6.0-7.9	6.4-7.0	7.9-8.9	5.2-7.9	5.4-7.1	5.4-7.8
Albumin	g/dl	3.0-3.6	2.4-3.0	2.7-3.9	1.9-3.9	2.6-3.7	2.6-3.3	2.1-3.3
Globulin	g/dl	3.0-3.5	3.5-5.7	2.7-4.1	5.3-6.4	2.6-4.1	2.7-4.4	2.6-5.1
Urea N	mg/dl	20-30	8-20	10-20	10-30	10-24	10-28	20-30
Copper	µg/dl	32 -35	58-160	-	133-278	-	100-200	-
Iron	µg/dl	57-162	166-222	-	91-199	73-140	30-180	68-215
Lead	µg/dl	0-24	5-25	5-25	-	5-25	0-50	-
Magnesium	mg/dl	1.8-2.3	2.2-2.8	2.8-3.6	2.7-3.7	2.2-2.8	1.8-2.4	-
Phosphate (inorg)	mg/dl	5.6-6.5	5.0-7.3	4.2-9.1	3.1-5.6	5.3-9.6	2.6-6.2	4.5-8.1
Potassium	mmol/l	3.9-5.8	3.9-5.8	3.5-6.7	4.4-7.1	2.4-4.7	4.4-5.3	4.0-4.5
Sodium	mmol/l	132-152	139-152	142– 155	135-150	132-146	141-152	147-156
Triglycerides	mg/dl	0-14	-	-	-	4-44	20-112	10-114

NORMAL VALUES OF URINE IN DIFFERENT SPECIES

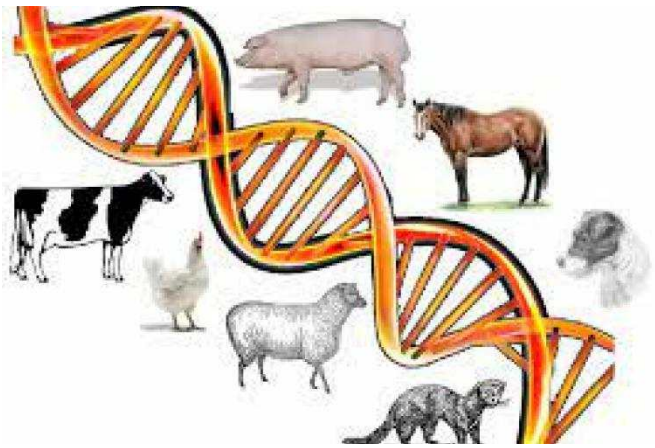
Parameter	Cattle	Sheep	Goat	Horse	Dog	Cat	Rabbit	Pig
Urinary volume (24h)	16-50 ml/kg	10-40 ml/kg	10-40 ml/kg	8-30 ml/kg	14-50 ml/kg	18-25 ml/kg	20-350 ml/kg	10-80 ml/kg
Colour	pale yellow – dark brown yellow	pale yellow – dark brown yellow	pale yellow - dark brown yellow	ochre	pale yellow –	yellow – strong dark yellow	pale yellow - red brown	pale yellow – dark yellow
Transparency	Clear	Clear	Clear	Turbid	Clear	clear	Clear	Clear
Odour	Aromatic	indifferent aromatic	indifferent aromatic	Aromatic	Garlic	Sharp	n.s	Aromatic displeasing
Blood	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative
Urobilinogen	Negative – weak positive	Negative – weak positive	Negative – weak positive	Negative – weak positive	Negative – weak positive	Negative – weak positive	Negative – weak positive	Negative – weak positive
Bilirubin	Negative	Negative	Negative	Negative	Negative – weak positive	negative	Negative	Negative
Protein	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative
Nitrite	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative
Ketones*	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative
Glucose	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative
pH values**	7.0 -8.4	7.5 -8.5	7.5 -8.5	7.6 – 9.0	5.5 – 7.0	5.0 -7.0	8.2	5.5 -8.0
Specific gravity	1.020-1.040#	1.020-1.040	1.020-1.040	1.020-1.040	1.001-1.065	1.001-1.080	1.003-1.036	1.020-1.040
Leukocytes	Negative	Negative	Negative	Negative	negative	negative	Negative	Negative

W. Kraft, U.M. Dürr, Klinische Labordiagnostik in der Tiermedizin, 6th Edition 2005, pp. 186-203 and 483-484

* For ruminant animals a slight positive reaction is possible at the end of pregnancy and early lactation

** depends on feed

The pH-value depends on the lactation. By the end of pregnancy it is 6.0-7.0 for ruminant animals



DEPARTMENT OF ANIMAL GENETICS AND BREEDING

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SELECTION AND BREEDING SYSTEMS

These are two ways by which the action of breeder can change the genetic properties of the population. First,by the choice of individuals to be bred as parents which is otherwise known as selection. The second is by the control of the way in which the parents are mated which is mating system (or) breeding system. A combination of both selection and mating system is known as breeding plan.

Importance of Selection in dairy animals:

Selection in dairy animals is a critical aspect of dairy farming that involves choosing and breeding animals with desirable traits to enhance overall productivity and profitability. The importance of selection in dairy animals can be highlighted in several ways:

- **Milk Yield Improvement and Adaptability to Local Conditions:**

The primary goal of selection is to improve the milk yield of dairy animals. Selecting animals that are well-adapted to the local climate, feeding conditions, and prevalent diseases is crucial. Indigenous breeds, known for their adaptability, are often preferred in different regions of India.

- **Genetic Improvement and Economic Viability:**

Selection plays a key role in enhancing the genetic potential of the herd. Traits related to milk production, reproductive efficiency, and disease resistance can be improved over generations through careful breeding. Selecting animals based on economically important traits, such as feed efficiency, helps in optimizing resource utilization. Animals that convert feed into milk more efficiently contribute to the overall economic viability of the dairy farm.

- **Disease Resistance, Health and Reproductive Performance:**

Selection helps in developing a herd that is more resistant to prevalent diseases. By choosing animals with a history of good health and robust immune systems, farmers can reduce the risk of disease outbreaks and minimize the need for medical interventions. Selection for desirable body conformation traits, including udder structure and overall physical health, leads to healthier and more productive animals. Efficient selection also contributes to improved reproductive performance, including shorter calving intervals and increased conception rates. This leads to a more consistent and productive breeding cycle.

- **Efficiency in Feed Utilization, Sustainability and Environmental Impact:**

Animals selected for efficient feed utilization help in reducing feed costs and improving the overall sustainability of dairy farming operations. Selection for traits that contribute to sustainable farming practices, such as reduced environmental impact and efficient resource utilization, is becoming increasingly important.

- **Conservation of Indigenous Breeds and Livelihood Improvement:**

India is home to several indigenous dairy breeds with unique characteristics. Selection plays a crucial role in the conservation of these breeds, preserving biodiversity and cultural heritage. And also for many farmers in India, dairy farming is a crucial source of livelihood. Selection contributes to increased income and improved living standards for farmers engaged in the dairy sector.

Characteristics of good dairy animal:

- Attractive individuality with feminity, vigour, harmonious blending of all parts,
- Impressive style and carriage
- Animal should have wedge shaped appearance of the body
- It should have bright eyes with lean neck
- The udder should be well attached to the abdomen
- The skin of the udder should have a good network of blood vessels
- All four quarters of the udder should be well demarcated with well placed teats.

Body Capacity: Viewed from the side, a cow with a deep, long body with wide, well-sprung ribs is said to have a large body capacity. Large body capacity is associated with ample space for the rumen and digestive system, and this, in turn, is associated with superior milk production. It should be obvious, but still needs to be stated, that a dairy cow with little body capacity cannot be a great milk producer. This is because the gut size is limited by the capacity of the abdominal cavity.

A broad muzzle ("shovel-nose"). A broad, strong muzzle implies the ability to get the food into her mouth and to masticate (chew her cud) effectively.

Width between the forelegs. This shows whether, or not, there is plenty of room for the vital organs situated between the shoulders and front legs. Cows with a narrow chest are normally not good producers.

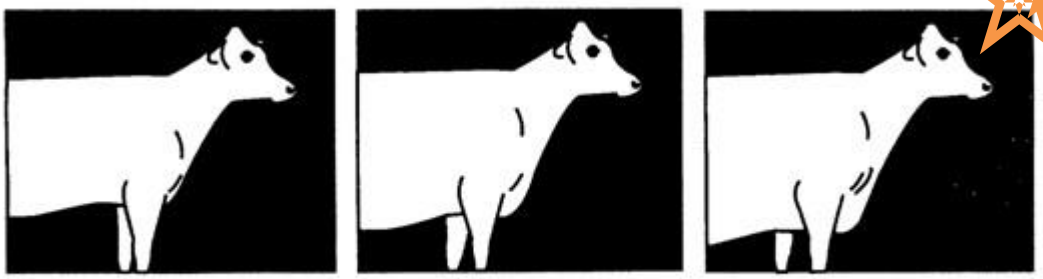
Width of rib. If at least two fingers, can be placed between the ribs of a dairy cow, she is said to have a fair degree of capacity. Ideally, in any cow, three flattened fingers would indicate great capacity. These pointers are quite acceptable rules-of-thumb to measure body capacity.

The bulls ability to breed (body capacity) should also be considered in any breeding programme. However, milk yield, fat and protein content, feet and legs, and udders, are most important, whereas with body capacity a certain amount of leniency is allowed.

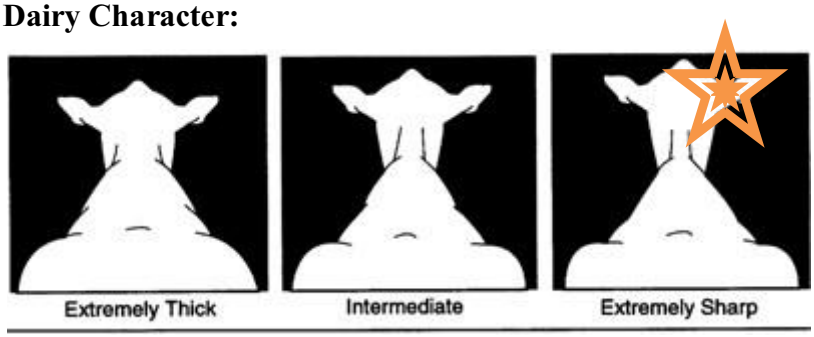
Udders. The udder must be pliable, silky in texture and sack-like in nature. When the udder is viewed from the side it should not hang below the cow's hock. Well developed milk vein is utmost important for giving maximum amount of milk. This must be extremely strong and well attached. Teat placement should also be considered important. Ideally, the front teats should be even and centrally placed on each quarter of the udder. Teat size (over- and undersized teats should be avoided), shape and placement are highly heritable.

History sheet or pedigree sheet which are generally maintained in organized farms reveals the complete history of animal The maximum yields by dairy cows are noticed during the first five lactations. So generally selection should be carried out during first or second lactation and that too month after calving. Three successive complete milkings have to be done and an average of it will give a fair idea regarding production by a particular animal. A cow should allow anybody to milk, and should be docile. It is better to purchase the animals during the months of October and November. Maximum yield is noticed till 90 days after calving.

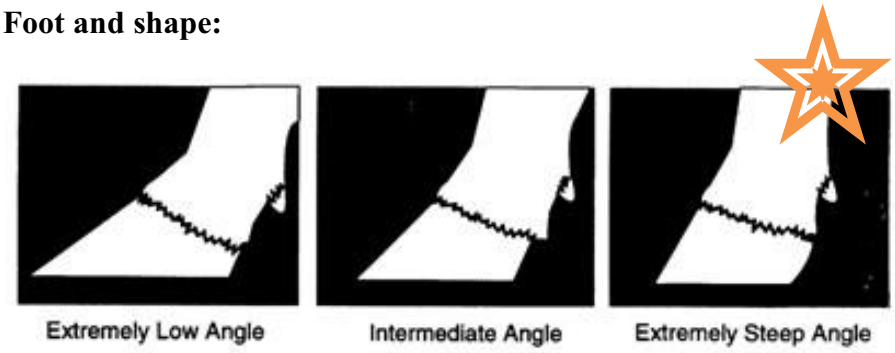
1. **Stature/ Chest and Body measurements:** Extremely tall/Deep body



2. **Dairy Character:**



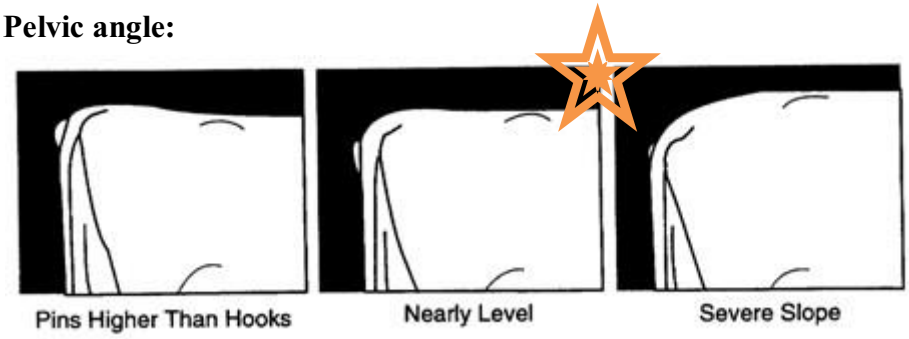
3. **Foot and shape:**



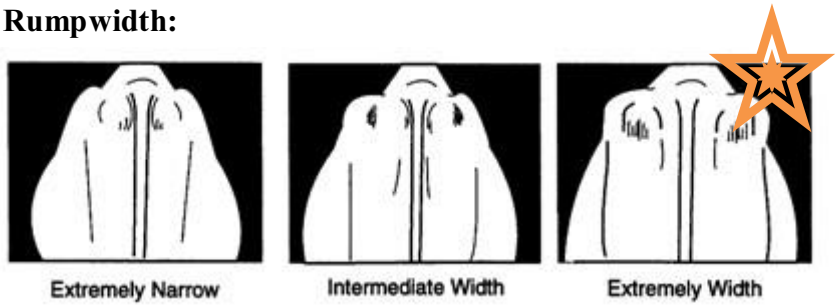
4. **Rear legs (Side view):**



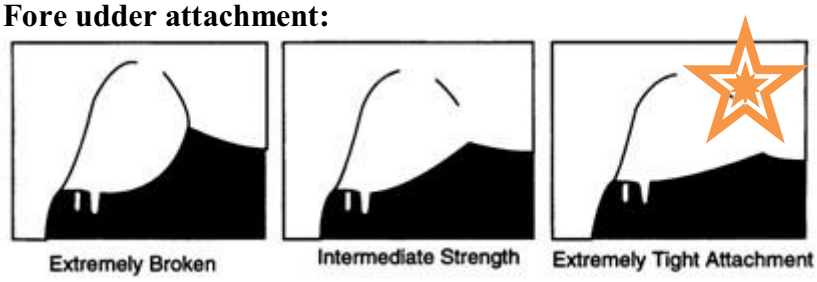
5. **Pelvic angle:**



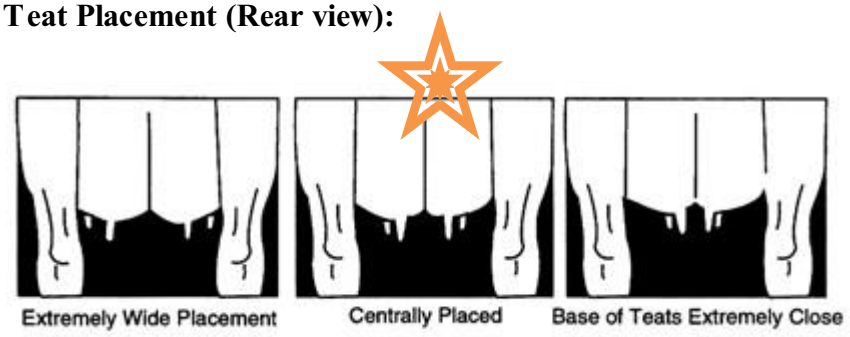
6. **Rumpwidth:**



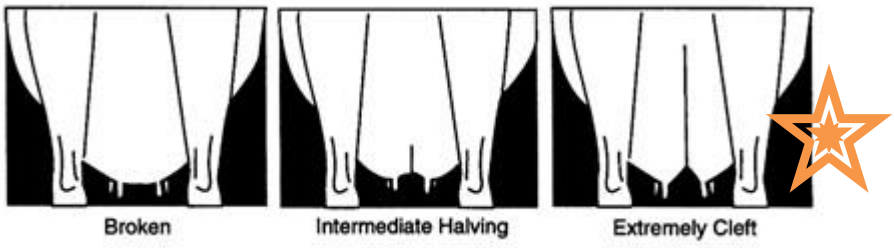
7. **Fore udder attachment:**



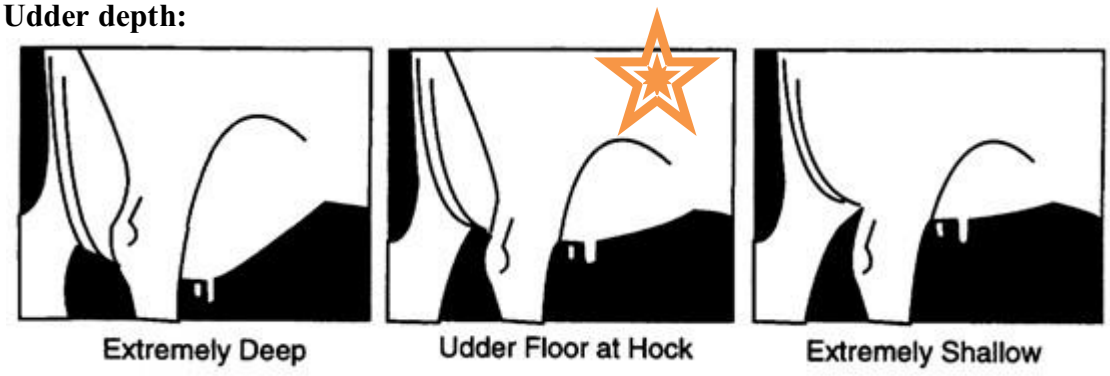
8. **Teat Placement (Rear view):**



9. **Suspensory ligament (cleft)**



10. **Udder depth:**



The Unified score card system:

The Unified score card system (Table) gives a good index of Dairy conformation of animals. This includes the following parameters.

A. General appearance : 18		
1	Size of animal- ideal to breed and age	3
2	Form of animal- symmetrical or stylish	2
3	Dairy character –lean, angular	5
4	Skin quality-thin, pliable, hairs smooth, fine and soft	4
5	Temperament- active vigorous disposition and docile	4
B. Head and neck : 09		
6	Muzzle- wide nostrils and large	2
7	Face – clean cut, facial veins prominent.	1
8	Forehead- wide fine at poll	1
9	Horns- fine, typical of breed	1
10	Neck-Slender, medium length	1
11	Eyes- Large, bright prominent	1
12	Ears- Typical of breed size, well set	1
13	Dewlap- Thin, light, graceful folds	1
C. Fore-Quarters :07		
14	Withers-Clean refined, free from fleshiness	3
15	Shoulders- light oblique, well attached free from fleshiness	2
16	Legs-Straight, well apart, fine and smooth	2
D. Body :20		
17	Chest, wide, deep fore-flank full	6
18	Back-Straight, strong, vertebra, well defined	4
19	Loin- Broad strong , leveled, free from flesh	3
20	Ribs – wide apart and well sprung	6
21	Flanks- Thin, deep and full	1
E. Hind Quarters :12		
22	Hip bones- Prominent, and wide apart	2
23	Rump-Long, wide leveled.	3
24	Pin bones-Prominent ,and wide apart	2
25	Tail setting –Long fine, tapering.	1
26	Thigh- Thin, widely separated and incurring.	2
27	Hind legs- Straight carried well apart, fine shank.	2
F. Mammary Development :34		
28	Udder, (a) Shape	
	(i) Fore Udder: Full attached forward	5
	(ii) Rear Udder: Full Attached, high and wide	5
	(B) Symmetry: Quarters even balanced, floor of udder leveled	3
	(C) Capacity: Large, Texture, pliable, Free from fat and fibrous tissue	12
29	Teats: medium sized, squarely placed	4
30	Milk Veins: Long, Tortuous	3
31	Milk Wells: Large, numerous	2
	Total	100

Classify the cows based on Dairy type as follows

Type	Grade Score
Excellent	90 and above
Very Good	85 to 90
Good	80 to 85
Acceptable	70 to 80
Fair	60 to 70
Poor	below 60

Animals scoring below 75 must be discarded.

MATING/BREEDING SYSTEMS:

Mating is a process that determines which males (selected) are bred to which females (selected). Primarily mating system can be classified as

INBREEDING

Inbreeding is defined as mating between animals which are more closely related to each other than the average relationship between all individuals of the population. Inbreeding is mating between animals related by ancestry. Two animals are said to be genetically related when they have one or more ancestors in common in the first 4 to 6 generations of their pedigree.

OUTBREEDING

The mating of unrelated individuals is called as out breeding, which is opposite or complementary to the inbreeding. Outbreeding is the mating of animals which are distinctly less closely related to each other than the average of the population i.e. the individuals that have no common ancestors in the proceeding 4 to 6 generations of their pedigree. The general effects of outbreeding are the opposite of those of inbreeding. Outbreeding increases the heterozygosity and variability of the population.

Grading or Grading-up

Grading is the continuous use of sires of one pure breed starting with foundation females which are of non-descript animals or another breed or no particular breed at all. Grading-up is backcrossing to the same breed takes place generation after generation. The object is to change the genetic makeup of a mixed population to a 'pure bred' with each new generation, the proportion of genes from the original mixed population decreases to half the proportion present in the previous generation, so that after 4 generations, it has decreased to 6.25 and after 5th generations to 3.125 per cent.

Crossbreeding

The mating of animals from different established breeds is called crossbreeding. The progeny produced is called crossbred.

Crossbreeding is done for the following purposes:

1) To exploit hybrid vigour or heterosis and for commercial production of market animals.

2) Complementarity is the second reason for crossbreeding i.e. to combine good qualities of two or more breeds.

3) Crossbreeding has been used in recent years to establish a broad genetic base in the development of **new breeds or synthetics.** A single population that is a mixture of various populations is called **Synthetic** or **Composite**. New breeds are formed from the synthetic population by selection.

Cattle and Buffalo Breeding Policy – India

The current breeding policy recommended by National Commission on Agriculture and adopted by Central and State Governments are:

1. Selective breeding:

In case of well-defined indigenous breeds of dairy, draught and dual cattle in their respective breeding tract for improvement of milk, draught capacity and both through associated herd progeny testing programme. By selective breeding it is expected that genetic improvement will be 1 to 1.5 % per annum in organised herds and 10 to 20 % per annum in farmers' herds.

2. Grading-up for improvement of low producing non-descript cattle:

The low producing local non-descript cows at drought prone areas, where feed and fodder resources are not available in sufficient quantity can be genetically improved by grading-up with bulls belongs to superior indigenous breeds like Sahiwal, Tharparkar, Red Sindhi, Gir, Deoni, Hariana, Kankrej etc. available in that breeding tract. The bulls to be used for this purpose should be from superior dam which have more than 2000kg as lactation milk yield.

3. Crossbreeding for improvement of low producing non-descript cattle:

In milk shed areas around cities and industrial town where good market for milk is available and good resources of feed and fodder and water supply are exist crossbreeding of low producing non-descript zebu cows with exotic breeds like Holstein Friesian and Jersey can be undertaken.

The choice of the exotic breed as

Holstein Friesian : for the irrigated plains and hilly terrain

Jersey : for coastal and other areas

The optimum level of exotic inheritance should be 50%.

4. For breeding crossbred cattle:

Inter-se mating with crossbred pedigreed / proven bulls (exotic inheritance 50 %) is recommended.

5. For improving buffaloes:

India possesses most important breeds of buffaloes and has about 58 per cent of the total world buffalo population. The breeding policy recommended for buffaloes are:

Selective breeding for recognised breeds in their respective breeding tract. For improving non-descript buffaloes **grading-up** with recognised breeds viz., Murrah, Surti is recommended.

In addition to breeding policy the committee also recommended the following for breed improvement and preservation.

1. Conservation of indigenous breeds and their germplasm.

2. Crossbreeding with exotic breeds should be totally banned in the home tract of the important cattle breeds.

3. Import of germplasm should be allowed only in very specific cases and after taking all the precautions to prevent the ingress of diseases into the country.

Culling in Livestock:

Culling is a management practice in livestock that involves the removal or elimination of animals from the herd or flock for various reasons. It is a strategic and necessary practice in livestock management that contributes to genetic improvement, disease control, reproductive efficiency, and overall farm sustainability. Effective culling decisions are based on a combination of performance data, health assessments, and the specific goals of the livestock operation.

The advantages of practicing culling include:

- **Genetic Improvement:**

  Culling allows for the removal of animals with undesirable genetic traits, helping to improve the overall genetic quality of the herd or flock. This is essential for breeding programs aimed at enhancing desirable traits such as milk production, growth rate, and disease resistance.

- **Disease Control:**

  Culling is an important tool for controlling the spread of infectious diseases within the herd or flock. Infected or carriers of diseases may be culled to prevent further transmission and protect the health of the remaining animals.

- **Reproductive Efficiency:**

  Removing animals with poor reproductive performance, including those with extended calving or lambing intervals, helps to enhance the overall reproductive efficiency of the herd or flock. This can lead to a more consistent and productive breeding cycle.

- **Improved Productivity:**

  Culling unproductive or low-performing animals contributes to improved overall productivity. It allows farmers to focus resources on animals that are more likely to contribute positively to the production goals of the operation.

- **Optimized Resource Utilization:**

  Culling helps in optimizing the utilization of resources such as feed, water, and space. By removing less efficient or unproductive animals, resources can be directed towards those that provide a better return on investment.

- **Reduction of Aggressive or Problematic animals:**

  Aggressive or problematic animals that disrupt the harmony of the herd or flock can be identified and culled. This improves the overall social dynamics and reduces stress among the remaining animals.

- **Economic Viability:**

  Culling is crucial for maintaining the economic viability of the livestock operation. It ensures that resources are allocated efficiently and that the cost of maintaining unproductive or problematic animals is minimized.

- **Quality of End Products:**

  Culling can impact the quality of end products such as meat, milk, or wool. By selecting and culling animals based on desirable traits, farmers can enhance the quality of the products they bring to market.

- **Adaptation to Changing Conditions:**

  Culling allows the herd or flock to adapt to changing environmental conditions. Animals that are well-suited to local climate and available resources are retained, promoting better overall adaptability.



DEPARTMENT OF LIVESTOCK PRODUCTION AND MANAGEMENT

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CVSc., R'Nagar

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CVSc., Mamnoor, Warangal

I. IDENTIFICATION

METHODS OF IDENTIFICATION

1. Branding

It involves making a permanent impression into the skin of the animal by the application of hot iron or with some chemicals. Such markings are quite distinct, difficult to destroy, cannot be lost by normal wear and tear of the skin and can be read from a distance. But these markings reduce the value of the hide to certain extent. Branding involves searing a number or letter or combination of these on the skin with hot iron or with chemicals. Sets of branding irons are available in the market. This comprises of figures 1 to 9 and 0 and letters A to Z.

There are three types of branding. A) Hot iron branding B) Chemical branding and C) Freeze iron branding (Cryogenic branding)

Sites for branding: Upper aspect of the hind quarter, trunk, shoulder, neck, cheeks, fore arm and hind limb below the level of stifle joint.

A) Hot iron Branding

The branding iron is heated to bright red and pressed over the body of the animal and thereby it causes partial burning of skin and tissues underneath and produces permanent scar on the animal. Heated branding iron should not be pressed on the skin not more than three seconds. A little mustard oil may be mixed with zinc oxide and smeared over the burns to encourage healing.

B) Chemical branding

In case of chemical branding, the branding iron should be dipped into the branding ink and pressed over the body. If it is applied lightly it will vanish after some months.

Generally the branding is done over the hips, thigh, quarters, horns and hooves. The figures should be big enough to be read from some distance and should be separated at least by 2.5 cm from each other to prevent sloughing off of skin. Branding reduces the value of skin. The advantages is animal can be identified even from distance.

C) Freeze branding

Branding of cattle with super chilled irons is known as freeze branding. It is more humane read more easily read than hot iron branding. The application of extreme cold selectively destroy melanocytes of the hair there by the hair of the branded area would become white or discoloured. For good freeze branding, cool irons in alcohol and dry ice or liquid nitrogen is used.

2. Tattooing

It consists of imprinting numbers of letters into the skin with the help of a tattooing forceps designed especially for the purpose. Combinations of letters can be used for proper identification. But these tattooed figures are not easily readable from a distance and fades out in due course of time. The marks are not easily visible on pigmented skin. When tattooing is properly done, the figures are permanent and clear. It is done generally in calves, sheep and goats.

Sites for tattooing: Inner side of the ears, in buffaloes and cattle with pigmented skins, it may be done on the under surface of the base of tail, gums and inside of the thigh in sheep.

3. Tagging

Tags are metal/plastic pieces with letter or numbers engraved/marked on them. These have pointed and inter locking ends. The disadvantage is tags may fall while animals are grazing in the fields and is not a permanent method of identification. Animals cannot be identified from distance and it requires handling of animals.

Sites for tagging

In sheep, goats, calves, cattle & rabbits they are applied to the ears with special tools. Sometimes in cattle or sheep they are tied around the neck with a strap.

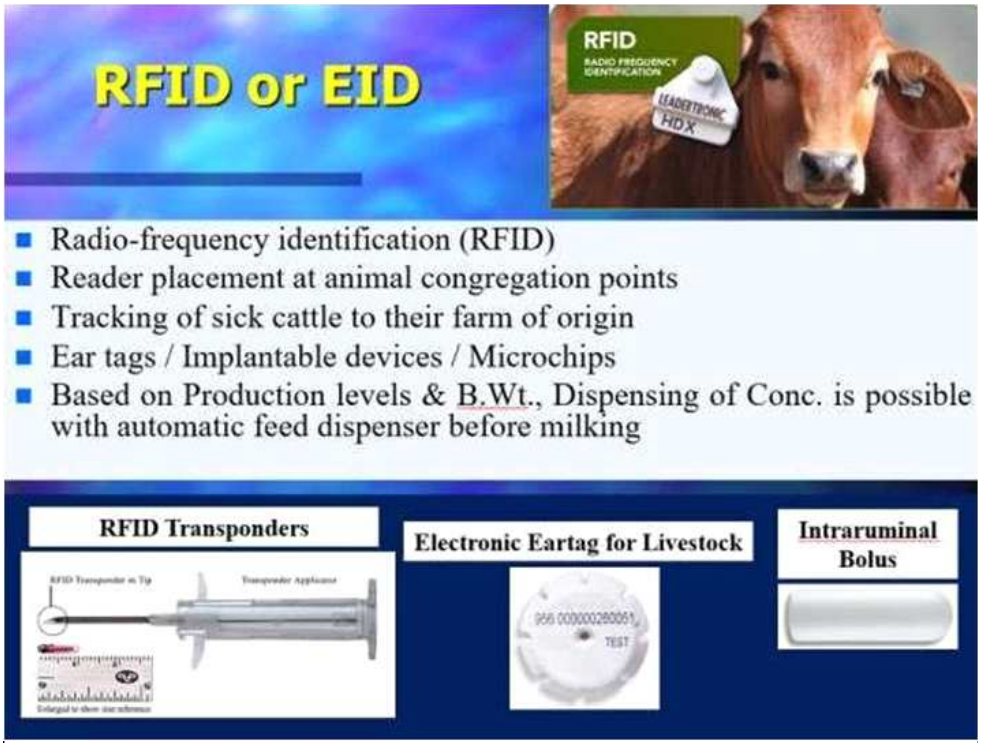
Ear-notching

It is a common method of identification in pigs. It is performed immediately after birth. Ear-notching plier, cotton swabs, antiseptics are required for the ear notching. Hold and restrain the pig, cut the edge of the ear(s) into 'v' shaped notch with the help of the sterilized plier or ordinary scissor. Notch should not be too superficial or deep. Apply antiseptic to the notch till healing takes place.

Other methods

Electronics tags, muzzle printing, photographs, karyotyping, neck chains or straps with metal or plastic tags, horn bands, map drawings, paint marks

RFID: (Radio Frequency Identification Device)



II. HANDLING AND RESTRAINING

METHODS OF RESTRAINING

Restraining of animals means controlling the movements and casting means throwing of animals on the ground and securing the limbs with rope.

Animals are controlled or restrained for a variety of reasons such as dehorning, shoeing, trimming of hooves, castration, major surgical operation etc.

Classification of Restraints:

I. General restraints

1. Travis
2. Single bamboo method
3. Double bamboo method
4. Casting

II. Head restraints

1. Pressing the septum nasi and raising head
2. Bull holder or bull tongs or bull dogs
3. Bull nose string
4. Bull nose ring
5. Bull leader or bull pole
6. Bull mask
7. Muzzles
8. Gags
9. Bull horn strap with chain

III. Neck restraints

1. Cradle or beads
2. Side-Rod, Side –Stick or Sword- Stick
3. Fixing a log of wood to the neck
4. Hobbling the neck to the fore limb

IV. Fore limb restraints

1. Lifting forelimb with a hand
2. Lifting forelimb with a rope

V. Hind limb restraints

1. Lifting hind limb with a pole
2. Lifting hind limb with the tail
3. Milk man's rope
4. Cow anti kicking device
5. Big rope method
6. Udder kinch
7. Reuff's method
8. Lifting tail vertically

CASTING

Casting is throwing down the animal and securing the limbs. It is one of the methods of restraints.

Purpose of casting

- For surgical operations
- For shoeing
- For better control during dystocia
- To trim over grown feet.
- For performing castration.
- For special examinations.

Precautions to be taken before casting:

- Animal should preferably be kept off feed 12 hrs. Before casting, specially large animals having voluminous stomach, which is liable to rapture during casting if it is distended.
- Use of narcotics and tranquilizers obviates the risk involved in casting.
- Apply stable bandages on all four legs of the horse to prevent accidental bruises from ropes. Valuable horses may have kneecaps and hock boots put on.
- If twitch is applied to control the horse during application of hobbles, it must be removed before the horse is actually pulled over.
- For casting cattle, buffalo and horses, a circular area of approx. 8m in diameter would be sufficient, while for small animals, an area 2 ½ of that size is required.
- At least 4 persons are required for casting cattle, buffalo and 7 for horses.
- The ground should be level, soft, grassy or sandy without stones, pebbles etc. If it is hard then straw bedding free from thorns, nails etc should be used.
- Apparatus used in casting should be thoroughly inspected and the persons/ attendants should be fully instructed with regard to their duties during the casting.
- Animal should not be casted for longer duration as they are likely to develop tympany.

SITE FOR CASTING

The site on which an animal is to be cast must be roomy as possible to avoid injury to the animal. The ground must be soft with turf of grass or bed of sand. If no soft ground is available, a one foot thick straw bed has to be provided. Remove all the sharp objects, from the area and bedding.

METHODS OF CASTING

1. Farrier's method or Indian method
2. Reuff's method or American method
3. Buffalo method
4. Burley method or alternate method

Burley method or alternate method

A 12-15 m long rope is doubled and its centre is placed over the withers of the animal. The ends of the rope are carried between the forelimbs and crossed at the sternum. One end is carried up each side of the animal's body and the ends are again crossed over the back. The ends are now passed between the medial surfaces of the hind legs and pulled to cast the animal. After casting, the tail is pulled inside the leg and is held at the flank region. The head is held firmly and the hind and fore legs are tied separately to avoid any pressure on the thorax and injury to the leg.

Rope squeeze method or Reuff's method

A loop is made around the animal's neck or horns using a bowline knot. The free ends of the rope is thrown over the back to the opposite side, then it is picked up and brought around the body under the standing part of the rope near the bowline to form a half hitch just behind the shoulder. Another half hitch is made by tossing the end of the rope over the animals back in front of the udder or prepuce. The rope is pulled to force the animal to lie down. The hind and fore limbs are then tied separately.

Casting a buffalo

Two ropes of about 5 m long are taken. With one end of a rope a clove hitch is applied on both forelimbs just above the fetlock, after bringing both the forelimbs together. With the second rope a similar half hitch is applied to the hind limbs around the hind cannon just above the fetlocks. The free end of the front rope is then passed back to that part of the hind rope which lies between the hind legs, first under it, then over it and then forwarded to the outside of the left fore-leg, where it is held by an assistant. In a similar fashion the free end of the hind rope is carried forward and under that part of the front rope which lies between the fore legs, then over it and back to the outside of the left hind leg. The two free ends of these ropes are then pulled in opposite direction by two men on each rope, thereby drawing all the feet together. The animal is supported with hands on the side to which the animal is expected to fall to prevent injury. The tail is slipped through the hind limbs and is held by an assistant. The limbs are then tied together.

Restraining a calf

The operator passes one hand over the neck and the other on the front side of the hind leg, the calf is then casted down to the ground. The hind limbs are tied by passing the rope over them. Both the ends of the rope are pulled from medial side of corresponding legs and then taken between the front legs. One end of the rope is taken over each side of the neck and tied at the nape.

RESTRAINING SHEEP AND GOATS

Sheep can be easily restrained than other livestock species.

I. SECURING

Sheep can be secured for examination, as follows

1) Twig of legs: Three legs of the sheep are tied together and the one left for examination.
2) Portable sheep stocks: This consists of wooden piece with Y shape, the branches being far apart to admit a sheep's head. Each branch is provided with holes through which an iron peg is passed. The bottom is driven into the ground. The head of the sheep into the two branches and pass the iron peg trough the holes. This prevents the removal of head back.
3) Two smooth stakes: Take two smooth stakes of 4 to 5 feet long and drive into the ground 4 to 5 inches apart. Keep the sheep head in between them and tie two ropes in the figure of 8 wise round the posts above and below the neck of the sheep.

The above two contrivances are useful for trimming feet, for doing dressing or to prevent a foster mother from injuring another ewe's lamb when she is suckling.

II. GAGS

Gags are used in sheep generally for dosing them with fluids or capsules of medicines for control of parasitic worms.

Two types of gags are used in sheep

1) Round gag 2) Linton's gag.

HANDLING AND RESTRAINT OF SWINE

There is a need to approach and handle the pigs either in single or in groups for routine farm operations like medication, dressing, vaccination, castration, weighing etc.

Careful approach and handling is required for safety of animal as well as operator. Avoid exciting the pigs.

- Pigs are temperamental animals, have rooting violent habit and are aggressive
- Care should be taken while approaching savage boars and broody mothers
- Young pigs are handled by securing their hind legs over the hock or by their ears
- During castration young pigs are held upside down by holding the hind legs and head is secured between the knees of the attendant with the pigs back facing towards the person who is handling the pig.
- Adult pigs are secured by using a running noose slipped over the upper jaw behind the tusks. A strong pig net or pig catcher can be used.
- Never handle pigs by tail
- Pigs are taken from one pen to other pen or to the weighing scale platform by driving the pigs from behind and directing them to the way by opening and closing doors. House design should facilitate hauling of the pigs and avoid stressful handling.

Pig catcher

It secures tusks of pig. It is metal rod of 2ft long and square in cross section. At one end, there is a handle and at the other end, a metal cap through which a loop of wire passes. The loop is applied over the snout and behind the upper tusks. It is tightened and fixed by means of a ratchet. A simple and efficient pig catcher can be made from a bar of iron of about 3 ft long with a handle at one end and the ring at the other end. Slip the ring round the upper jaw behind the tusks. The bar should be bent downwards to afford the best restraint

Casting of pigs

Casting is throwing down the animal and securing the limbs for various purposes like surgical operation, castration or any other ailment that requires handling for sufficiently long periods.

Requirement

Long ropes, small ropes and two men

III. HOUSING

LIVESTOCK HOUSING:

Housing is needed for comfort and security of animal. This can be achieved through

- Thermal comfort needs optimum temperature
- Physical comfort resting area suitable to the species or freedom to perform feeding drinking and excretion
- Psychological comfort it implies sense of security, absence of frustration.

Ideal site

- site must be dry elevated
- sufficient ground water free from impurities and feasibility for electricity
- Free from steep and slopes and should be nearer to the fields of pastures
- Must have access to main road communication medical facilities

Location of the sheds

- Building long axis should be oriented in east-west direction. How ever paddock should face north to get the sun light
- Plant shade trees for breaking unusual winds and to provide shade
- Avoid fire hazards in the premises
- Keep away from human dwellings
- Keep the sheds in at least 100m away from each

Housing of animal required to alleviate environment stress and management of livestock for the comfort of animal.

- **Housing**
  Type of housing, floor, bedding, tethering, manure removal, ventilation system, feed and water supply
- **Environment**
  Physical factors include temperature, relative humidity, air velocity, ventilation rate, light and noise etc. chemicals included gases, like CO_2, ammonia etc
- **Management**
  Stocking density of animals, management systems like all in all out etc.

Floor space requirements

Open or paddock areas of sufficient space is provided to cattle and buffaloes in warm regions since these animals lie down during the night. Maximum number of animals housed per pen also determines the comfortness of the animal. About 10% of animals can be stocked more for short period during emergency. The shape and size of certain pens/buildings like parturition pen, milking barns, sick shed, shearing pen, kid/lamb sheds depends in the individual animal for the purpose they are kept. Height of the shed is important for ventilation and to avoid heat radiation.

Roof

Roof protects birds from direct heat, radiation, rain. Roof material can be laid on wooden frame work or iron trusses raised on pillars of either cement or wood. Select the roof material depending on the budget and climatic conditions.

Roof height should be 2.5-3.0 m (8-10") at eaves. Height at ridge should be 3.5-4.3m (12-15) increases about 0.5m in case of cage house for better ventilation and to reduce radiation.

Roof materials

- Straw, coconut leaves, palm tree leaves etc
- Asphalt (lightly roof or bitumen sheets)
- Tiles
- Aluminium sheets
- Asbestos sheets

Roof designs

The skeleton structure of roof is made of many designs with following materials.

- Wood
- MS angle
- MS tube or steel rods

Types of roofs

- **RCC** suitable in storied houses and is a pucca requires high investment
- **Shed** useful in back yard keeping adjacent to main building
- **Gable** half and full monitor type house are better for good ventilation and avoid resting of squirrels, rats in the ridge.
- **Semi circular arch type** it minimizes heat radiation
- **Portable houses** required for small number of birds and are movable

Roof insulation and coverage

- Roof should be covered with insulation material to prevent radiation. Such insulation is necessary when roof height is less than 10 feet.
- Roof can be painted with hydrated lime, aluminium paint to minimize radiation
- Provide attic insulation with bamboo material, palmira leaves, ply wood hard board, poly urethane or fibrous material
- Roof can be covered by paddy straw, bamboo grass etc

Over hang

An out ward projection about 3-5 on either side at the height of eaves is termed as overhang. It depends on height of the shed. Will built over hang protects from exposure of direct sunlight and prevents splashing of rain water into the house.

Floor space requirements for different live stock

S.No	Type of animal	Floor space requirement (M^2)		Maximum no.of animals /pen	Height of the shed (Cm)
		Covered area	Open area		
1	Cattle and buffaloes Bulls cows Buffaloes Down-calves Young-calves	 12.0 3.5 4.0 12.0 1.0	 24.0 7.0 8.0 12.0 2.0	 1 50 50 1 30	175cm in medium and heavy rain fall and 220 in dry areas
2	Sheep and goat Ewe/nanny Lamb/kid Ram/buck Milch doe	 1.0 0.4 3.4 1.4mx1.2m	 - - - -	 60 75 - Single stall	300 dry areas & 220 in heavy rain fall areas

S.No	Type of animal	Floor space requirement (M^2)		Maximum no.of animals /pen	Height of the shed (Cm)
		Covered area	Open area		
3	Pigs Boar Farrowing sow Weaner/fattening pig Dry sow/gilt	 6.0-7.0 7.0-9.0 0.9-1.8 1.8-2.7	 8.8-12.0 8.8-12.0 0.9-1.8 1.4-1.8	 - - 30 3-10	220-250

Dimensions of feed mangers

S.no	Type of animal	Width (cm)	Depth (cm)	Height of inner wall (cm)
1	Adult cattle and buffaloes	60	40	50
2	Calves	40	15	20
3	Adult sheep and goat	50	30	35
4	Lambs and kids	50	20	25
5	Adult pigs	50	20	25
6	Growing pigs	30	15	25

Feeding and watering space requirements

A free access and sufficient feeding (manager) or watering space must be allocated. The animals should be at comfortable position and with no competition while activity. Feeding trough or manager must accommodate all the animals at a time. Water trough must accommodate at least 10% of the animal stock. The height, width, length is important for the comfort of animals.

Feeding and watering space requirements for different categories of livestock

S.no	Type of animal	Space/animal (cm)	Total manger length in a pen for 100 animals (cm)	Total water tank length in a pen for 100 animals (cm)
1	Adult cattle and buffalo	60-75	6000-7500	600-750
2	Calves	40-50	4000-5000	400-500
3	Adult sheep	40-50	4000-5000	400-500
4	Lambs and kids	30-35	3000-3500	300-500
5	Adult pigs	60-75	6000-7500	600-750
6	Growing pigs	25-35	2500-3500	250-350

HOUSING OF CATTLE

LOOSE HOUSING SYSTEM

- This system comprises of keeping animals loose in an open paddock or pasture throughout the day and night except at milking time.
- The open paddock is provided with shelter along one side under which the animals stay when it is hot or cold or during rains.
- A common watering tank and common fodder manger is provided within the shed.
- Concentrates are fed at time of milking in a separate milking barn.
- The open paddock is enclosed by half walls & wooden or plain wire fences of suitable height.
- Consist of four units for a successful layout
    1. Feeding area
    2. Bedded area
    3. Paved area
    4. Milking parlour

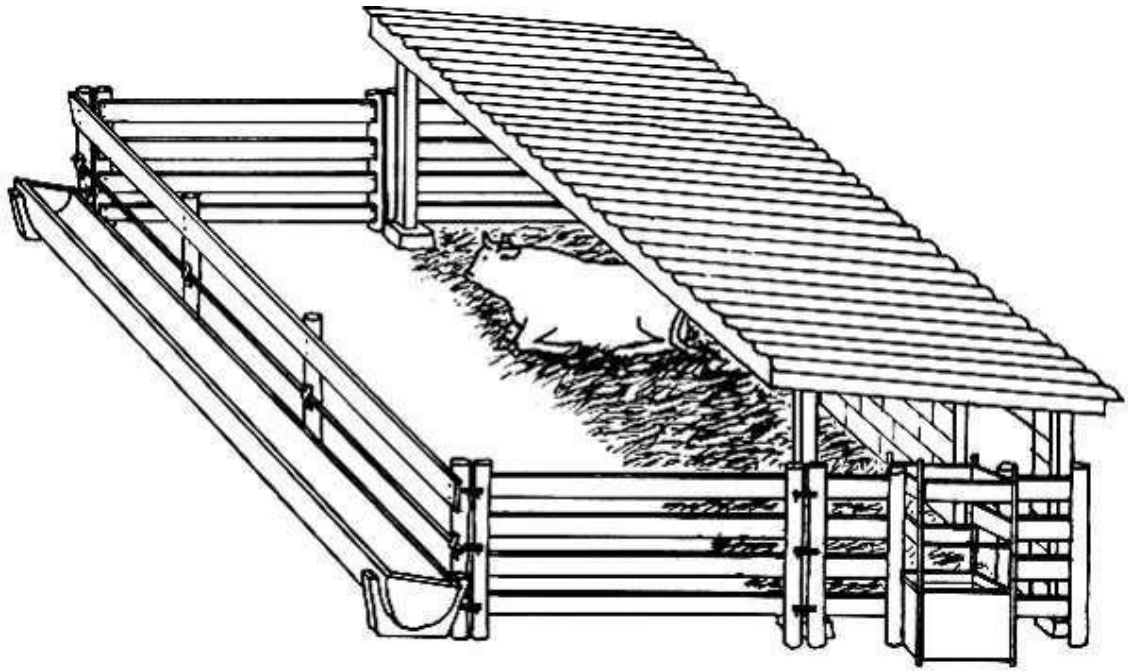


Fig: Loose Housing System to get 10% more milk compared to tie animals and to avoid environmental stress

STANCHION HOUSING

- These are also called conventional barns.
- Animals in this system are confined on a plat-form and secured at neck by stanchions or neck chains or ropes.
- The cows are fed with fodders, concentrate and as well milked in the barn.
- The barns are completely roofed and walls are also complete with windows or ventilators at suitable places.

Various buildings required for dairy farm

Milking barn

- This is a barn where milch are milked and is fully covered. It should be located at a central place with all other buildings arranged around it. Depending upon the number of milch animals, there are two types of milking barns viz single row milking barn and double row

milking barn. The former is being preferred when number of animals is less. There shall be individual standings in the milking barns and number if standings required should be 25% of the number of total milch animals. Double row milking barn is again classified into tail (facing out) system and head to head (facing in) system.

Advantages of tail to tail system

- Cleaning and milking of animals is easy
- Less danger of spread of diseases from animal to animal
- Cows get more fresh air from outside
- Supervision of milking is easy

Advantages of head to head system

- Animals are better exhibited to visitors
- Getting animals into sheds is easy
- Disinfection of gutter is possible with direct fall of sun rays
- Feeding of animals is easy

Disadvantages

- Possibility of transmission of diseases
- Milking supervision is difficult

Dimensions of milking barn

- Length of standing space : 1.5-1.87m
- Width of standing space : 1.05-1.2m(80% of length)
- Width of central passage : 1.5-1.8m
- Width of feed alley : 0.75m
- Width of gutter : 0.30m
- Slope : 1 in 40 towards drain
- Over hang : 50 cm beyond the side walls

Shed for milch/dry cows: milch and dry cows are separately housed. The floor in the covered area should be preferable of cement concrete.

Maternity pen: pregnant animals are transferred to maternity pen/calving pen to 2-3 weeks before expected date of calving. The number of calving pens required is 10% of the number of total Breedable female stock on the farm. It should be located near the farmer's quarter for better supervision. Slope should be 1 in 60 towards drain.

Sick animal shed: Located well away from the other sheds to avoid transmission of diseases to healthy stock.

Calf pens: located near the milking barns and calves of different age groups housed separately. Calves below one month are housed separately in individual boxes with good ventilation.

Young stock shed: heifer calves from 6 months age to breeding age are housed separately from suckling claves. No male calves are kept on farm beyond 6 months of age. If large numbers of young stock are present they are divided into different age groups to house separately.

Bull sheds: Constructed at one end of the farm one shed for each bull. The number of bulls required is one for every Breedable females on the farm. Wall of the shed 1.5m height, 30cm thickness, feed manager 0.5 meter, covered area 3x4 meters and paddock 12 sq meters.

Livestock farms also require stores, silos, milk house hay or straw sheds and handling yards based on the need.

SHEEP AND GOAT HOUSING

- Sheep and goats generally do not need elaborate housing and they do thrive well under natural conditions.

- They prefer grazing to any system of intensive housing. Because of their adaptability and the insulating value of wool and hair, artificial shelter for sheep and goats may not be necessary.
- In India, generally sheep are housed during nights only. Majority of sheep houses do not have roofs and will only have a simple enclosure.
- Basic objective of providing housing in the Indian conditions is to protect them from thieves and predators. As the economic value and demand is increasing the concept of shelter in the minds of the traditional keepers and housing is gaining importance.
- If housing is to be provided, it is to ensure that there is adequate ventilation, sufficient feeding space and sufficient lying area inside the house a clean and dry should always be available for comfort of animals at the time of lying down.
- Regular provision of fresh bedding is particularly important during lambing or kidding. Flooring should be designed, constructed and maintained to avoid any discomfort or injury.
- Solid floors should be well drained. When penned, the space allowance should be calculated in relation to the age, size and class of the stock. A layout is important before going for construction of a sheep/goat shed.
- It is important to decide about the nature of farm and the types of buildings required early. Location: Dry, elevated and well drained place should be chosen for construction.
- A place where there is a longer period of shade in a day should be preferred.
- Orientation: East-west orientation of side walls should be preferred.
- There are 3 types of houses: Open shed, semi open shed and enclosed shed.

Open shed

- It requires no special construction except for roof and fencing. During severe winter and summer artificial protection with grass or bamboo provided on the sides

Semi-open shed

- One side of the shed is open for free movement of the flock.

S.No	Name of the shed	L x W x H	No. of animals	Remarks
1	Flock shed	15x4x3m	60 ewes	----
2	Ram/buck shed	4x2.5x3m	8 rams	Make partitions length wise
3	Lamb/kid shed	7.5x4x3m	75 animals	Partition width wise to house unweaned and weaned separately
4	Lambing or kidding shed	1.5x1.2x3m	Single	Provide manager and waterer
5	Sick shed	3x2x3m	Single	Provide door and bedding
6	Shearing room	6x2.5x3m	Single	Make arrangements for storing wool
7	Shepherd house	6x4x3m	-----	Build nearer to herd
8	Milking doe	1.2x0.8x3m	Single	

- Ewe or doe shed: This is used to keep the adult stock meant for breeding and in each pen about 60 animals can be kept.
- Ram or buck shed: This is used to keep the adult stock meant for breeding and in each pen about 3 animals can be kept.
- These are meant for housing rams or bucks kept for breeding purpose. This shed must be partitioned lengthwise to form three equal compartments. The partitions may be of wooden planks and should not be more than 1 m high from the floor.

- Lambing or kidding shed: These are used as maternity room for ewes or doe. A manger for feed and hay and a bucket for keeping water should be provided in the shed.
- Lamb or kid shed (7.5 x 4 m): This is used for lambs or kids until they attain maturity.
- Sick animal shed (3 x 2 m): This is meant for isolating the ailing animals.
- Shearing shed and store-room (6 x 2.5 m): This room should consist of two compartments with a dividing wall. One room is for storing wool and shearing tools, and the other for storing feed and medicines.

Dipping

Tank of 28 x 2 x 5ft is built for 30-40 sheep to dip the sheep in the water containing ecto parasiticides for the control of external parasites like ticks and mites.

Dipping Purpose

1. To eradicate ectoparasites (lice, ticks etc.).
2. To cure and prevent skin diseases (mange).
3. To ward off attacks by the flies.
4. To remove dung, dirt and other waste materials from the fleece before shearing.

When to dip

1. When mange or any other skin disease breaks out, two dipping are carried out at an interval of 7-14 days.
2. As a preventive measure, sheep are dipped once before shearing and second time when fleece has grown long enough to retain certain amount of dip on it.

Dipping equipments

1. Hand bath

It is carried out in a tub made of galvanized iron, about 4x3.5x1.75 feet in dimensions. Each sheep is put into the bath and turned over on its back. Two men dip the sheep and one man catches them. It is useful when only small numbers of sheep are to be dipped.

2. Swim bath

It is made of concrete or bricks level with the ground or slightly raised. It is generally 25-30 feet long at the top and 15-20 feet at the bottom, 5 feet deep and 1.75 feet wide. It is used for larger flocks of sheep. Two or three sheep are put to swim in the bath at a time, from the side with dipper end. They swim through and walk up to the ramp into the drying pens. While swimming through the dip, they may be guided and helped along by a pole. The head must be immersed once.

Qualities of a dip

A reliable dip must provide protection against re-infestation, kill off the larvae, have prolonged stimulating action on skin and wool and should discourage fly striking. A large number of dips are available in the market. The active agents most commonly used are arsenicals, sulphur, tobacco, carbolic acid, DDT and gammexine. The instructions of the manufacturer should be carefully carried out while preparing the dipping solution.

Precautions before and after dipping

- Always offer water before dipping so that sheep may not drink the dipping solution.
- The quantity of dipping material in the dipping tank should be sufficient enough to submerge the sheep.
- The bath must be stirred from top to bottom occasionally since the chemicals have a tendency to settle down.
- Choose a day when the weather is not too hot. The temperature of the water should be nearer to the body temperature.
- The sheep dog should also be allowed to swim through the dip.
- The dipping pen should drain back into the bath to avoid wastage of the dipping material.

- On completion the dipping material must be disposed of properly so as not to pollute the water supply.
- Do not dip sick or animals with open wounds.
- Rams should not be dipped during the tupping period and ewes during lambing period.
- The concentration of the dipping material falls during the dipping process owing to its absorption by fleece, hence frequent addition of more chemicals is required.
- All the sheep and lambs of the farm must be dipped at one time, otherwise undipped animals are likely to re-infest them.

Shearing of sheep

Shearing is removing wool from sheep quickly, completely, easily and with minimum of discomfort to sheep and operator. Hand shearers or power driven shearing machines are used for this purpose.

Preparation of sheep for shearing

1. Wash the animal in running water to clean the wool from waste material and dung.
2. Do not feed the animal 10 hrs prior to shearing.
3. Clip away dung and urine stained wool and keep it separate.
4. The sheep should be placed on a clean and smooth board platform.

Methods of shearing

There are two methods of shearing sheep:

1. **Along the sheep:** The sheep is shorn in parallel strokes from head to tail until back is reached. First one side is done with the sheep lying on other side, then it is turned over and other side is completed.
2. **Around the sheep:** Sheep is made to sit on its buttocks, back away from the shearer. The wool is removed by strokes going round the sheep, from the fleece opening at the throat, first round the neck, then round the shoulder, back and so on.

Time of shearing

Sheep are generally shorn twice a year, before the start of summer (March to April) and beginning of winter (September to October).

Precautions

- Do not clip a sick animal.
- Avoid any cold or animal weather.
- Provide extra bedding and ration a few days after clipping/shearing.
- Shear only on clean and swept surface.
- The blades of the shears should be kept flat to the skin and last stroke should be as regular and as long as possible.
- Be careful not to clip the sheath/teats.
- Remove the fleece in one piece as it fetches more prices.
- Before releasing the fresh shorn animal, dress up accidental shear cuts if any with some antiseptics.

Tether or tying of a goat.

- It popularly way of keeping the goat which is tethered in a shade and moved often to get its feed. A running tether is one which has a long wire or rope stacked at both ends. The tether is attached with ring which gives an opportunity to eat forage in a widen area.
- Livestock farms require sheds such as stores, silos, milks house hay or straw sheds and handling yards based on the need.

HOUSING OF SWINE

Housing requirements of pigs are different from other livestock. Housing of pigs depend on the management systems which are classified below based on the capital investment and increasing managerial skill.

- Scavenging system
- Out door system
- Indoor of confinement or intensive system
- Integrated system

Scavenging system: Traditional pig keepers maintain pigs on scavenging and are primitive and involve no investment.

Out door system: it is also known as semi intensive system or backyard system. Pigs are kept in enclosure provided with small houses within enclosure for shelter. Pigs are fed on rotational grazing. If necessary movable pens are used for housing pigs or at time of farrowing.

Indoor system: this system is based on purely scientific know how. Investment is high. Modern pig industry is based on this system for efficient pork production on scientific breeding programme.

Integrated system: it involves swine keeping along with ancillary enterprises like fish farming production of algae methane gas generation etc. involving two or three operations simultaneously there by enhancing the efficiency of resource use and increasing out put for overall operation

Requirements of housing

- Consideration for comfort of pigs
- Protect pigs from climatic extremes viz direct sun wind and rain
- Provide dry conditions with hygiene
- Provide food and water

Details of house construction

Floor requirement

- Should allow easy cleaning, act as an insulation against cold and damp
- Should be ideal for footing and not slippery
- Should with stand to rooting and digging by pigs.

Conditions to fulfill

- Provide slope of 1 in 20 inches
- Floor must be of cement concrete with surface made of batten type or corrugated surface
- Follow pucca flooring even in low cost housing
- Slats will improve hygienic conditions of housing

Roofing

Depending on local climatic conditions the roofing can be built by making use of locally available materials such as grass leaves asbestos sheets. The roofing must be as far as possible cool. Party of the pen should be open type for exposure of natural light and for better aeration.

Walls

Depending upon the climatic conditions raise the wall for protection of pigs. Wall must be strong. Construct the wall of 9 inches width and upto a height of 1.2 meter with brick and cement. Doors must be sufficient for free movement of pigs.

Height of shed

Height of shed must be sufficient to expel fowl odour and allow fresh air into pen. The optimum height of shed at eves must be 200-250cm.

Pig houses

Pig house is known as sty. Each sty may have one or more pens and in each pen one or more animals can be housed depending upon the sex age etc, in large scale commercial piggeries different type of sheds like boar sty, farrowing sty, dry sow sty, fattening animal sty, sick animal sty may be provided for better management. Refer to the floor space feeder and water space requirements of each sites.

Boar house

Boars should be housed single in pucca house. A simple service area should be constructed outside to take advantage of good foot hold on the grass or soil and clears right angle corners and facilitates better service

Dry sow house

Non lactating sows are housed. Yard is one shared by several sows.

Sow stalls

Sows are individually penned or stalled to avoid bullying and fighting. Cleaning feeding is easy but lameness may result and reduce muscle tone due to confinement.

Cubical housing

It comprises individual stalls and dunging area. It tends to combine the advantage of sows stalls for individual feeding and attention and yard for exercise and comfort.

Electronic sow feeder house

Sow housed communally have an access to individual feeders by means of transponders installed around their necks or in their ears.

Farrowing house

Pen size 2.5mx3.0m with 1.6m alley. Place guard rails 25cm above floor level and 25cm from pen wall. It must provide comfort to sow and safety, warmth and free access to food for piglets. The guard rails should provide comfort to sow and expose both rows of teats. Provide source of brooding for warmth of pig lets. Provide bedding material like straw in the farrowing house for comfort. To keep the piglets well away from the mother and to avoid possible crushing the young ones by the moment of mother and to avoid possible crushing of young one by the mother one compartment with dimensions 2.5m length 075m breadth and 1.2m height may be provided along the walls of the farrowing pens. About 2 or 3 openings may be provided with dimensions of 2.5 ft to the wall of compartment.

Winter housing

Cover the open area with gunnies or thick mats to avoid excessive cooling of pen. Arrange supplementary heat by lamps or heaters.

Grower or finisher housing

Design central feeding alley on either side of pens with feeding trough on length wise. Pens of 5m length X 4.25cm width is suitable for accommodating 15 pigs upto body weights of 40kg and 10 pigs between 40-90kg. during summer thin the herd

Floor space requirement of pigs

S.no	Type of animal	Covered floor area/animal (m^2)	Typical dimensions	Open yard area/animal(m^2)	Animals/pen
1	Boar	6.25-7.50	2.5x2.5 or 2.5x3.0	8.8-12.0	1
2	Farrowing sow	7.50-9.00	2.5x3.0 or 3.0x3.0	8.8-12.0	1
3	Dry sow/gilt	1.80-2.70	0.8x1.2 or 1.2x1.5	1.4-1.8	3-10
4	Weaner or fattening pigs	0.96-1.80	0.8x1.2 or 1.2x1.5	8.8-12.0	30

Drainage

The sites should be provided with proper drainage. The minimum width of the drain should be 0.25m with a slope of 2.5 cm in every 10m.

IV. REPRODUCTION MANAGEMENT

Without reproduction there will be no lactation and nor the replacements for future. Therefore, the maintenance of high fertility rate is basic to the success of any dairy farming enterprise and its viability as a business. For high lifetime production and overall return per cow, a long life and regular reproduction are essential.

Reproduction parameters:

Calving rate: Calving rate measures the number of cows calving out of total cows(%) during a specific period. This depends on actual service conception rate and embryo foetus survivability.

Services per conception: A cow may need one or more services before she is settled. When the semen is of high fertility and the cow is inseminated at proper time, the number of services required for conception gives a quantitative measure of the fertility rate of the cow.

Non return rate: This measure is based on the assumption that if a cow after an insemination is not brought again for another insemination within 60 to 90 days the cow is pregnant.

Calving interval: The frequency of calving or the interval between calving is regulated by the management decision on how soon after calving a cow is rebred as well as the success of the first or subsequent services. A calving interval of 12 months for cows and 13 months for first calving heifers has been found to be optimum.

Breeding efficiency /reproductive efficiency: It is the ratio between actual calving to ideal calving interval of 365 days and expressed as a percentage.

Where, N–No. of calvings

D–Days between first and last calving

365– Ideal calving interval

Where, N– No. of calving intervals

A– Age at 1st calving

C– No. of days between 1st and last calving

- 365 days–Ideal calving interval
- 1020 and 1040 days – ideal ageof1st calving in cows and buffaloes, respectively
- In adverse environmental conditions, the poor milk producing animals may not be much affected compared to high milk yielders.
- *In buffaloes* lower productive efficiency due to long gestation period, long calving interval, silent heat and low conception rate.

Reproduction is an important consideration in the economics of dairy cattle production. In the absence of regular breeding and calving at the appropriate time, cattle rearing will not be profitable. A healthy calf each year is the usual goal. This is possible only by increasing the reproductive efficiency of the animals.

Successful reproduction encompasses the ability to mate, the capacity to conceive and to nourish the embryo and deliver the viable young ones at the end of a normal gestation period. In fact, interruption in this chain of events leads to failure of the cow either to conceive or the embryo to die or to have a premature delivery of the foetus.

The reproductive efficiency is a complex phenomenon controlled by both genetic and non-genetic factors, the non- genetic factors being climate, nutrition, and level of management. The reproductive efficiency varies not only between species and breeds but also among the animals within the same breed. Even the best feeding and management cannot coax performance beyond the genetic limit of an inferior animal. Improving the genetic merits of livestock populations is important at all levels of management. A sound breeding programme is a necessary part of the total animal production system.

FACTORS AFFECTING BREEDING EFFICIENCY

The factors which influence the breeding efficiency of cattle are as follows:

1. *Number of ova*

The first limitation on the breeding efficiency of fertility of an animal is the number of functional ova released during each cycle of ovulation. Ovulation is the process of shedding of ovum from the Graffian follicle. In the case of cow, usually a single ovum is capable of undergoing fertilization only for a period of 5-10 hours. Therefore, the time of mating, insemination in relation to ovulation is important for effective fertilization.

2. *Percentage of fertilization*

The second limitation is fertilization of ova. Failure to fertilize may result from several causes. The spermatozoa may be few or low in vitality. The service may be either too early or too late, so that the sperms and eggs do not meet at the right moment, to result in fertilization.

3. *Embryonic death*

From the time of fertilization to till birth, embryonic mortality may occur due to a variety of reasons. Hormone deficiency or imbalance may cause failure of implantation of fertilized ova which dies subsequently. Death may occur as a result of lethal genes for which the embryos are homozygous. Other causes may be accidents in development, over-crowding in the uterus, insufficient nutrition or infections in tile uterus.

4. *Age of first pregnancy*

Breeding efficiency may be lowered seriously by increasing the age of first breeding. Females bred at a lower age are likely to appear stunted during the first lactation, but their matured size is affected little by their having been bred early.

5. *Frequency of pregnancy*

The breeding efficiency can be greatly enhanced by lowering the interval between successive pregnancies. The wise general policy is to breed for the first time at an early age and to rebreed at almost the earliest opportunity after each pregnancy. In this way the lifetime efficiency is increased. Cows can be rebred in 9-12 weeks after parturition.

6. *Longevity*

The length of life of the parent is an important part of breeding efficiency, because the return over feed cost is greater in increased length of life. Also, it affects the possibility of improving the breed. The longer the life of the parents, the smaller the percentage of cows needed for replacement every year.

MANAGEMENT PRACTICES TO IMPROVE THE BREEDING EFFICIENCY

Some of the management suggestions which will tend to improve breeding efficiency of cattle and livestock are as below.

- Keep accurate breeding records of dates of heat, service and parturition. Use records in predicting the dates of heat and observe the females carefully for heat.
- Breed cows during near the end of mid heat or heat period.
- Have females with abnormal discharges examined and treated by veterinarian.
- Call a veterinarian to examine females not settled after three services.
- Get the females checked for pregnancy at 45 days to 60 days after breeding.
- Buy replacements only from healthy herds and test them before putting them in your herd.
- Have the females give birth in isolation, preferably in a parturition room and clean up and sterilize the area once parturition is over.
- Follow a programme of disease prevention, test and vaccination for diseases affecting reproduction and vaccinate the animals against such diseases.
- Practice a general sanitation programme.
- Supply adequate nutrition.
- Employ the correct technique.
- Provide suitable shelter management.

- Detect silent or weak heat, by using a teaser bull.

Oestrus Period: three phases in oestrus

- Pro estrus: for a period of 2 or 3 days
- Estrus: for a period of 12 to 18 hours
- Ovulation: for a period of 12 to 16 hours after the end of estrus (Mid oestrus)
- Estrous cycle length: 21± 3 days

Puberty:

- Puberty is the stage at which animal becomes sexually mature and secondary sex characteristics become conspicuous.
- The term sexual maturity means that the animal is for capable of reproduction.
- Puberty is the age at which the first estrus occurs in the heifer and the bull starts producing semen with viable sperms.
- The reproductive organs undergo marked increase in size at the time of puberty.
- Under good feeding a calf attains puberty approximately at 66 per cent of adult body size.

Signs Of Oestrus :

- Cow in estrus will be the first cow to rise in the morning.
- The cow become restless does not eat and frequently bellows and seldom ruminates.
- Sudden drop in milk production.
- Searching for male.
- Traits of homosexuality is shown in which the cow will attempt to mount other cows while other females not in estrus tend to mount the estrus cow which she permits.
- The cow is receptive to the act of mating and will stand when the bull mounts her.
- The behaviour of standing quietly while being mounted by the bull or other cow is referred to as the 'standing heat' which is the surest sign of estrus.
- This extends for 14-16 hours and shows other symptom like bellowing, nervousness, anorexia, reduction in milk yield.
- Mucous discharge may be found sticking to the tail.
- In early heat the discharge is watery and copious in mid heat (standing heat) it becomes thick and sticky and in late heat it will be scanty and discoloured.

Heat Detection in Buffaloes:

- Cows do mount over other cows when they are likely to come in heat and stand for mounting when they are in good heat. This is not seen in buffaloes. Buffaloes neither mount on other buffaloes nor other buffaloes mount on buffaloes in heat. In buffaloes copious ropy hanging discharge is not seen on the contrary it gets suddenly dropped and is not noticed by the owner and the discharge is scanty. Some buffaloes do not bellow and show silent heat, especially high yielding buffaloes.
- The main heat symptoms of buffaloes are as follows. The vulva becomes edematous, swollen. The lower portion of vulva looks oily. The gap is seen between vulvar lips and slight opening is seen. The wrinkles which are present in anoestrus buffalo become shallow or vanish.
- The mucous membrane of vulva becomes reddish, moist and glossy.
- Mucus discharge which is not seen normally can be seen before or after oestrus spontaneously.
- The colour, consistency and fern pattern of mucus help in determination of correct oestrus.
- Engorgement of teats in lactating buffaloes which is due to holding of milk following increased estrogen level in blood is seen when they are in heat.
- Frequent urination. The urine coming in spurting action wetting the part of skin below vulva and above udder (perineum). The drying of the urine leaves white mark on skin.
- Buffaloes in heat remain restless, off feed, raising head in a typical fashion.

- Local non-descript buffaloes bellow, become restless and remain off feed. Milk yield is reduced. The bellow is sharp and for longer duration.
- The buffaloes expose their teeth while bellowing which is very characteristic.
- The mucus discharge, in buffaloes is seen in about 49% cases. It is thin on the day of heat, become thick as the time passes and changes the colour from clear to white.
- 60-70 % of the buffalo come in heat from 6 pm to 6 am (after sunset and before sunrise) and this should be borne in mind and attendant should watch the buffaloes in the evening and early morning for expression of heat symptom.
- Teaser bull (Vasectomised bull), can be used for parading in buffalo barn for detection of heat

Other methods to detect oestrus:

- Crystallization pattern of cervical mucous will show long crystals in a typical fern-like pattern
- There are many estrus-detecting devices available. They are usually attached to the tail or rump of the cow.
- Mounting may causes these devices to discharge a coloured fluid which can be observed afterwards even from the distance.
- Chin ball mating device can be used for heat detection. It works on the same principles of a ball point pen and is fixed by means of a halter below the chain of the teaser bull. When the checking animal mount the cow in heat, the dye exuded round a spring-loaded ball of the device marking the back of the cow.
- Russian workers have developed an instrument basically consisting of an ohm meter and electrodes. When applied to the mucous membrane of the vagina, the resistance indicated on the ohm meter shows whether the cow is in heat.
- Pedometer is an instrument used to monitor the movement of animal. The principle is the activity and movement of the cow increases on the day of heat and this can be detected by means of a pedometer tide to the leg of the cow.
- The vaginal temperature can be recorded, which gives an indication about the heat. Generally during estrus, the vaginal temperature increased by about 1°C on the day of heat. Both methods are not very practicable.
- The methods described above had little applicability in developing countries due to technological and economical and managemental reasons. Close observation of signs of heat, standing heat remains the most practicable method of heat detection.
- In large farms this can be supplemented with a bull-parade using a teaser bull. A teaser may be a vasectomised bull or bull in which penis has been amputated and the urethra exteriorized.
- An intact bull can also be used by hanging a thick cloth or gunny bag curtain in front of the penis preventing entry of penis and mating.
- Special care should be taken to prevent spread of disease by teasers. Vasectomised bull is more harmful in this regard.

Time of Insemination:

- Ovulation takes place about 12 hours after the end of estrus. It takes another six hours for it to travel half-way down the oviduct.
- The sperm, even though reach the oviduct within minutes after insemination, must be exposed to the female reproductive tract for about 6 hours to attain the capacity to fertilize.
- This process of preparing the sperm for fertilization is known as capacitation.
- Sperm are viable for 24 hours in the female reproductive tract whereas the ovum remains fertile for only about 10 hours after ovulation.
- This implies that mating or insemination between mid-estrus (middle of standing heat followed by another insemination in about 6 hours after that.

- As a routine practice, if a cow is seen showing signs of early heat in the morning, it may be inseminated in the evening.
- If such signs are first manifested in the evening, the cow may be bred next day morning.
- A cow is expected to show estrus in 30-40 days after calving. Cows that fail to show heat even after 50 days have generally some problem and need examination.
- It may be due to infection or malnutrition and remedial measures may be taken accordingly.
- Insemination should be done only when buffalo is in standing heat. In buffalo to understand standing heat one should know the symptoms of heat.
- Buffaloes normally are not seen standing for mounting by herd mates but standing heat can be known from the changing colour of mucus discharge which is early estrus is clear and watery but in standing heat or mid heat the colour is changed to little buffy with thick consistency.
- In mid heat the oedema of vulva is intense there is little gap in vulvar lips and lower lip looks oily.
- The vulvar mucus membrane is glossy reddish or pink and wet.

Package of Practices to Improve Reproductive Efficiency

- Accurate record kept is very important in ensuring reproductive efficiency of the herd.
- There production detail like date of estrus, date of service and calving should be maintained properly.
- This data should be used to predict the probable date of heat, such animal should be watched carefully in the morning and evening for signs of heat.
- In larger dairy farm teaser bulls can be put in use.
- Complete breeding history, past performance and difficulties of a individual cow should be maintained.
- Irregular estrus and abnormal discharge should be attended immediately.
- The cows with retained placenta should be treated promptly and when such cows are put in breeding next time, the reproductive tract should be examined thoroughly for involution and possibility of infection.
- A manager should examine a cow 24 to 36 hours after service for metestrus bleeding. If it occurs under 24 hours after service, the cows were bred too late.
- If it occurs over 36 hours after service, they were bred too early during estrus. This will help in pinpointing of failure of conception.
- Cow should be examined for pregnancy 45 to 60 days after service so that if they are non-pregnant, steps can be taken to re-breed them at the earliest opportunity.
- If the conception rate under A.I is lower than natural service, time of insemination, insemination technique and quality of semen must be checked.
- Short irregular cycles indicate cystic ovaries, short and long irregular interval point to missed head.
- Silent or quiescent heat : the behavioural manifestation of heat may be very weak or imperceptible in such case. It is very common in buffaloes. But there is a normal ovulation and if inseminated at proper time the animal can conceive.
- Cows go through the normal ovarian changes of the estrus cycle except the behavioral heat and sexual receptivity.
- It is more in summer season than other seasons and more in heifer than adult animals.
- Use of balanced feed, proper summer management, use of teaser bulls can be of used for detecting silent heat.
- Anestrus or absence of sexual cycle may be due to under developed genitalia or due to persistent CL. In the former case follicle fail to develop and a heifer will not come to heat at all.

- One of the major causes of under developed genitalia is malnutrition. Besides there can be genetic causes.
- The second probability is the anestrous also may be due to persistent CL, due to certain hormonal disturbances, the C L persist beyond the life expectancy in a normal cycle, thereby preventing further cycling. A common cause for persistent CL is endometritis of the uterus.
- Sometime anoestrus is often observed in the early post partum period when the lactation is strong, probably due to the influence of lactation(due to secretion of prolactin) 'e' lactational anestrum.

Detection of heat in farms

Heat or oestrus is the period of sexual receptivity of females during which the females are ready to mate and initiate pregnancy. Accordingly, female exhibits certain physical and behavioural changes to convey its willingness and to attract competent males. Detection of heat promptly and breeding at the right time are utmost importance for breeding efficiency. Detection of heat may be carried out two or three times in a day, preferably early in the morning while letting out to paddock and in the late evening or night.

Methods of heat detection

Cattle & Buffalo

- Herd observation or visual observation
- Parading of vasectomised bulls
- Bulls fitted with marking harness
- Chin ball marking device
- By use of paints
- Heat mount detectors
- Measuring the temperature of milk
- Hormonal assay
- By using pedometer
- By measuring the electrical resistance of vaginal fluids

Ewe

- Use of aproned intact rams
- Vasectomised rams
- Rams wearing marking harness
- Rams with brisket painted run continuously with flock and ewes observed once or twice daily for marks on their rump.

Doe

- Use of vasectomised buck
- Aproned intact buck.
- Observation on approach of doe to buck kept within separate enclosure with a common portion of wire net.

HEAT DETECTION IN RUMINANTS

What is Heat?

- The female reproductive system consists of two ovaries and a womb.
- Every so often the ovaries produce very small eggs (ova).
- The time when this happens is called heat or oestrus.
- Cattle and buffalo regularly come into heat all the year round.
- Most of sheep and goats come into heat at a particular time of the year (breeding season - autumn).

Knowing when an animal is in Heat

- If you know when an animal is in heat you can introduce her to a chosen male for mating or you can arrange for her to be artificially inseminated if the service is available.
- You can also able to identify the animals which do not come in to heat.
- The best time to look for signs that the female is in heat is early morning or in the evening.
- Take care not to disturb the animals but just watch the animals for the signs.

Signs of Heat

- Ruminants can be kept on pasture or they may be stabled or tied up for most of the time.
- It is therefore necessary to consider this when looking for signs of heat:

Signs of Heat in Free Animals (At Pasture):

- Most females in heat will allow other animals to mount them.
- Cows in heat will mount one another, from the rear or from the front. However, the cow on top may not be on heat.
- The vulva becomes swollen and the area around the tail becomes wet and dirty.
- If cows sniff each other's' vulva and urine they may both into heat.
- If the cows in heat, they stand resting the chin on the back of another or are seen to lick or gently butt each other.
- Restlessness and calling loudly can also mean the female is in heat. Goats particular become very noisy.

Signs of heat in the stabled or tied animal:

- The animals should be allowed out twice a day when they can be watched for signs of heat. If the female is not allowed out then the following will be the signs of heat:
- Swollen vulva.
- The animal is active, there is a loss of appetite and she calls loudly.
- In milking animals the amount of milk produced suddenly drops.
- A jelly-like mucous can be found on the floor with the dung.

Note: You will need to be able to recognize the differences between signs of heat and signs of ill health in the animal which is tied up.

When do animals come into Heat for the first time?

- Animals come into heat when they reach puberty. This occurs at different ages in the different ruminants:
- Well-fed cows and buffalo heifers come into first heat at 10 - 20 months of age.
- Sheep and goats come into first heat between 8 - 12 months of age.

How long does Heat last?

- The duration of heat is very short.
- In cows and buffalo, it lasts for less than a day.
- In goat's heat lasts for 1 - 3 days.
- In sheep heat lasts for 1 - 2 days.

CARE AND MANAGEMENT

Signs of Approaching Parturition

- Cow will leave the herd and seek isolation.
- Loss of appetite and distress.
- Distention of teat and udder, considerable milk appears in the udder and there may be dripping of milk.
- Relaxation of pelvic ligament one day before calving, the ligament on the sides of the tail head is loosened so that hollows appear on either side of the backbone and the tail head is raised and the quarters are dropped.
- The vulva become enlarged and flabby

- Animal will be restless and will pace about often trying to kick or scratch the flank region.
- The parturition process has three stages a. preparatory stage (uterine contraction and dilatation of cervix) b. active expulsive stage c. expulsion of foetal membrane.
- Cow will deliver the calf within 12 hours after commencement of first stage , if lapse in this, vaginal examination or assistance by a veterinarian is required.
- Care must be taken to observe expulsion of placenta (after birth). It should be removed immediately so as to avoid cow eating it.

Care of pregnant animals

- Do not allow pregnant animals to walk long distance particularly on uneven ground
- Avoid transportation during long journey
- Don't frighten them
- Prevent fighting with other animals.
- Don't chase or allow being chased by others like dogs
- Don't harass them to run fast.
- Don't subject them to violent exercise.
- Feed liberally on scientific basis with kind treatment.
- Provide adequate nutritive diet for need of dam and foetal growth.
- Don't excite them by teasing, abusing or kicking or rough handling.
- Allow them to go nearby pasture for grazing as thus is the best method for their need for exercise to remove limb stiffness, keep thrifty and maintain good appetite.
- Don't allow them mix with aborted animals.
- Provide protection from extreme weather.
- Isolate pregnant animals in separate stall.
- Groom them twice daily and water twice a day.
- Strictly avoid slippery condition in the stall.
- Take all necessary care, close supervision and regular watch of the expectant animal during early stage and last one-third of the gestation period.

Care of neonatal and young stock

- Care and management of the new born commences before birth since its early intra- uterine life. Management care calls for special attention during different stages of the prenatal as well as post natal life.
- Foetus may regarded as a parasite living within the mother but most likely it may suffer from maternal under nutrition which occur towards end of gestation.
- A healthy and strong calf would not be borne in absence of proper breeding and intrauterine environment during pregnancy of the dam.
- During prenatal stage the care of dam indirectly means care for the neonate. Supply of nutrients in prenatal life achieved in different stages of its development especially histotrophic nutrition must be ensured through mother by keeping the pregnant animal in well fed condition.
- The cow requires special attention during last two-thirds of pregnancy before parturition as most of the growth and development of the neonate occurs during this stage of pregnancy.
- The pregnant animal should be fed liberally at this stage to enable her stand the normal strain of parturition as also to contribute to the tissue growth of the young.
- Soon after birth of the offspring removal of mucous from nose and mouth should receive immediate attention.
- The wet-thin greasy membranes covering on the eyes and part of body, if any, should be cleansed with hands.
- Such greasy membranes present in the mouth, should be removed by introducing fingers, or blowing in the mouth.

- So long as the umbilical cord attachment is intact with placenta there is little danger of asphyxia, but if it detached and offspring does not breathe take care of the calf's respiration immediately as it is a pointer to the non – functional stage of lung since it is lungs which first becomes actively functional, promptly use artificial means and method of respiration by compressing and relaxing chest walls with the hand.
- If the mother does not show mothering ability due to lack of mothering instinct, sprinkle a little salt or flour over the calf to promote and encourage licking by the mother. It would help the young one to dry soon and act as sensory stimulation for it to start breathing.
- After failure of such measure to induce licking better clean the new born by rubbing on her body parts with a new or thick clean soft piece of cloth or towel, ensure removal of wet skin as quick drying off makes the calf agile and helps it in his effort to get on its feet, and avoid also the risk of catching a chill.
- The natural orifices, especially the anus, should then be examined. If the anus is imperforate, a cross –wise surgical incision should be made.
- **Navel cord treatment:** If proper care is not taken in cutting and disinfecting the navel stump, a big abscess soon develops on this part, and causes considerable harm to the young one.
- Under normal conditions, the young one will try to stand itself and make its way towards the udder to suck. It may have to be helped on to the teats and taught to suck.
- The young should receive colostrum from its mother within 6 hours of life. Colostrum feeding should be continued for the first 5 days of life.
- Dehorning of calves should be done about a week or two old, and when the horn button can be felt with fingers.
- Identification of young one is done by different methods as early as possible.

Raising Orphans:

Foster Mother Technique:

- Cows identify their calves by smell.
- Foster mothers, immediately after calving the nostrils of cows may be rubbed with kerosene. This temporarily disturbs the sense of smell and makes it difficult to detect the difference in calves.
- Tying such cows that have lost their calves closer to the orphan calves.

Grafting method:

- Putting the whole skin of the dead calf over the body of the orphan calf. An attempt by the cow to lick an orphan is an indication of success.

By Hand Feeding:

- The orphan calf should be fed two or three feeds of colostrum from another cow.
- For Bottle feeding, the milk should be warmed to 36^0C before feeding.
- Later, other cow's milk may be substituted.
- Feed small quantity of 30 gm at 2hours interval for few days, later the amount may be increased.

MANAGEMENT PRACTICES DURING AND AFTER FARROWING (PIGS)

Farrowing or parturition is undoubtedly one of the most critical stages in the whole reproductive cycle of pigs. Problems at this stage lead very quickly to high mortality rates and reduced efficiency of both sows and piglets. It is estimated that 80-90% mortality may occur within one week after farrowing. An attendant should watch the sow during farrowing to prevent crushing of piglets by the mother, to remove the born piglets and also to clean mucus from the air passages of the piglets. It generally takes 2-4 hours for complete farrowing and dropping of placenta.

- Deworm the sow 2-3 weeks prior to farrowing.
- Prepare the farrowing pen and keep ready well in advance by cleaning, disinfecting, provide bedding material and heat lamps if necessary.

- All equipment must be thoroughly cleaned and disinfected prior to their introduction into the pen. Sows may be allowed to farrow in farrowing pens equipped with guard rails and creep boxes or in farrowing crates
- Introduce farrowing crate into pen well in advance for sow acclimatization. It saves floor space, avoids injury to piglets
- Use non moldy, dry, clean bedding material in the farrowing pen
- Use guard rails on two sides of the wall in the farrowing pen to avoid harm to piglets
- Keep sow clean. Her sides, underline, feet and legs are brushed and washed with soap water and spray insecticides to prevent insects on body
- Move the sow to farrowing pen at least a week before she is due to farrow
- Restrict traffic into farrowing pen. Thorough biosecurity measures should be followed.
- Avoid constipation in sow before farrowing. Bran, any green stuff or extra fat supplementation in diet facilities easy farrowing in case of constipation
- Provide warm condition in the pen when temperature drops below 50˚ F. Use heat lamps or pig brooders or infrared heat lamp. The bulb should be 250 watts. Place brooder 30" above the top of bedding.
- Monitor the sow for comforts and rectify and managemental errors
- Observe signs of farrowing. Observe the behaviour of sow before farrowing. Sow shows increased restlessness and start making nest by re-arranging her bedding
- Milk letdown in teat is seen one day prior to farrowing.
- Care is needed in case of difficult farrowing particularly gilts if the piglets are relatively large.
- Remove piglets until farrowing is completed and then reintroduce slowly under supervision.
- Exercising sow can help but it may be necessary to muzzle or tranquilize the sow
- A time gap of more than 30 minutes between presentation of piglets indicates dystocia. At this stage introduce hand (washed in disinfectant, later soap water) into birth passage and release stuck piglets. If necessary give oxytocin injection for aiding farrowing. Passage of after-birth (placenta) is only sign that farrowing is completed
- Still births are due to asphyxiation or weak condition. Many factors such as large litters, very small litters, older sows, genetic make-up of the sow, nutrition, high ambient temperature and piglet diseases are responsible
- Remove after birth membranes and soiled bedding
- Increase feed allowance gradually
- Feed sow with good ration to produce 3-4 kg of milk per day for nursing piglet
- Provide fresh, wholesome water ad lib
- Do not disturb the entire bedding material. Replace only soiled bedding

CARE AND MANAGEMENT OF PIGLETS

Piglets are born with very limited supplies of energy and are naked. The subcutaneous fat reserves are feeble. We must ensure high survival and healthy management of piglets.

A healthy, good size piglet will get to its feet within minutes after birth and instinctively try to reach the sows udder. Piglets obtain high energy colostrum by suckling first time with in 45 minutes after birth. Assist the weaker and lighter pigs (less than l kg birth weight for exotic breeds) to move to suckling mother so as to receive antibody rich colostrum to protect from early infection. In case of poor mothering ability or orphan piglets on artificial milk feeder or cross fostering is practiced.

- Immediately after birth, clear the mucus from nasal passages and on the body and keep the piglets warm
- The piglets should suckle the mother immediately after birth

- Cross-fostering: When sows farrow within a few hours of each other, transfer some of the piglets from large litter size to sow with small litter. It is advisable to transfer bigger piglets on to foster mother
- Split suckling : Piglet from large litter when had a good suckle of colostrum (approximately one hour at udder) they are shut in warm box, the next two hours give chance for remaining smaller piglets for their share colostrums. This can be repeated twice in the first l 8 hours.
- Small and weak piglets can be fed on stored colostrum. Colostrum can be obtained by milking sows before they farrow, or during farrowing and stored in deep freeze. Piglets can be fed on this through stomach tube (25cm long) or bottle feeding.
- Supplement fat in the diet of sows for 7 to 10 days before farrowing so as to increase the body fat reserves of sow to provide milk to piglets. Judge the condition of the sow.
- If milk is not available with sow, feed piglets on cow's or goat's milk
- Piglets under confinement system of housing must be given iron (imferon 1 ml) intramuscular injection on the 4th day after farrowing and there after 14th day to prevent piglet anemia.
- In injectables are not available ensure oral intake of ferrous sulphate. This is practiced by smearing the saturated ferrous sulphate solution on teats or it can be made available in the pen.
- Ensure proper disposal of sewage from the pen and farm, insist regular cleaning of the shed and maintain sanitation and hygienic conditions.
- Piglets at birth have sharp corner and canine teeth (8 needle teeth) and cause injury to teat while suckling. Clip the needle teeth with the help of sterilized cutting plier without causing injury to gums
- Piglets are identified by ear-notching at one day old age
- Immediately after farrowing sow should be examined for any disease problem particularly.
- MMA syndrome (mastitis-metritis-agalactia syndrome). If symptoms are seen treat animal with symptomatic treatment.
- Provide plenty of water to sow to replenish about 8 liters of body fluid loss from uterus during farrowing. Failure to provide water can cause agalactia.
- Weaning piglets earlier than 5 weeks may cause problems like diarrhoea and diseases in piglets.
- Castrate piglets at 2-4 week age. It often avoids boar taint to meat
- Vaccinate healthy piglets as per the vaccination schedule
- Deworm the herd at least once in a month

Clipping of needle teeth

Purpose: Piglets born with sharp corner and canine teeth and may injure the teat while suckling. This may lead to inflammation of teat and agalactia. To prevent this piglets require blunting of these teeth immediately after birth.

Equipment: Scissors / small bone cutter / cutting plier

Method: Secure and restrain the piglet by your hand. Cut the 8 needle teeth with plier to make stubs with out injuring the gums. If necessary apply antiseptics

V. MILKING OF DAIRY ANIMALS

Milking of dairy animals is by and large, done manually by hand milking. But modern dairy farms have switched over to mechanical or machine milking.

METHODS

Hand milking: Milking is accomplished only by proper application of force in which the sphincter muscles surround the teats may streak to make an opening for milk to the discharged.

1. **Full hand milking:** Most appropriate method. Teat is held within fingers encircling the teat. The base of teat being encircled by thumb and for finger. The teat is squeezed in between the middle, ring and little finger and hallows the palm, and then milk is forced out. The process is repeated in quick succession of alternate compression and relaxation.
2. **Stripping method:** Teat is firmly squeezed at its base in between the thumb and forefinger which are then drawn downwards the entire length of teat pressing it thus causing downwards milk flow. The process is completed in quick successions using of both hands for different teats.
3. **Knuckling method:** Teat is pressed with folded thumb and forefinger and drawn in downward direction. In this method, teat injuries may lead to mastitis. Pain may cause incomplete evacuation of udder and increased residual milk. This is not a good method.

Full hand milking	**Stripping method**
Quick	Slow
Useful for cows	Useful in cows with small teats
Stimulate natural suckling process	This method is necessary even after full hand milking to remove complete milking
	Discomfort to animal

Machine milking

With the growing industrialization, the skilled labour for milking is decreasing day by day, thus, necessitating the urgency for switching towards mechanical milking. Milking machine was first devised in 1903 by Alexander Gillies of Australia. It is one of the most important equipment in dairy as it is used more hours per day. In India machine milking was first introduced during early 20th century by the Britishers at M/S Tara Devi Farms near Shimla.

Modern milking machines are called double action milking machines since they use alternatively negative and atmospheric pressure in a double chambered teat cup assembly

Components of milking machine

1. Source of vacuum by vacuum pump
2. Receptacle for collection of milk
3. Teat cup and liner for each cup
4. Pulsator

Principle of machine milking

Here, the squeezing action of muscle surrounding the teat canal overcoming the utilization of vacuumcreated by the milking machine. In the milking machine there is a double chambered teat cup which consists of metal shell with rubber.

The purpose of pulsator is to introduce atmospheric air and vacuum, alternately between the shell and liner of the teat cup. When pulsator is an open space for vacuum, liner takes its normal open shape and milk flows out.

When air is introduced to open space, pressure is increased and outside of the liner of the teat cup causing collapse. This massages the teat and closes the teat orifice. In this phase of cycle, milk will not come out.

Pulsation: Opening and closing of the teat cup liner together add up to one pulsation.

Pulsation rate: Optimum number of pulsation/min is 48 to 52.

Pulsation ratio: Ratio of length of time of teat cup liner is in milking phase to the length of time it is in collapsed phase gives the pulsation ratio. Normal pulsation ratio is modern milking machine is 2:1.

Milk film is formed at the tip of the teat at the end of the milking operation. So, apply antiseptic lotion around the teat to prevent the milk film and microbial growth. Stripping can be done by using the machine by drawing the teat cup slowly.

Procedure

1. Tie the animal after cleaning and wiping its udder & teats and offer concentrate.
2. Turn the milking machine on and check the vacuum pressure. It should be 380 mm Hg for cows and 400/420 mm Hg for buffaloes.
3. Massage the teats and udder to ensure let down.
4. Apply the teat cups to the respective teats and see whether they are in correct position.
5. Stand quietly near the animal till milking is in progress.
6. When the milk flow ceases, remove the cluster by breaking its vacuum supply.
7. Weigh and record the milk produced.
8. Dip the teats of the animal in antiseptic solution.
9. Untie the animal

Milking Hygiene

Milk should be harvested and stored under hygienic conditions. Equipment used to harvest and store milk should be suitable and well maintained.

- Ensure milking routines do not injure the animals or introduce contaminants into milk to prepare animals for hygienic milking:
- Identify individual animals that require special milking management
- Ensure appropriate udder preparation for milking
- Milk animals regularly using consistent milking techniques
- Segregate milk harvested from sick or treated animals for appropriate disposal
- Ensure milking equipment is correctly installed and maintained
- Ensure a sufficient supply of clean water
- Ensure milking is carried out under hygienic conditions:
- Ensure housing environment is clean at all times
- Ensure milking area is kept clean
- Ensure the milkers follow basic hygiene rules
- Ensure milking equipment is cleaned and, when necessary, disinfected after each milking
- Ensure milk is handled properly after milking:
- Ensure milk is cooled or delivered for processing within the specified time
- Ensure milk storage area is clean and tidy
- Ensure milk storage equipment is adequate to hold milk at the specified temperature
- Ensure milk storage equipment is cleaned and when necessary, sanitised after each milk collection
- Ensure unobstructed access for bulk milk collection

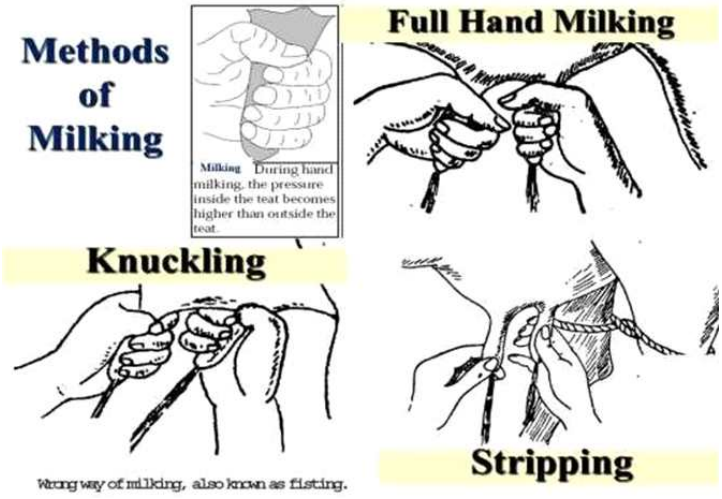


Fig. : Milking Methods

VI. OTHER FARM MANAGEMENT PRACTICES

WEIGHING OF FARM ANIMALS

Purpose

- To know the approximate weight of the dressed meat.
- To compute the fodder and balanced ration requirements.
- To calculate the dose of medicines to be administered.
- To determine the growth of the animal so as to keep a check on the health.

Materials required: Measuring tape 10 m long, measuring stick, weighing bridge etc.

BODY MEASUREMENTS

1. Height

It is the vertical distance from the ground to the highest point of withers. It is measured in hands (1 Hand = 4 inches) in horses and in inches in case of other animals. It is measured with the help of a measuring stick, which consists of a marked upright stick and a cross rod carrying a spirit level. The cross rod slides up and down the upright stick. It is important to make the animal stand on a hard level surface ground, on all its four legs with equal weight on each limb and let the cross rod rest on highest point of withers. In case of zebu cattle though hump is the highest point, the height is measured just behind the hump as the exotic cattle do not have any hump.

2. Length

It is measured from the point of shoulder to the point of buttock (in horse) or pin bones (in cattle sheep and goats). It is measured with an ordinary measuring tape and expressed in inches/cms.

3. Girth

Girth or circumference is measured at girth place, which is just behind the point of elbow. It is measured with a measuring tape and expressed in inches. The tape is neither held loose nor tight, but just sufficient pressure is put on. It is important to keep the animal off feed and water for 12 hours for satisfactory results.

Frequently the weigh bridge is not available. Under such conditions, a simple but reasonably accurate method of estimating body weight on the basis of body measurements is useful.

Procedure for weighing of animals and taking body measurements

1. Lead the animal gently to the weighing bridge platform.
2. Allow the animal to stand quietly.
3. Note the weight on the scale.
4. Now make the animal to stand on a hard-leveled ground, on all of its four legs.
5. Take the body measurements i.e. height, length and girth as discussed earlier.

Estimation of body weight from body measurements

Based on body measurements, a number of workers have developed following formulae for estimating the body weights.

1. Shaeffer's formula: (For cattle, buffalo, young calves, sheep and goats).

Live weight in pounds = $\frac{L \times G^2}{300}$ where L= Length in inches , G= Girth in inches

Live weight in kg. = $\frac{L \times G^2}{660}$

2. Agarwal's formula (Modified Shaeffer's formula):

Live weight in Seers = $\frac{L \times G}{Y}$ Seer = 0.95 kg

Where, Y= 8.0 If girth is less than 65"
Y= 8.5 If girth is between 65"to 80"
Y= 8.0 If girth is over 80"

3. Aggarwal's (1967) formula for crossbred cattle:

Live weight in pounds = (3xL) + (11xG) + (18xH)-907

Where L, G and H stands for length, girth and height in inches.

4. Mullick's (1950) formula for buffaloes:

Live wt. In pounds = 25.156 x G – 960.232

Where G= girth in inches

* To convert pounds into kg. divide by 2.2.

Monitoring of body weights – Pigs

Body weight is an indicator for good health, better growth and feed efficiency. It is practiced to find out litter weight, sow weight, weight at pre and post-weaning growing and finishing stages. Body weights can be taken either individually or in groups on platform scales with an arrangement of cage of suitable sizes (young /adults). Haul the pigs carefully by driving them from behind and direct them by opening/closing shutters. Pens must be convenient for hauling and should not cause undue stress to pigs and must be easy for operator. Take body weights during cooler part of the day. Young pigs are weighed by using spring balance.

Hoof trimming

It can be done 3-4 times in year in sheep and goat which are reared in confinement.

Purposes

- To prevent over growth of hoof.
- To keep animal fit for walk
- To prevent lameness of legs.
- To prevent foot rot and other ailments which normally ruin the feet by accumulation of dirt or filth.
- To prevent injuries to female at the time of breeding.

VICES MANAGEMENT

A vice is an undesirable quality in an animal. The degree of this undesirability may, however, vary considerably. Some vices are dangerous while some are injurious either to the owner or to the animal or to both.

Vices of Cattle

Self sucking: Sucking her own milk is called self sucking. This can be prevented by applying to mouth a plate which will form a barrier between mouth and teats.

Kicking: This vice can be controlled during milking with help of anti kicking straps applied above the hocks.

Butting: Hurting another animal or human being with horns is a serious bad habit of cattle.

Masturbation in bulls: This is a grave vice and endangers the utility of the bull. This is induced by licking.

Coprophagy: It is a vice of eating dung which may be due to bad weather, indigestion, half starved condition and mineral deficiency.

Pica: The eating own excreta or in the pasture field, breaking and cutting of ropes. This is mainly due to mineral deficiency.

Sucking or intersecting: It is a vice acquired in dairy calves where calves are bucket fed, grouped shortly after birth and where purchased calves are kept in groups. This will be prevented by separating the calves after feeding, alternatively providing good food and delaying grouping calves until they are more than 4 weeks of age

CULLING AND REPLACEMENT

Culling and replacement

In culling, the animals with undesirable characters are removed from the herd. Different economic traits mainly like milk production, body weight, growth rare, birth weight, calving interval, age at maturity, age at first calving, service period, reproductive efficiency are taken into consideration for culling of the animals.

Every year 20% of the animals can be culled from the entire herd and farm grown heifers calves used as replacement stock. Dairy does should not be culled before the age of 8 years because prolificacy increases up to 6 to 7 years. There is only one way to select the animal – keep the best and cull the poorest.

Reasons for cow culling may be as follows:

- Low production
- Dairy purpose
- Udder trouble
- Sterility
- Abortions
- Death
- Old age

For profitable dairying, all animals which are uneconomic or no remunerative, maturing late, have longer service period and low milk production should be culled. Aged animals and calves from parentage of low productivity, longer calving interval and slow growth must be removed. Male calves when not required should also be culled and disposed off.

Culling of dairy animals based on low reproductive performance

A well managed dairy herd should have 65-70 per cent of cows/buffaloes conceived on first service with an average of 1.3 to 1.7 services per conception. There should be less than 10 per cent of the cows with reproductive problems. The calving interval from one calving to the next should be between 12 to 14 months.

RECORD MAINTENANCE

It is essential to maintain different records in any commercial enterprise, without which, it would be difficult to have a check, or evaluate the enterprise periodically. In case of dairy industry, it is essential to maintain the overall milk production for sustained economic growth. For this purpose, a check on feeding (feeds and fodders), animal health and periodicity of calving is important. A good number of records are to be maintained on the farms and list of some important records is given below.

- Livestock register
- Pedigree sheet or history sheet
- Daily milk production register
- Milk production and disposal register
- Fat testing register
- Vaccination register
- Deworming register
- Animal treatment register
- Breeding register
- Growth record register
- Calving register
- Mortality register
- Labour engagement register
- Record of economics
- Record of feed and fodder
- Dung register
- Temporary dead stock register
- Permanent dead stock register etc.

Management of records in swine farm

The information on various activities in the farm can be intelligently used for achieving good results. The information can be on breeding, feeding, slaughter, culling etc., and decides upon replacements for which record keeping is essential. Production records are useful for estimating the rate of progress and for determining the relative emphasis to place on each character.

Keeping of farm records is useful and must be practiced for better organization. See the list of farm records to be maintained. Every day data must be posted. Records are useful for calculating the economics of pork production

Various records to be maintained are.

- Day book.
- Sow record
- Sow Production record
- Litter record
- Individual pig record.
- Feed register
- Mortality register
- Slaughter record
- Expendable article register.
- Permanent article register/non- expendable article register.
- Vaccination register
- Treatment registers, medicines stock register, miscellaneous register

Individual Sow Record

Breed _____

Date farrowed _____ Identification No. _____

Bred by _____

Sow's pedigree: Sire No _____

Dam No. _____

Record of litter mate

No. in litter _____ No of pigs weaned _____ Weaning wt at _____ days of age,

Her weight _____ Avg. Wt. of litter _____

Litter mate carcass record if any:

No. Carcasses _____ Avg. back fat thickness _____ (cm)

Loin eye area _____ (sq inches) Carcass length _____ (cm)

Number of teats _____

Production record of sow

Litter No	1	2	3	4	5	6	7	8	9
Sire No									
No. of services									
Farrowing data									
Date									
Temperament of sow gentle/nervous/cross									
No. of pigs born									
Alive									
Dead mummies									
Total									
Avg. birth weight									
No. functioning teats									
Weaning data									
Age									
No. weaned									
Avg. weaning weight									
Offspring kept for breeding									
No. gilts									
No. boars									

Individual pig record

Pig No	Sex	No. teats	Birth wt	Color	Defects	Weaning wt--days	Date castrated	Dt & cause of death	Disposal Date & to whom

VII. DISEASE CONTROL MEASURES AND SANITATION

- Proper housing which is conducive to good health, comfort and protection from inclement weather and which would enable the animals to utilize their genetic ability and feed for optimal production.
- Considering site selection, designing the animal building which includes structural biosecurity and climatic factors are important for effective disease control.

Site selection:

Following conceptual biosecurity like

- Site should be away from other livestock farms, processing plants, livestock markets, water bodies and feed mills etc. in order to prevent disease transmission.
- Structural biosecurity
- Farm should be elevated to avoid flooding, provided with Proper drainage of rain and subsoil water to keep healthy environment and to protect the building from dampness.
- North-south orientation, the sun will strike every part of the floor area under and on either side of the roof at some time during the day. This will help to keep the paved area dry. In regions where temperatures average 30 °C or more for up to five hours per day during some period of the year, the east-west orientation is the most beneficial.
- Fence the entire farm, provision of wheel dip at main gate, showers, hand wash, change over facilities.
- Farm buildings with cross ventilation/ridge ventilation and bottom ventilation for poultry.
- Gap between two sheds atleast twice the width of sheds to minimise the disease spread.
- Protection from wind and solar radiation.
- Provision of washable and easily drained floor, washable walls will control spread of diseases.
- Designing of suitable drainage system for quick and hygienic disposal of wastes is required for preventing disease.
- Dampness resistant surface will reduce the high humidity, which is the predisposing cause for respiratory disease in young animals.
- External loose box accommodation is necessary for isolation of sick animal.
- Provision of quarantine sheds, dipping tank, waste and carcass disposal systems.
- Disease control measures and sanitation:
- Isolation and quarantine.
- Nutritional balance
- Vaccination programme.
- Proper disposal of infected litter material or manure.
- Use of antibiotics.
- Control of arthropod, pests and external parasites.
- Proper sanitation and disinfection.

Selection of purchased animals:

- Select all the animals from known source and health status to reduce the chance of infection.
- Never bring the animals without knowing the vaccination history.

Isolation and quarantine:

- Strict isolation prevents contact between animals after arrival on farm and reduces the chance of spread of a disease.
- Quarantine all new purchased animals at least for 40 days, for rabies about six months.
- Cattle must not allow for common grazing.

- During the quarantine period, animals should be thoroughly screened for parasitic infestation by faecal examination and de-worming carried out on the 23rd/24th day, if need be.
- The animals should also be subjected to dipping or spraying on the 25th/26th day for removing ectoparasites if any.
- Routinely clean and disinfect feeding equipment and cattle handling equipment.
- Isolation simply means the separation of diseased animals from healthy ones. Complete isolation is particularly important in case of contagious diseases.
- The sick animals, their belongings and beddings are removed promptly and totally to a separate housing set up.
- Partial isolation is followed in case of non-infectious problems like traumas, nutritional diseases and burn injuries.
- The feeding and watering facilities of sick animals are also separated.

Nutritional balance:

- A number of infectious agents are opportunists and infection occurs in weakened animals.
- Proper nutritional balance and adequate feed intake will help,promote immune function and resistance.
- Some vitamins and minerals and overall nutritional balance have been identified as influencing immune function.
- Nutrition can also influence physical barriers to infection (e.g. skin, mouth and tissue).

Use of antibiotics:

- Antibiotics are used as prophylactic agents to prevent occurrence of disease, besides its use as therapeutic agent.
- Addition of small amounts of antibiotics to feed results in better feed utilization and markedly decreased morbidity and mortality among animals.

Elimination of carriers:

- Certain diagnostic screening tests can be used for spotting out carriers animals in the herd. These tests should be periodically conducted on all animals in the herd so that carriers can be diagnosed and culled.
- Some of the commonly used screening tests are tuberculin test, Johnin test, agglutinatin test for brucella and test for detection of subclinical mastitis(strip cup test,CMT)

Deworming and vaccination:

- It is good to deworm adult females after parturition.
- All the animals should preferably be fasted for 24 hours before giving the anthelmentic.
- Young animals should preferably be dewormed every month using a suitable anthelmentic.
- Older stock can be dewormed at 4-6 months' intervals. In adult animals deworming is done on examination of dung.
- Adult stock are dewormed at twice a year once before monsoon season in (May-June) and during monsoon (August-September).
- Vaccination is used as preventive measure. The administration of immunoprophylactic agents either prevents establishment of the pathogens in the hosts or leads to the neutralization of their toxic metabolites (toxins).
- The ring vaccination is done to all the susceptible animals at a radius of 5 km. from the focus of infection.

Proper disposal of infected litter material / manure and carcass:

- Proper disposal of infected litter material/manure/animal waste from the animal house is highly essential to prevent spread of various infectious diseases.

- Pathogens like FMD virus, *Bacillus anthracis*, *Clostridia* spp., *Salmonella* spp.,*E. coli* spp. and *Coccidia* in animal wastes have frequently been suspected to be the cause of serious out-breaks of diseases.
- Animal wastes are highly conducive for mosquito and fly breeding. Several kinds of parasitic larvae thrive in wastes.
- Proper disposal of carcasses of animals died of infectious disease is of utmost importance in preventing the spread of diseases to other animals and humans.
- Carcasses should never be disposed off by depositing them in or near a stream of flowing water, because this will carry infections to points downstream.
- An animal died of a infectious disease should not be allowed to remain longer in sheds as biting insects, rodents, etc. can reach it.
- All carcasses should be disposed of properly either by burying or by burning.

Control of arthropods pests and external parasites :

- Pest control is necessary because they act as mechanical vectors for many disease causing agents.

The control measures are:-

- Treatment for external parasites in infected animals.
- Regular cleaning of animal houses.
- Sealing of all cracks in the floor and walls of livestock housing with cement or mud.
- Removal of grass/plants around the barn.
- Collection and disposal of all litter out of animal contact.
- Spraying of house with an appropriate pesticide every two weeks if possible.
- Reduction in breeding places for flies. Exterminate rats and mice by using traps, glue boards, and poisons. Care should be taken to place poisons where the animals cannot contact them.
- Routinely treat the grounds and facility with an insecticide like Malathion, parathion, nevugon etc.
- Positive airflow from the interior of the shelter to the outside will make it harder for flies to enter the building.
- The animal shed should also be regularly cleared of cobwebs, spider webs and sprayed with insecticides at least once in a month.
- Keep rodents from entering a building by covering drains, weather stripping, and sealing holes and doorways.

SANITATION IN ANIMAL SHELTER :

- *Physical cleaning* is defined as the removal of urine, faecal matter and other organic material from the environment. It should result in a visibly clean surface but may not remove all of the harmful pathogens.
- ***Disinfection*** is the process that will kill most of the contaminants in a given area.
- ***Sanitation*** is defined as the combination of both cleaning and disinfection and is a requirement for all shelters.
- Under ordinary conditions, daily scrubbing and washing of houses and the action of sunlight falling in the houses are sufficient enough to keep them moderately germ-free.
- But when a disease outbreak has occurred disinfection is a must and should be carried out scrupulously.
- All floors, walls up to height of 1.5 m, interiors of mangers, water troughs and other fittings and equipments coming in contact with animals are all to be disinfected.
- The first step in disinfection of animal houses is removal of all filth, as the power of disinfectants is greatly reduced in the presence of organic matter.
- Floors, walls up to height of 1.5 m interior of water troughs and mangers should be well scrubbed and all dung, litter etc. should be removed and stacked separately, where animals cannot reach.

- In case of an outbreak of anthrax, the dung, litter etc. should first be disinfected in situ thorough sprinkling of suitable disinfectant. If the floor is of earth, which is generally the case in Indian villages, the top 10cm earth should be removed and disposed off along with litter.
- After removal of filth, the place should be scrubbed and washed with 4 per cent hot washing soda solution (i.e., 4 kg washing soda in 100 litres of boiling water).
- The approved disinfectant solution should then be coated liberally over the place by sprinkling or preferably by spraying and left so to act for 24 hours.
- After this period, the animal house should again be washed with clean water and left to dry by wind and sunlight.
- The interior of water troughs and mangers should be white washed. (This can be done even routinely at fortnightly intervals.)
- Movement control, records of all visitors in farm both human and domestic animal is essential.
- Traffic control should stop or minimize contamination of milk, cattle, feed, feed handling equipment and equipment used on cattle or to process milk.

COMMON DISINFECTANTS AND THEIR USAGE

Bleaching powder (Chloride of lime)

- It can be used for disinfection of animal houses when a contagious disease has occurred and for sterilization of water supplies.
- It should not be used in milking barns as its strong odour may taint milk.
- Concentration required is not less than 30 per cent available chlorine.
- Mode of application is dusting.
- Bleaching powder must be stored in airtight bins as damp surroundings, exposure light and air causes it decompose rapidly.

Boric acid

- It can be used as an udder wash.
- It is a week antiseptic and is likely to harm nervous system if absorbed into body in large quantities.
- It is used as wash for eyes and other sensitive parts of body.
- Concentration required is 6 per cent solution.
- Mode of application is splashing.
- Nowadays antibiotic solutions are replacing boric acid as eyewash solution.

Caustic soda (Sodium hydroxide)

- For general use in farm buildings and animal houses, caustic soda is a very effective disinfectant as it is an excellent cleaning agent as well as a powerful germicide.
- It is highly destructive to virus of foot and mouth disease, hog cholera etc.
- It is not effective against tuberculosis and johne's disease organisms.
- Concentration required is 2 per cent solution for general use and 5 percent solution against spores of anthrax and black quarter.
- Mode of application is splashing.
- Rubber gloves, goggles and protective clothing should always be worn when caustic soda solution is being used as it burns skin and damages fabrics.

Cresols

- The cresols are only slightly soluble in water and are therefore generally emulsified with soap.
- Effective against a wide range of organisms including acid fast tuberculosis and Johne's disease bacteria but not effective against viruses and spores.
- Good for disinfecting floors, walls, equipment etc. but not in milking barns because of its phenolic odour.
- Concentration required is 2-3 per cent.
- Mode of application is splashing.
- Use only soft water for preparing solutions, hard water precipitates soap.
- Lysol is a solution of cresol with soap.

Lime (Calcium Oxide, quick lime)

- It is a deodorant as well as a disinfectant.
- It can be used for sprinkling on manure and animal discharges, on floors or as a whitewash or milk of lime (also known as slacked lime).
- Mode of application is sprinkling, scrubbing or sometimes dusting.
- Always use freshly prepared lime only.

Phenol (Carbolic acid)

- Effective against several types of bacteria; not so effective on spores and viruses.
- Its disinfectant value is not reduced by the presence of organic matter but oil or alcohol does so.
- It is very toxic, corrosive and irritant.
- Concentration required is 1-2 per cent.
- Mode of application is splashing.
- Great care should be taken in using phenol to protect eyes, skin and clothing.

Quaternary Ammonium Compounds (QAC)

- These are cationic detergents.
- They have no effect on spores and viruses.
- They can be used to disinfect dairy utensils, udders, milkers' hands and towels for wiping udders.
- Cetrimide, a white powder is an example for QAC.
- Concentration requires is 0.1 per cent solution (0.5 per cent cream for applying on teats and hands to prevent mastitis.
- Mode of application is wiping of udder with clothes wetted in 0.1 per cent solution; washing of milkers' hands.
- Utensils should be scrubbed with boiling water before rinsing with QAC.

Soap

- Soap is an anionic detergent.
- It is a very week germicide.
- But its great usefulness in cleaning various surfaces including skin.
- It can be used preparatory to the application of a disinfectant.
- Mode of application is scrubbing.
- It should preferably be used only as surface-sanitizing agent.

Sodium hypochlorite

- It is a chlorine compound.
- It is an excellent disinfectant but is not effective against T.B bacteria and its effectiveness is reduced by the presence of organic matter.

- Concentration required is 200 parts per million of available chlorine about 300 ml sodium hypochlorite and about 200g of washing soda in 100 litres of hot water for washing utensils etc. For udder wash-about 60 ml in 10 litres of clean water.
- Rinsing of utensils, wiping of udder.
- Should be stored in air-tight containers as hypochlorites deteriorate rapidly when exposed to air.

Washing Soda (Soda ash, Sodium carbonate)

- It is good for disinfection of barn premises upon which an outbreak of virus disease like foot-and-mouth disease has occurred.
- It is a good detergent.
- Concentration required is 4 per cent solution.
- Mode of application is scrubbing.
- Lye is better against Foot-and-mouth disease virus than soda ash.
- It should be used as a hot solution.

Water quality and water system :

- The sanitary quality of water is determined by microbiologic testing for coli form and other microorganisms.
- Water supplies (well area, ponds and streams) should be protected from fecal contamination where possible.
- Watering cups, tanks and troughs should be designed and located for ease of cleaning and reducing contamination of feed and water.
- Prevent excessive water on ground and floor around water systems.
- Water odour, taste, excessive mineral or compounds necessiate the need for testing of water sources.

Foot bath and spray race :

- Foot bath is important in protecting animals from contagious diseases.
- A foot bath is a tank 6x3 m at bottom, 12x4 m at the top, and 0.3 m deep and constructed near the entrance. This tank is filled with germicidal solutions.
- Only iodophores, phenolic, cresylic compounds are effective for foot bath and wheel dips.
- Sprays races are for spraying germicidal solutions on animals for controlling pests, fly and bacteria.
- Spray nozzles are fixed overhead at a height of 2 meters above the platform.

Disinfection of pastures :

- Removal of any obvious infective material, like carcass, aborted foetus, dung etc. from over the pasture and prevention of animals from grazing on the pasture under question for at least three to four months.
- The pasture can be ploughed up and left fallow for about six months during which period the pathogens would be destroyed by sun.

For control of mastitis :

- Housing systems related to udder health is a deep pit stable not the ideal situation because microorganisms can survive easier in the straw bedding.
- Therefore, cubicle housing is more ideal because in cubicles, mattresses, sawdust or a sandy bedding can be used which is less susceptible for microorganisms.

Training and education of personnel :

- Personnel training and education are essential components of an effective infection control program.
- All personnel, including temporary personnel, students and volunteers, should receive education and training about disease prevention and infection control.
- Training should emphasis on awareness of the hazards associated with individual work duties, and prevention of zoonotic disease exposure

Record keeping :

- Records will be maintained on immunizations and exposure and injury incidents.
- Report and record changes in health status (e.g. pregnancy) that may affect work duties.
- Records related to vaccination programme, daily routine,medicine avaibility, feeding and labours hygiene are helpful for disease control practice.

VIII. HEALTH CARE

PREVENTION & CONTROL OF INFECTIOUS DISEASES IN CATTLE

DIAGNOSIS

- To control a disease , 1st find out the organism responsible for disease.
- Know the nature of the causative agent.
- How it gets excreted from infected body.
- Mode of Transmission to Healthy animals.

After OBR Occurs :

- Organized Dairy Farm or Individual Farmer
- Segregation.
- Stop movement of Persons, Equipment, Vehicles etc.
- Seek the advice of a Vet.
- Avoid grazing in common areas.
- Measures like Foot Dip with Disinfectants.

Disease control measures

- Isolation
- Quarantine
- Vaccination
- Elimination of carriers
- Disposal of carcasses
- Interference
- Disinfection
- Disinfestation

Isolation:

- Sick animals and healthy animals
- Separate housing for aick animals
- It should not be at higher level.
- Or keep the sick animal far away.
- Separate use of equipment/buckets etc.
- First attend healthy animals, then sick animals.
- Disinfection of equipment.
- After recovery, bring back the recovered animals.

Quarantine:

- Segregation of apparently sick animals which are brought into herd for 1st time from the healthy animals present in the farm.
- The Q.P is equal to Incubation period of diseases.
- Usually it is 30 days which covers almost all diseases except Rabies.
- Objective of Quarantine is to give sufficient time for a disease to become active and exhibit symptoms, if any.
- Screen for parasitic infestation.
- Deworming on 23rd/ 24th day.
- Dipping / Spraying 25th / 26th day.

Vaccination:

- Artificially developing immunity by injecting biological agents against specific diseases is called Vaccination.
- Vaccine : An antigen – live, attenuated or dead organism used for development of Active immunity in animals.
- Toxins, Toxoids, metabolites etc produced by microbes are used as vaccines.
- Antibodies develeop in 14-21 days – Active immunity.
- Booster dose on 21st day , if required.
- Vaccination is not a substitute for good sanitation & hygiene.
- No vaccination in already affected herds.
- Passive Immunity**:** Injection of Immune sera into healthy valuable animals to protect against bacterial, viral diseases.

Ring vaccination:

- After OBR declared, identify the villages fall under 5 zones.
  1. Affected Herd.
  2. OBR Village.
  3. Villages fall under 3 K.M radius.
  4. Villages fall under 5 K.M radius.
  5. Other specific areas like streams, watery areas etc.
- Vaccination should be conducted from periphery villages to the center.
- Or make two teams to conduct in OBR village and periphery villages.

VACCINATION SCHEDULE:

S.No.	Names of the disease	Animals	Time of vaccination	Duration of Immunity
1.	Anthrax	All animals	Endemic areas only	One season
2.	B. Q	Cattle & Buffalo	Before onset of monsoon	One season
3.	H. S	Cattle & Buffalo	Do	One season
4.	Brucellosis	Cattle & Buffalo	At 6 months of age	3 or 4 calvings
5.	Hog Cholera	Pig	After weaning	One year
6.	Pox	All Farm Animals	OBR	One year
7.	F& MD	Cattle, Buffalo, sheep, Goat & pig	Above 4-5 months of age	6 months
8.	Rinderpest	Cattle & Buffalo	Above 3 months of age	Long life
9.	Swine Erysepelas	Pig	After weaning	One year
10.	T. B.	All Farm Animals	Above 6 months of age	1-2 years

Elimination of carriers:

- Causative Organism has to be eliminated from body.
- Carriers may be for shorter duration duration or for years together like TB, Brucella Leptospirosis.
- Carriers should be identified and eliminated from herd.
- Conduct lab tests periodically to detect carriers.
- Ex. Tuberculin Test, Mastitis test, Agglutination test for Brucellosis.

Disposal of carcass:

- Burial of Carcasses: Deep burial of carcass to prevent the worms carrying the germs to the surface.
- Also that the carnivorous animals dig the pits. min. 1.5 meter depth.
- Burning of carcass in 0.5 meter trench.

Interference:

- Disinfection
- Disinfestation
- Deworming
- Control of Arthropod vectors
- Treatment of sick animals

Disinfection :

- Destruction of pathogenic organisms by disinfectants.
- A substance which is able to kill organisms at appropriate concentration is called Disinfectant.
- Sun light, Heat, Chemicals.
- Clean the area before doing disinfection because the disinfectant can't work in presence of organic matter.
- Use 4% washing soda before disinfection.
- Disinfection of infected pastures : By removal of carcasses, aborted foetus, dung etc. rather than chemical disinfection.
- Common Disinfectants used : Bleaching Powder, Caustic Soda, Cresols, Lime, Phenol, Quaternary Ammonium Compounds, Washing Soda etc.

General:

- Feed troughs cannot be contaminated by faeces and waterers
- Good grazing management will control pasture or grassland borne helminthic infections.
- Use of clean or safe pastures (not grazed for 6 to 12 months) will help to control helminths problems.
- Rotational grazing of livestock.
- Young animals are generally more susceptible to parasites than adults. Therefore young animals should be housed separately from adult animals.
- Treatment should be followed by chemoprophylaxis to prevent reinfection.
- Control of snail population may result in control of liver fluke infestation.
- A concentration of one part of copper sulphate in one million parts of water is generally recommended but stronger solution may be necessary when large quantities of decaying organic matter are present.

NADCP (National Animal Disease Control Programme)

CONTROL (VS) ERADICATION.

- CONTROL OF FMD: Vaccinations conducted in Bovines in 23 rounds at 6 months interval since 2004 in Telangana.
- ERADICATION of FMD : Bovines, Sheep,Goat and Swine all Cloven hoofed animals are going to be vaccinated.
- Meat Export – FMD free zone required.

Objectives of the programme:

- Eradication of the disease from the country.
- Control FMD by 2025 with vaccination and its eventual eradication by 2030.
- This will result in increased domestic production and ultimately in increased exports of milk and livestock products.
- Parasitic control: Deworming before vaccination help to get better immune response.

ACTION PLAN FOR NATIONAL ANIMAL DISEASE CONTROL PROGRAMME (NADCP) FOR Foot and Mouth Disease (FMD)

1. Target animal population
2. Vaccine requirement & vaccination schedule (all animal should be covereed in 1 schedule)
3. Tagging requirement and tagging schedule
4. Man power requirement
5. Training of man power
6. Public awareness
7. Cold storage facilities

FMD vaccination strategy

- Step 1: formation of district monitoring unit
- Step 2: formation of mandal monitoring unit
- Step 3: manpower assesment requirement,identification
- Step 4: finalization of vaccine requirement
- Step 5: deworming
- Step 6: training of manpower
- Step 7:cold chain maintenance plan
- Step 8 : publicity
- Step 9: vaccine procurement
- Step 10: accessories putting in place
- Step 11: vaccination strategy
- Step 12: sero monitoring plan
- Step 13: monitoring & supervision plan

MASTITIS MANAGEMENT

- Management is the most effective means of control of Mastitis.
- Mastitis is a disease complex- High clinical & economical significance especially in medium and high yielding Dairy cattle.
- Its more important in and around periparturient period.
- Sub-Clinical mastitis is more serious economic concern and it accounts 40 times more than clinical Mastitis.
- **Etiology :** About 150 Bacteria sps. Cause Mastitis.
- 4 Types : Bacterial,Mycotic, Mycoplasmal and Nocardial Mastitis.
- Contagious , Environmental and Opportunistic Bacterial types.
- Nocardial Mastitis caused by saphophytic Bacteria which is resistant to Antibiotics.

Factors in mastitis management

- Breed : Highy Yielders.
- Stress : is a predisposing factor.
- Environmental factors : Wet bedding, Dirty lots, milking the wet udders, poor housing systems, poor fly control, unhygeinic milker's hands etc.
- Climate : Hot & Humid climate – flies spread the organisms.
- Pathogenic factors.

PREVENTION & CONTROL STRATEGIES.

Integrated Mastitis Control Programme.

1. Sanitization & Udder Hygiene :

- Reduce the exposure of teat ends to pathogens.
- Increase the resistance of cows to infection.
- Udder hygiene.
- Environmental hygiene.
- Sanitization measures to milker's hands/milking machines.
- Proper disposal of excreta.
- Disinfection of housing.
- Sanitization of cow's udder
- Prior and post milking-Teat dips with isopropyl alcohol, chlorhexidine etc.

2. Milking Order :

- Milking 1st Primiparous cows – then multiparous cows.
- Healthy cows , then mastitic cows.
- Forequarters- then hind quarters.

3. Dry Cow Therapy :

- Intra mammary infusion with long acting antibiotics.
- Teat sealing with Acrylic latex- dipping teats into solution.

4. Lactation Cow Therapy :

- Sub clinical Mastitis – 3-5 days treatment
- Clinical Mastitis – Longer time
- Udder screening : every year 3-4 times each quarter of cow should be screened.

5.Maitenance of optimum udder immunity:

- It depends upon nutritional status of animal.
- Dietary supplement of micro elements like Zn, Cu, Co, Fe, Mn, Cr, Se .
- Beta carotene, Vit A, C, E, Lactoferrins etc will improve the immunity.

6. Autogenous mastitis vaccine :

- A vaccine is prepared with S.aureas and E coli. (prevalent mastitogenic bacteria), But due to multi etiological nature of mastitis , it is difficult to develop a vaccine.

7. Breeding for Resistance to Mastitis :

- Selection of cows with health related traits etc. can be bred.

8. Theraeutical Management of Mastitis :

- Anti microbial approach
- Phyto therapy/ Herbal Remedies etc.

CONTROL OF PROTOZOAL DISEASE IN DAIRY CATTLE

- Control of ticks by dipping, spraying at periodical intervels.
- Vaccination: Live, killed vaccine , inactivated cell culture vaccine, irradiated vaccine etc can be used in Babesiosis and Theileriosis.
- Theilioriosis mostly observed in Summer and rainy season (May – October) because vector is highly active atthis time.
- Control of Theileriasis is difficult because the tick Hyaloma feeds on wild animals and Rats.
- Others : Vector control, Rotational grazing.
- Infected feed and water spread the disease. Droplet infection.
- Strict isolation of infected cattle.
- Culling of animals with positive for disease.

- Screening of the animals at the time of procurement.
- Quarantine.
- Ensure that the Semen used for AI is free from the diseases.
- All the aborted foetus, placenta etc –handled properly.
- Breeding bulls screened regularly.

SPOTTING OF SICK ANIMAL

Spotting of sick animals from flock of sheep or goat for treatment, preventive vaccination and deworming.

Signs of ill health

- Dry muzzle
- Rough coat
- Sick animal stand with head down or tendency to separate from herd are warning symptoms.
- Lateral recumbency
- Loss of appetite and no rumination
- Coughing, sneezing will be seen with nasal lachrymal discharges.
- Deviation from normal temperature, pulse rate and respiratory rates.
- Changes in colour and consistency of urine and faces.
- Change in colour and quantity of milk with presence of blood clots in. milk.
- Improper gait.
- Urination and defecation while sitting only.
- Soiling of buttocks, tail with faecal material is assign of diarrhoea.
- Excessive salivation, foul smell from mouth.
- Congestion of mucous membranes with dull eyes

HEALTH CARE-PIGS

Biosecurity and sanitation

- Follow high biosecurity measures. Avoid unauthorized farm entry. Vehicles, personnel must be disinfected.
- Dispose wastes from the pen and scrub the area, walls and wash the entire premises with pressure pump
- Prefer dry conditions and it is batter to keep the pens empty for two days in a week to lessen the germ load
- Every day dispose off the wastes environmental friendly and disinfect the area
- White wash pent atleast once in a productive cycle to avoid stinking smell and stickiness of walls
- Clean pigs atleast once in a day by water using spray or allowing into wallowing tank
- Clean and disinfect almost all the equipment before using in the pens
- Use commercial disinfectants and follow the recommended dose.

Routine health care

Observe the pigs twice daily for their comfort. Piglets must be comfort in the creep pen. Check the skin condition, movement, alertness, feeding, watering pails, room temperature and humidity, ventilation etc and correct the management by adopting suitable measures immediately. Identify underfeeding piglets, sick animals and isolate into sick pen. Observe very frequently the in-heat animals, mating, farrowing, piglets for first few weeks of age as these require suitable steps time to time in the management.

Signs of health

Healthy signs in pigs are vigorous, alertness (look at you when go near), springy tail, moist snout, warm ears, skin not scaly or discolored, good appetite, firm dung, quiet steady breathing, no coughing. A normal pig barks when disturbed, stretches when it gets up, eats well and does not stay apart from other pigs. Normal body temperature is 39˚c or 102˚F, pulse (at inside thigh) is 70-80/minute and respirations are 10- 16 per minute.

Medication

Medication in pigs can be individual or group. Medicines are administered through oral route by drenching (young pigs), mixing in feed/water (young or adults). Injections can be given by subcutaneous at flank area or at neck region under the loose skin, intra-muscular at thigh region and intravenous at ear vein. Practice deworming at all ages regularly once in a month either by injecting or oral route.

Vaccination

Pigs are immunized against certain diseases i.e. bacterial/viral. Vaccinate healthy animals if necessary follow booster dose to build up better immunity. Deworm all the pigs prior to vaccination. Follow the instructions of vaccine manufacturer while administering the vaccine. Vaccines are stored as per the instructions and dispose off the used bottles effectively.

Culling

Dispose off the pigs. Culling is practiced for efficient management of herd. This can be young or adult, sick or unwanted pigs. In pedigree breeding, the culling is practiced for various economic characters during the selection process.

Disease prevention and control of parasitic diseases

- Provide satisfactory housing conditions i.e premises must be clean, dry well ventilated, protect from heat, winds. Relieve stress by following good managemental practices.
- Follow strict. biosecurity and hygienic measures in the swine farm. Adequate foot disinfection programme for all visitors is needed.
- Divide the hogs into smaller groups based on size, age, sex.
- Wallow must be clean and hygienic.
- Concrete floor is better the left over feed and to improve sanitation
  Provide fresh and clean water at all times,
- Vaccinate the animals against common swine diseases (see diseases).
- Screen the breeding herd brucellosis at least once in a year
- Force the brood sow and herd boar to take plenty of exercise
- During disease troubles, isolate the sick animals at least 100 meters away from the healthy flock.
- If foraging is practiced, keep the pastures under hygienic, practice rotational grazing
- Fecal samples are to be screened periodically once in a month and if necessary dose them with suitable deworming drugs
- Change the deworming medication now and then to avoid drug resistance
- Medicate the animals through water/feed/injection, follow correct dosage
- Use broad spectrum parasiticides to check internal and external parasites
- Check the transmission through intermediate hosts like earth worms, snails, flies and ticks etc.
- Spray insecticides / acaricides on the walls, floors, on animals and white wash the walls at least once in a reproductive cycle
- Dispose off wastes environmental friendly and prevent fly breeding
- Quarantine the new animals before introducing in to herd

Vaccination Schedule of Swine

Disease	Vaccine/manufacturer	Dose	Route	Age	Immunity
Swine erysipelas	Erysipelas vaccine IVRI Alum adjuvant	0.5ml	S/c	3 months	3 months
Hemorrhagic septicemia.	HS vaccine (VBRI)	5m1	S/c	6 months	6 months
Anthrax	Spore vaccine	1 ml	S/c	6 months	1 year
FMD	Multi strain, Hoechst	5ml	S/c	1 month	6 months
Rinderpest	RP vaccine	1 ml	S/c	6 months	3 years
Swine fever	IVRI vaccine	1 ml	S/c	3 months	1 year

IX. WASTE MANAGEMENT

Manure is an inevitable byproduct of livestock and poultry production. Manure is a valuable material that can be used as a source of organic matter and fertilizer for crop and pasture production. Manure can also be used as source of energy on the farm through anaerobic digestion to produce biomethane or thermochemical process (such as pyrolysis, gasification, or combustion) to produce heat or electricity. Some of the by-products of energy production can be further processed to produce value added chemicals.

Quantity of Manure Produced

Typically, manure includes excreted material from the animal (feces and urine), used bedding, as well as wasted feed, water (drinking and wash), hair, and soil.

The quantity of manure produced depend on several factors including:

- Animal type (ruminant or non-ruminant),
- Diet (forage-based or grain-based),
- Animal age (which can influence the amount of feed consumed),
- Animal environment and
- Animal productivity as well as other factors.

Composition of Manure

The chemical characteristics of manure primarily depend upon the chemical composition of the feed given to the animal. The animal metabolizes the feed to provide itself with energy and produce new body tissues and products. The waste products of metabolism are largely collected in urine and passed out with the feces (which may contain unused feed).

Nutrient requirements by animals vary with animal type and stage of production. Usually, when the animal's protein requirements decrease, the concentration of protein in the diet can also be decreased, thereby decreasing the concentrations of nitrogen excreted as a percent of body weight. Similarly, increased levels of minerals fed (e.g. copper, phosphorus, sodium, potassium) increase the level of those nutrients in the manure. It is recommended that manure analysis be done regularly especially if diet formulation and major changes in management of the livestock occurs.

Manure Treatment Technologies

Historically animal manures have been handled as a solid and were either deposited directly to pasture by the animals or collected along with the bedding used in the animal shelter and applied to land as a crop nutrient. As the number of animals on farms has increased the need for more efficient methods of manure management has also developed. The emphasis of the resources on these web pages are to provide an overview of manure treatment technologies, research being done in this field, and highlight the considerations involved in selecting candidates for a particular farm.

Why treat Manure?

Manure from animals is a very wet, bulky material, containing as much as 90% water. Of the 10% that is dry matter, much of it is carbon. The manure handling system can impact the characteristics of the animal waste stream. Water-based waste management systems may have a liquid stream with greater than 98% moisture while manure scraped from open lots can contain a very high percentage of soil. As a result, the plant nutrient content of the manure is a very small portion of the weight/volume. Hauling nutrients to cropland in the form of manure can get very expensive compared to hauling the same amount of nitrogen or phosphorus in the form of commercial fertilizer.

Correcting the imbalance in manure nutrient distribution will involve finding ways to economically move excess nutrients off the livestock or poultry farm. Many alternatives to land application of raw manure are being examined. Many of these "manure treatment technologies" have been used in one form or another for many years, while others are recent solutions. Often, technologies are used in combination to create a system that can be tailored to the species, management of the farm, climate, or other factors. Technology that may be very successful on one farm may not be appropriate for another.

Aerobic Manure Treatment

The term “aerobic treatment” refers to biological treatment processes that occur in the presence of oxygen. In these processes, aerobic microorganisms oxidize bio-available organic and nitrogenous compounds. Removal of these oxygen demanding compounds provides a means to reduce odor emission and to reduce ammonia emissions. Aerobic treatment has not been used much in treatment of liquid or slurry manure primarily due to the costs associated with operating the motors, compressors or fans required to supply enough oxygen to support aerobic bacteria.

The amount of aeration needed (in increasing order) depends on whether it is desired to just reduce odor, or completely remove the oxygen demand of the organic matter, or to supply enough oxygen for oxidation of ammonium to nitrate (nitrification).

Advantages of Aerobic Manure Treatment

Advantages of aeration include the potential reduction of emissions of odor, methane (a greenhouse gas), and ammonia. Nitrification of ammonia to nitrate also has the advantage of conversion to a nitrogen form that is readily crop available, although it is also more prone to leaching. The nitrate can also be biologically converted to nitrogen gas in the presence of organic compounds, resulting in nitrogen removal from the liquid or slurry.

Disadvantages of Aerobic Manure Treatment

Disadvantages of aerobic treatment include higher capital cost for aeration equipment, higher operating cost (particularly energy for pumps or aerators), higher maintenance requirements, and possibly monitoring requirements for checking the dissolved oxygen level in the liquid.

There are various methods and types of equipment for aeration, whether in a tank reactor or in an aeration pond, and selecting the most efficient equipment and methods may be difficult. There are also various designs to maintain the aerobic bacteria in sufficient quantity, such as attached to suspended solids or on fixed media. Consultation with knowledgeable professionals is advisable.

Vegetative Treatment System

What is a Vegetative Treatment System?

Runoff from livestock barnyards and feedlots can kill fish and cause algae blooms in lakes and streams. A Vegetative Treatment System (VTS) can be an economical alternative to retention (holding) ponds for controlling runoff from a livestock waste facility.

A Vegetative Treatment System (VTS) refers to a combination of treatment steps for managing runoff. It treats runoff by settling, infiltration, and nutrient use. Individual components of a VTS include, a settling structure, an outlet structure, a distribution system, and a Vegetative Treatment Area, when put together we consider it a Vegetative Treatment System.



Vegetative Treatment Area

A Vegetative Treatment Area (VTA) is an area of perennial vegetation, such as a grass or a forage. The VTA is used to treat runoff from a feedlot or barnyard. It treats runoff by settling, infiltration, and nutrient use. A VTA is commonly confused with vegetative buffer (or filter) strips. A buffer strip is a narrow strip of vegetation (usually 30-60 feet wide), between cropland and a stream or other surface water. Runoff passes through buffers with some "filtering" of pollutants, but no attempt is made to control solids or flow. A VTS, however, collects runoff from a barnyard or feedlot, separates the solids from the liquids, and uniformly distributes the liquid over the vegetated area. Little or no runoff should leave a VTA.

The first step in a VTS is to collect runoff from a open lot or barnyard area in a sediment settling structure, usually a basin. Such basins are very effective for removing most solids. The runoff then flows into a VTA (Vegetative Treatment Area) whose soil treats and stores the runoff. Once the runoff is in the soil, natural processes allow plants to use the nutrients.

The general idea behind this technology is that the plants will take up the nutrients contained in the runoff and that natural factors will eliminate undesirable components such as pathogens. There are many different types of VTA's, level, infiltration basins, sloped, sprinkler, dual and multiple systems, etc. To learn more about the different combinations, and when they are appropriate, see VTS System types and configurations.

Animal waste handling methods

- In some countries especially developing countries, little information is available about livestock waste production and management. The quantity and composition of animal waste is dependent on breed, species, production level and feeding practices.
- At present, data on these determinants appear to be based on various assumptions.
- The loss of nutrients from agricultural operations will become a critical issue in areas that are exposed to eutrophication .
- There is need to develop a collection, handling, storage and transport systems that are compatible with the requirements of current production systems that are environmentally friendly
- The following livestock waste handling techniques have been used to ensure timely application of manure to the crops, improved nutritive value and reduced viability of pathogens.

Pit disposal

- Disposal of animal wastes in dogged pits has been the method of choice for years because of its low cost and convenience.
- A deep pit with inside framing and a tight-fitting cover, or an open trench prepared by a backhoe has been used for the disposal of death birds.
- Some farmers use a transplanting auger to dig smaller round holes for disposal.
- In order to control odors and flies, and discourage scavengers, a covering of at least two feet of earth must be maintained.
- Disposal in a municipal or commercial landfill is also an option when the operators will permit carcass burial.
- This route is usually reserved for larger or emergency disposal needs because of transportation costs.

Introduction to Biogas and Anaerobic Digestion

On-farm biogas production has long been a topic of interest for farmers, with historical records of biogas production going back several hundreds of years. In modern livestock production systems, for example, the benefits of producing biogas are significant and include:

- provision of supplemental renewable energy
- odor reduction
- reduction of emissions of greenhouse gases pathogen control
- waste biostabilization.

The economics of biogas production, however, are sometimes difficult to justify unless the accompanying environmental benefits and other by-products are considered.

What is a Biogas?

Biogas is a by-product of the anaerobic (without oxygen) breakdown of organic matter. The organic matter could be any of a number of materials, but on the farm, it most often comprises animal manure or other agricultural waste.

The most important component in biogas is methane, a flammable gas that can be used in furnaces, for cooking, or even as an engine fuel. However, biogas also contains carbon dioxide and small amounts of hydrogen, hydrogen sulfide, nitrogen, and water vapor.

How is Biogas Used?

Biogas generated from anaerobic digestion processes is a clean and environmentally friendly renewable fuel. There are many uses for this fuel, including use in engines, generation of electricity, heat and hot water systems, and even refrigeration.



This generator makes electricity using biogas from a digester on a 1,000 cow dairy farm.

What is a Digester?

A digester is a sealed vessel or container in which anaerobic digestion of organic matter occurs. The bacteria "feed" off the manure and, in the process, release biogas as a by-product. This process is referred to as anaerobic digestion, and the sealed vessel or container is thus usually referred to as an anaerobic digester. Anaerobic digestion also occurs in the anaerobic zones of open or unsealed swamps, bogs, and wastewater lagoons.

Today, farmers in developed countries are using digesters primarily to improve the quality of their manure and to reduce manure odors, the energy content of the methane being simply a by-product. However, as the price of energy increases, more farmers are looking at using anaerobic digestion as a way to generate supplemental heat and electricity for their farms. Digesters are a popular technology in rural areas of the developing world, where electricity and petroleum fuels are often unavailable or unaffordable.

Composting Manure

Compost not only describes the completed degradation of a mixture of materials; it also denotes the process that materials undergo before becoming compost. A workable definition for compost is that it is an organic soil conditioner that has been stabilized to a humus like product, is free of viable human and plant pathogens and plant seeds, does not attract insects or vectors, can be handled and stored without nuisance, and is beneficial to the growth of plants. A more useful explanation of the process of composting is the controlled biological process of the decomposition of organic materials into a humus rich product that can be used beneficially as a soil amendment or in erosion control techniques.

Compost is produced through the activity of aerobic microorganisms that require oxygen, moisture and food. These microorganisms generate heat, water vapor and carbon dioxide as they transform raw materials into a compost product. Effective composting begins with a basic knowledge of the material or feedstock properties, the general principles of decomposition and a method for controlling the process.

What factors influence composting?

There are a few feedstock characteristics that are most influential in the composting process. These include carbon to nitrogen ratio (C:N ratio), moisture content, and the size and distribution of the feedstock particles. Raw materials blended to provide a C:N ratio between 25:1 and 30:1 is ideal for active composting, although initial C:N ratios from 20:1 to 40:1 consistently give good composting results.



High quality mature compost



Aerated static pile composting

When ratios fall outside this range, odor problems and longer composting times can be the result. Too little moisture, as well as too much moisture, can lead to poor composting conditions and decreased microbial activity. A moisture content ranging between 40-60% usually provides the water levels needed by microbes without saturating the required air pore space within the compost matrix . With regard to particle size distribution, a size of 90 percent cumulative passing through 2 to 3 inch openings usually is sufficient to provide a composting substrate with adequate surface area for microbial degradation and with adequate porosity for the storage of oxygen.

Methods of manure composting

Harnessing the natural process of decomposition to best serve a purpose within a set of specific parameters is the basis for composting systems. There are four general composting groups or methods commonly used by the composting industry:

- Aerated manure compositing
- Compositing manure in windrows
- In vessel compositing of manure
- Passive compositing of manure
- Vermicompositing animal manure

Vermicomposting animal manure

Vermicomposting is a process that relies on earthworms and microorganisms to help stabilize active organic materials and convert them to a valuable soil amendment and source of plant nutrients. Earthworms will consume most organic materials, including animal manure, agricultural crop residues, organic byproducts from industries, yard trimmings, food preparation scraps and leftovers, scrap paper, and sewage sludge.

Of the more than 4,000 species of earthworms, only half a dozen are used for vermicomposting worldwide. The earthworm species most frequently used for vermicomposting is *Eiseniafetida*, which is commonly called Red Wiggler.



Vermicompost production

- Vermiculture can be defined as the non-thermophilic biodegradation and stabilization of organic materials resulting from interaction between earthworms and micro-organism living in both the worm's intestine and organic materials .
- Vermiculture system world wide uses two epigenic earthworm species Eisenia Andrei and Eisenia foetida .
- Animal dropping can be potentially converted into vermin-cast and vermin-meal (protein meal) via low cost vermiculture system.
- Casts are digested organic remains, mucus and nitrogenous excretory substances from the worm intestinal tract .
- The gizzard of worms allows them to produce casts that have a much finer texture than both raw and composted waste .
- Vermicast is becoming increasingly valuable due to its soil like texture and pleasant odour .
- Vermi-cast derived from animal manure have been shown to supply growth benefit to plants which out perform conventional inorganic fertilizers when compared on nutrient basis, and are sold as a biologically enhanced organic fertilizer .
- They also provide microbial biomass, plant growth hormones, enzymes and humic acid.

How to choose a Vermicomposting system

A variety of methods may be used to process large volumes of organic residuals with earthworms, ranging from land and labor-intensive techniques to fully automated high-tech systems. Types of systems include windrows, beds, bins, and automated raised bioreactors. Choosing which vermicomposting system to use will depend upon:

- Amount of feedstock to be processed
- Funding available
- Site and space restrictions
- Climate and weather
- State and local regulatory restrictions
- Facilities and equipment on hand
- Availability of low-cost labor



Swine Manure Vermicomposting, Vermicycle Organics



Dairy Manure Vermicomposting, Worm Power

What are the advantages in using Vermicompost?

Earthworm casts are covered with mucus from their intestinal tract; this layer provides a readily available carbon source for soil microbes and leads to a flush of microbial activity in fresh casts. Vermicompost improves soil structure, reduces erosion, and improves and stabilizes soil pH. In addition, vermicompost increases moisture infiltration in soils and improves its moisture holding capacity.

Plant growth is significantly increased by vermicompost, whether it is used as a soil additive, a vermicompost tea, or as a component of horticultural soilless container media. Vermicompost causes seeds to germinate more quickly, seedlings to grow faster, leaves grow bigger, and more flowers, fruits or vegetables are produced. These effects are greatest when a smaller amount of vermicompost is used—just 10-40 percent of the total volume of the plant growth medium in which it is incorporated. Vermicompost also decreases attacks by plant pathogens, parasitic nematodes and arthropod pests.

Utilization of livestock wastes

- It is obvious that there is an urgent need for a sustainable use of livestock waste manures in animal and crop production. Some of the approaches that might be used within this research have also been proposed.
- Therefore, reducing waste from animal agriculture is important to maintain clean environment.
- Livestock waste management via recycling is an important step in sustainable livestock waste management as well as to reduce the negative environmental impact associated with its mismanagement.

Alternative animal feed

- Animal wastes when properly handled and dried will contribute to reduction of feed cost in areas where feedstuffs are scarce and expensive thus increasing the profit margin accruable to the farmer
- This will increase the profit margin and at the same time lower the cost of poultry meat and eggs reduce hunger and lower the competition between humans and poultry for food (El Boushy and Vander Poel, 2000).
- Depending on the production system used, 60 - 70% of cost of production goes to feed under intensive system of livestock management.

- Due to this high cost of conventional feeds and feed ingredients, nutritionist and other related workers in developing countries have seriously advocated the use of non conventional feeds and feed ingredients such as processed animal waste, leaf meals and agro industrial waste in animal nutrition.
- This will lead to a reduction in the use in animal feeds of traditional feed ingredients such as maize, wheat and soybean that can be consumed by human.
- Poultry and swine manure collected in confinement feeding facilities can be recovered for re-feeding to beef cattle, dairy cattle and sheep.
- This practice has been shown through research to be an effective system of recovering, processing, and re-feeding such waste as source of energy, protein, and mineral nutrients in ruminant animal production.
- Dried animal waste such as poultry dung is broadly equivalent to cereal such as barley in terms of protein and essential amino acids .
- In UK, for example, when properly processed, dried poultry waste present no serious hazards to ruminants and poultry and had no negative effects on meat, egg or milk quality.
- This by-product of animal waste has been generally proven by a number of workers to be economically marginal because of the relatively low percentage of proximate compositions and amino acid profiles of poultry waste as reported by several researchers and high ash contents.
- However, a precise determination of the benefit to an animal of animal manure is very difficult since manure is a dynamic organic material continually undergoing biological and chemical transformation.
- The benefit therefore, depends upon the composition and nutrient forms present as at the time of feeding. The manure nutrient content is affected by the overall manure handling system.
- Poor handling of animal waste generated from livestock industries over the years had posed serious public concern on environmental quality and biosecurity issues and had made direct disposal of livestock wastes on land socially less acceptable.
- The conversion of livestock waste to useful products that are environmentally friendly turn out to be the only alternative to the emerging environmental issues associated with indiscriminate livestock waste disposal.

X. FODDER CONSERVATION

SILAGE MAKING

Conservation of green fodders under anaerobic conditions in the green form is called ensiling and the conserved green fodder is called silage.

Silage is highly palatable, slightly laxative, easily digestible and loss of carotene during ensiling is very less. Organic wastes, weeds, coarse fodders and thick stemmed forages can be effectively conserved as silage. The surplus green fodder from rainy season can be preserved as silage for feeding during lean season.

The device or container used to prepare silage is called silo. Silos can be permanent structures like towers, trenches, or bunkers prepared using bricks, cement, or stainless steel, or they can be pits dug in the ground and plastered with cow dung and clay.

Crops suitable for silage making

- The crops should give a high yield of vegetative mass.
- The crop should contain adequate level of soluble sugars and starches (NFE) for acid fermentation.
- Monocotyledons crops have higher sugars and lower level of nitrogen Eg: sorghum, maize, hybrid napier.
- The crop chosen for silage must be in bloom stage.
- Ideal silage can be obtained from crop with dry matter content of 30-36 per cent.

Grab Test

The farmers can easily test the consistency and moisture content of the forage, by making it to a ball and as per the condition of the ball the moisture % can be assessed.

Condition of forage ball	Approx % of moisture
When the ball holds its shape and there is considerable free juice	Over 75
When the ball holds it s shape but there is little free juice	70-75
When the ball falls apart slowly and there is no free juice	60-70
When the ball falls apart rapidly (too dry for best stage)	Below 60.

Important steps in the preparation of good silage

- Cereal crops should be cut at 50% flowering stage for silage making. Crops like hybrid napier should be harvested 45-50 days after previous cut.
- The moisture content in the harvested material should be reduced to 60-65% by wilting if necessary.
- The material should be thoroughly chaffed using chaff cutters into small bits of 1-2 cm size.
- Legume fodders, if any, to be added for ensiling can be added to the chaffed material. These additives are intended to promote lactic acid fermentation and discourage the activity of other organisms. About 3-4 kg of urea can be dissolved in water and the solution sprinkled on one tonne of chaffed material. For every tonne of green fodder, add either 30 kg of molasses, or 50-60 kg of cribbled grains of sorghum or maize or any cereal, or add 45 kg of citrus fruit pulp. Any one of the above should be added. Usually molasses is preferred.

The material is filled into the silos in uniform layers and compacted to eliminate the air. It should be airtight packing.The packing should reach 1-2 m above the ground level of the bunker or pit in a dome shape.

To make the silo airtight for continued anaerobic conditions, it should be sealed using any type of insulators like mud, plastic sheets, mud and dung mixture, etc. After few days the material gets compressed leaving open space on the top. Cracks may be seen in case of mud plastering. These cracks should be immediately sealed.

- After a period of 1.5 to 2.0 months the silage is ready for feeding livestock
- During this period it is fermented. Due to the activity of enzymes and bacteria, organic acids like lactic acid, acetic acid, butyric, etc. and also ethyl alcohol are formed. The pH is brought down to 4.0 lactic acid fermentation is important for good quality silage. Aerobic conditions or more proteinaceous material used for silage, lead to butyric acid fermentation which is not desirable.

- Good quality silage is golden yellow or greenish yellow in colour, bright and moist in appearance with characteristic pleasant aroma.
- While using the silage, silo is opened to remove sufficient quantity of silage and immediately made airtight. Once opened, the silage should be removed and fed daily till it is finished.
- Silage made from material with high dry matter content, or dried material is called **haylage,** and that prepared from waste materials is called **Wastelage.**

About 400 kg of silage can be stored in one cubic metre space as against 66 kg of hay. If the preparation of silage is not proper, there would be more losses mainly due to aerobic fermentation, clostridia and effluents. Animals do not accept poorly prepared silages.

HAY MAKING

Conservation of forages in the dry form is known as hay making. The moisture content in the forage plants is reduced drastically to 15% or below for long period storage. Hay differs from straw or stover in that straw is a by –product in the dried form while hay is the complete plant in the dried form.

In a tropical country like India, the green fodder is available only during monsoon season. The excess green fodder has to be conserved and used during the lean periods. Usually the excess fodder is harvested, dried, bundled, heaped and used during summer. This is the local practice evolved through several years of experience by farmers. The grass from forest area and the natural pastures is also cut, dried and stored as hay.

Fine stemmed grasses and legumes make good hay. They should be cut at the right stage and properly dried so that the hay is leafy, pliable, and green in colour, free from moulds, weeds and dust and has pleasant characteristic smell and aroma.

Stage of harvesting

Pre flowering or early flowering stage of the plant is the best stage of harvesting of most of the crops for hay making.

Losses from delayed harvesting

1. Shattering of leaves
2. Reduction in palatability
3. Decrease in nutritive value
4. Lower yields of subsequent cuttings

Losses from premature harvesting

1. Lower yields of food constituents
2. Lower yields of dry matter
3. Difficulty in harvesting method
4. Longer time required for curing

Thin stemmed and more leafy grasses like oats are good for hay making. However, crops like sorghum and maize are also converted into hay. Most grasses from pastures like Cenchrus ciliaris, Dicanthium annulatum, Cynodon dactylon when properly cut and dried make good hay. Grasses with spiny awns such as Heteropogon contortus should be cut very early for hay; otherwise, the hay will be unpalatable to livestock. Cultivated fodders like hybrid napier, para grass, guinea grass, teosinte are not suitable for hay making.

Legume hays are more useful because of higher protein content. The legume crops suitable for hay making are lab-lab, cowpea, french beans or guar, horsegram, sunhemp, pillipesara and lucerne. Leaf shedding will be a very big problem during drying and curing process in the legumes. It is because, the moisture is lost more easily from the leaves than from the stems. Leaves constitute nearly half the green material and 75% of the protein. So, loss of leaf will reduce the feeding value very much. Cowpea, lab-lab and pillipesara are less liable to leaf shedding than other legumes. Beseem is not suitable for hay making mainly because of this problem of leaf shattering. The perennial legume lucerne is good for hay making. In western countries, lucerne hay is powdered, mixed with other ingredients and sold as lucerne meal.

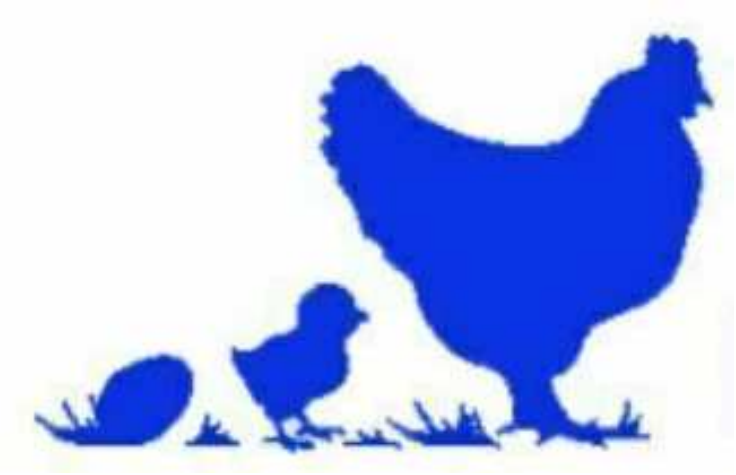
Testing for moisture level of hay

The farmers can test the level of moisture of hay physically by using squeezing method.

47% moisture	-	Juice can easily be squeezed from stems
35% moisture	-	Hard to squeeze juice from stems
25% moisture	-	Slightly tough
18-23% moisture	-	Safe far bailing

The residues of most cereal crops like paddy, wheat, sorghum, maize, bajra, etc. are dried and stored as straw or stover. Straws are inferior in quality compared to hay because grain, which contains most of the nutrients is removed. However, use of dried straws is wide spread in India.

In western countries, where natural drying is difficult because of the climatic pattern due to low sunshine, low temperatures and high humidity; artificial drying is practiced using heavy machinery like driers, blowers, etc. Hay and straw make excellent roughage for the ruminants.



DEPARTMENT OF POULTRY

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RURAL POULTRY FARMING

Rural poultry farming is an age old farming system adopted at village level. Farmers are rearing backyard poultry as it can serve as a source of income for them and it can also meet the nutritional requirement. Rural poultry farming involves rearing of indigenous, genetically improved poultry birds. Improved backyard poultry varieties like, Rajasree, Vanasree, and Gramapriya are preferred due to their moderate body weight and high egg yielding capacity under extensive or semi-intensive farm conditions in rural or tribal areas. The feather colour of all the rural type birds are multiple coloured and mostly brown eggers. They have the better immune capacity and thereby strength of survivability is maximum. Because of moderate body weight the birds can escape from predators. Initial brooding up to 6 weeks in brooding unit/nursery is required and are let out for semi free range or free range management system.

CHICK MANAGEMENT

Preparation of poultry shed/housePreparation of poultry shed/house

- After liquidation of old flock the following operations are required to be created for clean and healthy environment in the poultry house.
- Remove all the movable equipment from the shed. Soak in water and clean thoroughly in tap water and finally dip in disinfectant solutions. Finally wash in clean water, sun dry and store.
- Litter should be removed from the shed and transported away from the farm in closed containers or in gunny bags and disposed off properly.
- Lightings and feed and water pans should also be taken out of the shed and cleaned properly.
- Accumulated dust and cob web formed on the wall, ceiling, mesh etc., should be removed.
- Insecticide is to be sprayed over the litter, walls, mesh, roof etc.
- Shed should be washed using a pressure washer.
- All the repair works of the shed including cages, equipment and mesh should be carried out.
- Water tank, pipeline and water channel in the shed be cleaned thoroughly. First drain the water, fill the water lines with de-scaling and disinfectant agent overnight. Flush with water for 2-3 times to remove all dirt and debris.
- Flame guns should be used inside and outside of the houses.
- Walls should be white washed and metal surfaces should be painted if needed.
- The equipment and fitting should be re-assembled and the curtains be tied.
- Spray an insecticide to kill the insects.
- Shed should be kept under lock (shed rest) for a minimum of 2 weeks or until arrival of chicks:
- Set heating system (switch on brooders) at 29-32 (85-90^{o}F) for cage brooding or at 32-35 (90-95^{o}F) at chick level for floor brooding.
- Cover the floor (litter) of brooder with news paper and arrange feeders, waters etc.
- Check water system and adjust to proper height of chicks, Disinfect and flush water lines.



On arrival of chicks:

- While placing chicks in the brooders, count the number of chicks placed in each portion cell to ensure proper stocking density.
- Fill waterers with clean water and feeders to provide feed more than twice daily.
- Check brooder temperatures.

On placing chicks:

- Encourage chicks to take water from water cups.
- Provide the feed in mash or crumble form. Crumble/pellet feed will ensure more uniform growth.
- Provide adequate light continuously during the first two days.
- Electrolytes/antibiotics supplementation in drinking water will reduce transportation and environmental stress and also reduce initial chick mortality.

BROODING

Spot brooding: This conventional method of brooding depends overhang on spot heating either by using electrical bulbs or gas brooders. In this system one (over hanging or standing) is provided for every 300-600 chicks. Hovers are reflectors which provide warmth to chicks using electrical bulbs or gas brooders. The air temperature under the hover is kept at a required level. Hovers are made up of metal, wood or bamboo baskets fitted with electrical bulbs, infra red bulbs or heating elements and gas heaters.

Brooder guard: 2 to 2½ foot away from the edge of hover, brooder guard is provided to prevent chicks straying away from heat source, feed and water. Brooder guards are generally made up of G.I sheet with 18 inches height. For first 2 days, feed is sprinkled on the paper and after that chick feeders are provided. Chick waterers should be provided first day onwards. Feeders and waterers are arranged in cart wheel manner, so that chick need not have to walk long distance to access feed and water.

Temperature: The temperature is regulated by adjusting the height of hover has with the number of bulbs/flame. During the first week, brooding temperature under hover (2 inches above litter at the top of the hover) should be 32 -34°C (90-95°F)with a weekly reduction of 5°F till it reaches 27°C (80°F).

Brooder temperature for chicks at different ages:

AGE OF CHICKS IN WEEKS	BROODER TEMPERATURE	
	°F	°C
1st	90	32.2
2nd	85	29.4
3rd	80	26.7
4th	75	23.9
5th	70	21.1
6th	70	21.1

FEEDING OF CHICKS

Feeding of chicks

The rural type chicks need balanced feed during the initial 6 weeks of age under nursery rearing/brooding. In the nurseries, the chicks are reared on standard chick starter ration containing 16-18% protein, 2300-2700 Kcal ME, 0.85% Lysine, 0.36 % methionine 0.7% calcium and, 0.35% available phosphorus. The diet can be formulated using the locally available feed ingredients to meet the above nutrient specifications.

Preparation of feed with locally available feed ingredients:

Maize/Bajra/ Ragi/Broken Rice etc.	50 parts
Rice bran/Wheat bran/ De -oiled rice bran etc	20 parts
Soybean meal/ Groundnut meal/ Sunflolwer meal/ Till cake/ Linseed cake	28 parts
Vitamin and Mineral mixture	2 parts

Feeders: During the first day, feed may be sprinkled or provided in the trays for encouraging the new born chicks to pick up feed. From day two onwards feed is provided in trough type of feeders. As the chick grows bigger suitable feeders are used. The feeders should be at proper height for the birds to eat properly. As chicks grow the feeder should be lifted up by adjusting their height to the back level of the bird. The level of feed in feeder has a direct correlation with feed wastage. As a thumb rule, 10 percent feed is wasted if the feeders are two thirds full compared to 3 percent wastage if they are half full and only 1 percent if they are one third full. Therefore, feed should be offered more frequently with small quantity at each time and helps to gain weight more uniformly.

Feeder space allowance: Trough feeders 2.5cm – up to 2 weeks and 5cm –up to 6 weeks.

Waterer space: Clean and fresh water should be provided to the chicks waterers from day old chicks should be conveniently placed close to the hover and alternatively to feeders. Water may be provided using troughs, bell shaped drinkers and caps. With these drinkers 0.75 inches (2 cm) of water space per bird is recommended.

Water should be provided before the chicks are released under the brooders. Bell type chick drinkers are essential during first three days of brooding irrespective of type of brooding. In deep litter brooding drinkers should be evenly distributed. Height of the drinkers needs to be adjusted according to the chick height. One chick drinker is enough for 100 chicks up to 2 weeks of age and regular bell drinker is sufficient for 50 birds from third week onwards chick feed/grounded maize should be provided 2 hours after chicks are placed under the brooder. During first week, frequent feeding of small quantity should be practiced to stimulate feed consumption.

PREVENTIVE MEASURES FOR CHICK MORTALITY

Preventive measures for chick mortality:

Due to the high mortality rate in chicks, poultry farmers suffer huge financial losses. First week of chicks in particular can be very troublesome. Chicks at this stage are sensitive and have very low immunity. So make sure that chicks do not fall victim to death.

Causes of Chick mortality:

1) Genetic causes: Some chicks may be born with genetic defects or weaknesses that make them more vulnerable to disease or death.

2) Diseases caused by microorganisms: Common infectious diseases causing mortality in rural chicks are Newcastle disease, Marek's disease, salmonellosis, coccidiosis, E.coli and mycoplasma infections. Eggs which are contaminated with microorganisms such as E.coli, Pseudomonas, and Staphylococcus etc also act as source of infection.

3) Dietary causes: If chicks are deprived of feed for 24-48 hours there will be a drop in blood glucose levels and mortality occurs. Chicks get essential vitamins, nutrients, antibodies through Yolk sac until 2-3 days after hatching. But chicks die if they are not given complete nutrients. Additional nutrients must be supplemented for proper gut development, immunity and health.

Mortality in chicks	Causes
5-6% mortality	E.coli and yolksac disease
6-8% mortality	Pseudomonas
3-4% mortality	Klebsiella
1-2% mortality	Coli bacillus

Feed that is too dry will cause impaction in the crop and the chicks die due to suffocation. Sufficient feed and water bowls must be provided to reduce the competition among the chicks. Lack of sufficient feed and water can also lead to mortality of chicks. Chicks may also die due to toxins present in the feed.

Mortality occurs even if they are not provided with drinking water that is free from salts like sodium, chlorine and potassium which regulate body temperature.

Deaths can also occur due to cannibalism, calcium and phosphorus deficiency and deficiency of vitamin A, D, E, K.

4. Managemental causes: Mortality occurs

- Due to the stress caused by traveling long distances.
- By eating the litter during brooding.
- Due to inadequate number of watering and feeding facilities, overcrowding of chicks.
- Due to high humidity, high light intensity and inadequate ventilation in the brooding room.
- Injuries caused during vaccination, debeaking, handling of chicks.
- Wet litter, If the ammonia gas exceeds 25 ppm
- Vent pasting.
- Due to rodent and predator attack during brooding.

The "high temperature" during brooding causes chicks to lose 70% of their body water, down to 10% and die of dehydration. If the high temperature is given for a long time, they will get sunburned and die. Chicks huddle together and die of suffocation due to "low temperature" during brooding. During brooding insufficient temperature, yolk sac infection can occur and the chicks will not be able to use the yolk.

Measures for preventing mortality in chicks:

- Choose only quality chicks that are active and have good weight. The transit time should be short.
- Chicks should be brought to the farm during cold weather to prevent stress. Also, chicks must be given glucose and electrolytes through water up to 15 hours after they are placed within the chick guard.
- Grinding maize corn sprinkled on newspaper should be small.
- Vitamins like A, D, E C, mineral like calcium and phosphorus should be given to chicks in feed and water.
- Litter should examine the papers without accidentally extracting them. Adequate number of water and feed containers should be kept. Do not place them under light.
- Chicks should be given enough space so that they are not overcrowded. Adequate temperature and ventilation should be present so that the chicks do not get cold. Care should be taken to avoid fluctuations in brooding temperature.
- The feed should be of good quality without toxins. A mixture of minerals, vitamin and coccidiostat should be given in the feed.
- Drinking water should be fresh and clean. The salts in the water should meet the quality standards. Water should be tested and salts content of water should meet the quality standards.
- Vaccinations should be done as per schedule to prevent infections.
- If the droppings are stick at vent of chicks, clean it with a cotton swab dipped in dettol or potassium permanganate solution.
- Care should be taken to prevent dogs, birds and rodents from entering the brooder shed.
- At least 100-200 feet distance must be there between brooder and layer sheds.

VACCINATION

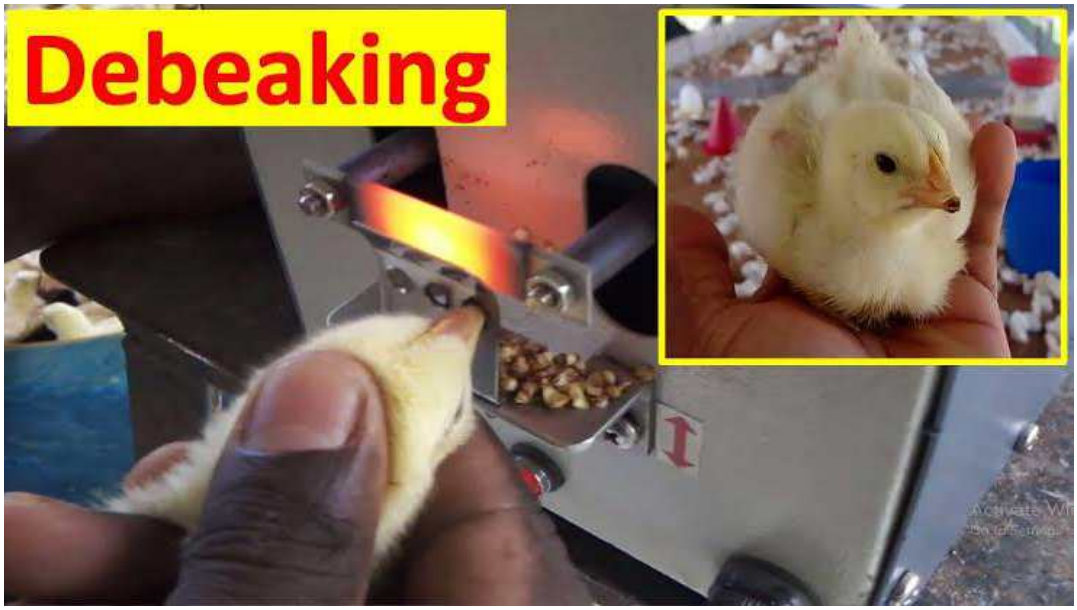
Vaccination schedule for the rural layer birds:

Age	Vaccine	Route
1st day	Marek's disease	Subcutaneous
7th day	ND, Lasota (live)	Eye drop
14th day	IBD	Eye drop
6th week	FOWL POX	I/M or Wing Web
8th week	R_2B	Subcutaneous or I/M

Debeaking:

Trimming of beak is an important managemental practice. This is done to prevent cannibalism and wastage of feed. Beak trimming is a sensitive operation and it should be done by trained people. The beak trimming is done between 7-10 days. One third of the beak should be trimmed. There are different, methods, cutting and cauterization with hot iron method is popular. Cauterization helps in arresting and destroys the tissue responsible for generating beak growth. Proper care should be taken not to burn the tongue of the chick. Use electrolytes and vitamin (K and C) in the water two days before and after beak trimming





GROWER AND LAYER MANAGEMENT
FLOCK SPACE REQUIREMENT

Flock space requirement: At 6 weeks of age, birds attain 650-750g body weight. These birds can be let out under backyard free-range system @ 10-12 birds/ house depending on the area and natural feed base available. About 200 adult birds can be reared per acre of land (or) 400-500 young birds per acre of land.

Skills to limit the predators:

- The easiest way to prevent predation is to keep flocks within buildings. However, for the majority of backyard flocks and organic flocks, this is unfeasible or is not a desired alternative.
- Lock birds up during the night and maintain a vigilant eye.

- Open poultry houses should be enclosed by fine meshing to prevent entry by wild birds.
- Motion sensor lights and sound equipment can be used.
- Objects with motion, i.e., flags and pinwheels, CD's on thin wire.
- Loud noises.
- Scare crows and dummy predator birds.
- Chemical/pheromone repellents.
- Diversion feeding.
- Fence wire size - small enough to prevent predators.
- Dig a trench 12 inches to 1.5 feet deep around the entire coop and bury hardware cloth there. This will prevent digging predators.
- Elevate the coop off the ground to help prevent mice, rats and weasels from getting into the coop.
- Inspect the bottom of the coop and patch any holes where predators could gain entry.
- Check around windows and doors - any point of entry for an entry.
- Keep your compost pile far away from the coop and don't allow food scraps to linger - clean up any food scraps that the chickens don't eat before nightfall.
- Keep the area around the coop mowed and clear - an open field without cover is a deterrent to predators.
- If you have serious problems with hawks and owls, consider covering the chicken run with hawk netting.
- If in pasture, consider long narrow rotational grazing areas.
- Cover outside runs with mesh wire or netting to prevent problems from flying predators.
- Tall leafy vegetation provides cover for birds to hide.

Night shelter: A major advantage of the homestead poultry system is the ability of chickens to find their own feed. Providing a coop for night shelter and allowing scavenging during the day is often the best system for rural poultry farming. If possible, fencing in a small area around the coop is useful for supplementary feeding and monitoring chickens. Night shelter should have good ventilation, required light and protection.



When constructing a night coop, the following points must be considered:

Location of the night shelter: The night coop needs to be in a shady area on flat dry ground if possible. The area around the coop should be cleared of bushes and tall grass to keep snakes and rats away. About 3 meters of cleared area on each side is good. The coop should be near the house to hear the chickens if they are disturbed by predators or theft. Attaching something to the door or fencing that makes a loud noise, like a bell, will alert home owners if someone is trying to take a chicken. The movement of the sun and wind needs to be considered when deciding the position of the coop. This will provide natural shade and ventilation at certain times of the day. The coop should face south or east in humid climates. To provide a source of light and warmth in the winter and good ventilation in the summer, place windows on the south side of the coop. If the coop is rectangular in shape the end walls need to face east and west so only these walls are hit by the hot morning and afternoon sun.

Size of the night shelter: The size of a night coop will depend on the space and materials available, and the size of the flock. The coop needs to be large enough that the flock is comfortable so they don't peck each other, and so the space does not become filled with humidity and gasses. A recommended size for a flock of 10-15 chickens is 1 meter x 2 meters. It is best if the night coop has 2 rooms. The larger room is for roosting. The smaller room should be used for nesting, and should have laying boxes and nests. This space could also be used as holding area for mother hens and chicks during the first few weeks after hatching while using the basket system (more details in chick management section).

PERCHES INSIDE THE NIGHT COOP

Perches inside the night coop: Perches are necessary because hens need to have a place to rest at night where they feel safe from predators. Perches also minimize the risk of disease. When roosting on perches, chickens have less contact with droppings and parasites because the chickens are of the ground while they sleep. Perching also keeps hens warm at night in cool climates. The perches can be made from bamboo poles or round branches from trees. The bark must be removed to avoid parasites. The ends of the perch (where they meet the wall) may be treated with oil or kerosene to limit parasites. The perches should be placed horizontally, and raised the period goes with .7–1.5 meters of the ground. The perches should be approximately 3 cm in diameter so the chickens' feet can comfortably grip the perch. A 1 meter perch comfortably holds 5 chickens. If more than 1 perch is needed it is better to have them at the same level, about 50 cm apart. This will limit fighting for the highest roost. Perches should be put in the roosting area of the night coop. To limit easy access in case of theft perches should not be near the door.









Nests: There are 2 types of nests needed for raising chickens. Both types should be kept inside the night coop to protect the eggs from theft and predation.

The **first type of nest** is for laying eggs. A row of nests can be provided where more hens can lay at one time. It is best to have 1 laying nest for every 5 hens. Laying nests makes collecting eggs twice a day easier

The **second type of nest** is for brooding. Nests for brooding must be individual nests. These nests need to be placed in a quiet, dark place where the hens feel safe and are not disturbed. Food and water should be placed nearby to limit time away from the nest so the hatchability of the eggs remains high. Both types of nests may be baskets made of local fiber, cardboard or wooden boxes, or clay pots. The nest should not be too big or the hen will not feel comfortable. Nests need to be padded with clean, dry material such as straw, leaves, old cloth, or sand. This will keep the eggs warm and help prevent damage to the eggs. Nesting material should be changed each week if possible. Mixing ash, tobacco leaves or anti-parasitic products and then sprinkling on nests will reduce the chance of external parasites. Nests should be fumigated with smoke/neem 2-3 times each year. If there has been a serious outbreak of disease or infestation of external parasites, the nests and padding material should be burnt and then replaced using fresh materials.

Supplemental feeding: The birds are let out for foraging during the daytime while at night they are kept in night shelter. Generally, the birds under free range conditions meet their protein requirements through scavenging. Therefore, feeding the birds with available cereals (bajara, ragi, jowar, kora, broken rice, rice polish, rice bran, etc) is always beneficial to sustain the production. These grains can be offered (10-20g/ bird) every day in the morning or evening. The nature of supplemental feed depends on the purpose of rearing. For meat purpose, feeding the birds with commercial broiler chick starter feed is suggested 5-6 weeks of age, later supplement local available feed ingredients up to the market. If the purpose of rearing is for egg production, the birds should largely depend on feed available in free-range conditions. Care should be taken to restrict the weight of pullets (females) between 1.5 to 2.2 kg at 6.0-6.5 months of age. Excess body weight may reduce egg production. The broken or shell eggs can be minimized by supplementing the calcium sources (lime powder, shell grit, stone grit, etc.) @4-5g/bird/day.

Guidelines for Supplementary Feeding:

- Feed should be given fresh daily.
- Feed should be given at the same time and place so chickens are used to it.
- Feed should be given in a feeder so it does not mix with soil or get stepped on by chickens, this reduces the chance of spreading disease.
- Feeder should be cleaned daily before refilling to reduce spread of disease.
- Feeder should be placed where the chance of attack by predators is limited.
- Feed should be broken into small pieces since chicken have no teeth.
- Feed the cock last. If the cock eats first he will eat too much and leave little for the hens. He is more able to find his feed while scavenging.

Deworming:

Round worms and tape worms are a major problem for the poultry farmer; a worm burden will lower immunity, lower feed efficiency and reduce the profits to the farmer. Deworming is mostly done through water but is also done through feed. The first deworming is done at 8 weeks of age, followed by deworming at 16 to 18 weeks of age. Layer brooder chicks and grower are dewormed as per the above pattern. The above mentioned programme for deworming must be altered if on post-mortem it is observed that the birds are harbouring these worms and need to be dewormed immediately. Mostly growers suffer from round worm infestation of the intestines and sometimes with tape worms also if the rearing area is wet. Hence, as a routine, the birds may be dewormed at 16th week of age or at 18th week. Piperazine, mabendol, levamisole, thiobendazole, zodex etc, are the drugs used to remove round worms while panacur, taenil, helmonil, dicestal etc., are used against tape worms at recommended dose levels.

Treatment

The most common medicine used is Piperazine either as 45 % or 65 % solution and the dose of Piperazine 45 % - 0.5 ml to 1ml /bird 65% - 370 ml/2000 growers (or) 370 ml/2000 layers. Piperazine can be used only for round worms.

Levamisole can be used for almost all round worm infections but not effective for tape worms. It is also an immunostimulant. Levamisole hydrochloride 30% w/w -20 to 25 mg/Kg body weight. 50g/1000 birds at 8 weeks of age. 100g /1000 birds at 18 weeks of age

Albendazole 10 to 15% is effective against tape worms also but must be administered for 2 to 3 consecutive days for good results provide 100g / 1000 birds. Fenbendazole 25% -60g/2000 birds. This is also effective against tape worms and should be administered for 2 to 3 consecutive days for good results.

Disposal of dead birds:

Dead birds act as a source of disease that can be spread by rats, mice, dogs, cats, flies, beetles, mosquitoes, free flying birds and insects. Methods of disposal may vary from farm to farm and area to area. Different methods of carcass disposal are:

A) Disposal Pit: A less desirable but acceptable method of dead bird disposal is through the use of an adequately designed and tightly covered disposal pit.

This saves labour.

Birds cannot be dug up by dogs or rodents.

It has no noticeable odour if tightly covered.

No fire hazards.

Pit can be used year round.

Birds decompose fairly rapidly without the use of chemicals. A pit of 6ft (1.83 m) in diameter and 6ft (1.83 m) depth is large enough to take care of one 10,000 capacity birds.

B) Composting: The composting process is one that must be monitored and managed well.

SELECTION OF GOOD LAYER

Selection of good layer from poor layer:

Good Layer	Bad Layer
Head small, lean and well proportionate	Head large and thick
Beak strong, shining and well curved	Beak long, thin and dull coloured
Comb and wattles warm; brightly red and full	Comb cold, shrunken and dull coloured
Eyes bright, well opened and alert	Eyes dull and sleepy
Neck short and strong	Neck long and thin
Body long, deep and proportionate	Body short, weak and thin
Back broad and straight	Back long and curved
Skin thin, smooth and oily	Skin coarse and thick
Abdomen large and soft	Abdomen small and hard
Ventral oval, soft and moist	Ventral small, dry and narrow
Feathers moult late	Feathers moult early
Shank thin and soft on back	Shank hard on back
Good appetite	Poor appetite
Friendly temperament	Shy and nervous temperament.

RECORD KEEPING

It is important to keep records on the flocks behavior and production on a daily or weekly basis. This will help the poultry keeper notice signs of injury or illness and reduce the risk of loss. It will also help to decide which chickens to breed and which to sell or consume. The flock should be observed for a little time each day. This can be done during the supplementary feedings in the morning and evening.

- Signs of disease or malnutrition
- Injury
- Parasites
- Hens with good brooding and mothering abilities (to hatch her eggs for future laying hens)
- Good looking cockerel who grew fast to have on hand as a replacement
- Low egg laying
- Negative behavior (egg eating, excessive chick pecking, hen pecking)
- Number of live hens, cocks, growers, chicks
- Number of dead hens, cocks, grower, chicks
- Number of eggs and clutches laid by each hen
- Number of fertile eggs being incubated
- Number of hatched eggs
- Number of spoiled eggs
- Number of sold hens, cocks, growers, chicks, eggs
- Number of consumed hens, cocks, grower, chicks and eggs
- Vaccination dates
- De-worming dates
- Medicine given
- Illness

DETECTING SPOILED EGGS

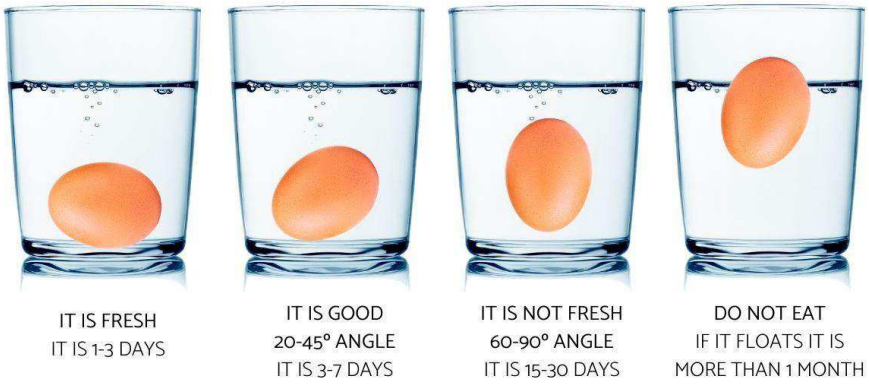
Detecting spoiled eggs from fresh eggs:

Detecting whether an egg is fresh or spoiled can be essential for ensuring food safety. While it's often challenging to determine just by looking at an egg, several methods can help to identify the fresh egg from spoiled egg.

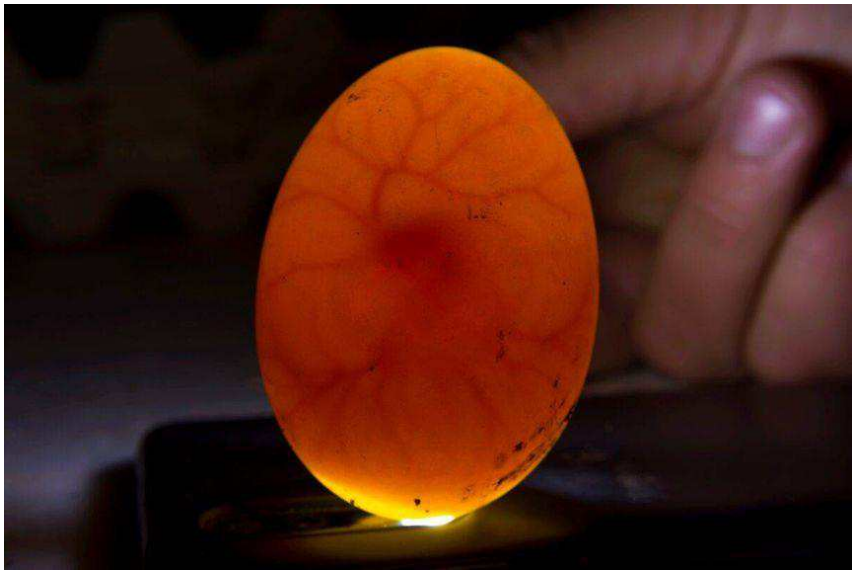
1. **Check the Expiration date:** If the eggs are store-bought, check the expiration or sell-by date. This date indicates the egg's freshness and viability. However, it's worth noting that eggs are often good for a few weeks beyond this date if stored properly.
2. **Float test:** Place the egg in a bowl or glass of water. A fresh egg will sink and lie horizontally on the bottom due to its higher density. A slightly older but still good egg will stand upright on the bottom. However, if the egg floats to the surface, it's likely spoiled and should be discarded. This floating occurs because as eggs age, they lose moisture and develop a larger air cell, causing them to float.

HOW TO TELL IF AN EGG IS FRESH

ONEHOWTO



3. **Odour test:** Crack the egg open onto a plate or into a bowl. A fresh egg will typically have little to no odour. If the egg emits a strong, unpleasant odour, it's likely spoiled. The smell of sulphur or a rotten odour is a clear indication of spoilage.
4. **Visual inspection:** Examine the egg's shell for any cracks or unusual discoloration. While cracks alone don't necessarily mean the egg is spoiled, they can allow bacteria to enter and spoil the egg more quickly. Additionally, if the shell is excessively dirty or stained, it may indicate poor handling or storage conditions, which could lead to spoilage.
5. **Yolk and white appearance:** A fresh egg will have a thick, firm white and a rounded, compact yolk. If the white is watery or spread out, or if the yolk appears flattened or broken, the egg may be old or spoiled.
6. **Candling:** egg-grading process in which the egg is inspected before a penetrating light in a darkened room for signs of fertility, defects, or freshness. This method also involves examination of internal contents of eggs. Fresh eggs will have a clear, well-defined yolk and white. Any discoloration or cloudy spots may indicate spoilage. Because the air cell at the wide end of the egg shrinks with age, its size is a good indicator of freshness. The shadow cast on the shell by the yolk also shows the age; since an older egg has thinner albumin, its yolk rests closer to the shell, casting a sharper shadow.



INCUBATION AND HATCHERY MANAGEMENT OF CHICKEN

Collection of hatching eggs from hen house

- Collect eggs at least 3-4 times daily, more often if extremely hot or cold weather.
- Use clean baskets, plastic or paper flats, cartons.
- Discard dirty, cracked or mis-shapen eggs.
- Immediate transfer to egg cool room
- The cracking of eggs between the time they are laid and set in the incubator should be less than 1%. If the cracks appear in more than 2% of the eggs collected, the collection method is faulty

Choosing Fertile Eggs

- Selecting fertile eggs is vital for successful incubation. Ensure you have a reliable source, such as a trusted breeder or healthy backyard flock. Choose eggs that are clean, uncracked, and of the appropriate size for the breed.

Sanitation of Hatching eggs

- Litter floored contain about 20 to 30 times the microbial load than the egg in a wire floor house.
- To avoid adverse effects on hatchability do sanitization with fumigation or spraying QAC (200 ppm in luke warm water)

Egg Quality

A. The egg size:
   - Extremely large and very small eggs
   - Large eggs require more time and less humidity than normal egg to hatch well.
   - Eggs weighing 50 to 55 gm hatch better

B. Shape of egg :
   - Don't select abnormal, wrinkled, slightly off shape eggs use Oval/ normal shape.

C. Shell quality
   - Cracked, rough, thin shell not preferable for hatching
   - It should be sound with smooth texture and free from body checks, hair cracks, Strong and normal.

D. Clean eggs :
   - Soiling substance seal the pores of the shell interfering in air movement through the shell to the embryo.
   - Dirt also arbor microorganisms rendering eggs more prone to spoilage

E. Shell color

F. Interior quality

Storage of hatching eggs

A. Temperature
   - The optimum temperature of 10-12°C (or) 50-55°F

B. Humidity
   - Optimum humidity range from 75 to 80%

C. Length of storage / Age of egg

- After 5 days – Each additional day of storage decreased hatchability by about 4% and the hatching time increased by 20 minutes .

D. Handling of egg / position

- Hatching eggs should be held small end down
- Large end down develop tremulous air cells and such eggs with loose air cells do not hatch well.
- Rough handling may result in cracked eggs which is decrease hatching.

E. Turning

- During the long period storage-Prevent the blastoderm from sticking to the shell.
- If the eggs are stored in the same position for a long period albumen may part resulting in the developing embryo to come in contact with the shell membranes.





Fumigation of hatching eggs

After traying, eggs are to be kept in the fumigation chamber for fumigation. Fumigating with 3x concentration of formaldehyde for 20 minutes will kill about 97.5 to 99.5% of the organisms on the shells. One 'x' concentration means 20 g of $KMnO_4$ with 40 ml of formalin for 100 cubic feet (3x means 60 g of KmnO4 + 120 ml of formalin for 100 cubic feet).

Fumigation	Concentration	Time (Minutes)
Hatching eggs after laying	3x	20
Eggs in incubator (first day)	2x	20

INCUBATION

Prewarming of hatching eggs

Approximately 6 hours prior to placing eggs in the setter they should be moved from the egg-cooler room to normal room temperature. Here, atmospheric air condenses over eggshell and form water droplets over eggshell, which is called as '*Sweating*'. It is advantageous to warm eggs before placing them in the incubator by avoiding creation of low temperature in the machine by placing cool eggs directly.

Types of incubation

1. Natural incubation
2. Artificial incubation

Natural incubation

- Brooding hen sit on hatching eggs on about 10-15 eggs in a nest and incubate the eggs.
- Commercially not suitable but well suited for rural (or) backyard poultry as eggs of others species (Ducks) is can be hatched with brooding hen.



Artificial incubation

- More no.of chicks can be produced with good hatchability
- Multi layered trays are kept
- Commercially popular
- Minimum egg capacity is 10,000-20000
- There are 2 types of machine

  (a) Setter - 1st 18 days

  (b) Hatcher - Last 2 days

Setting up the Incubator

- Prepare the incubator according to the manufacturer's instructions. Clean and disinfect the incubator, ensuring it is free from any debris or contaminants. Set the temperature and humidity levels as recommended for chicken eggs.

Loading of eggs

- Placing of eggs in the setter is called '*Loading of eggs*'. Eggs can be set in the setter either all-in all-out basis or batch basis. Most of the commercial hatcheries are practicing batch system of loading eggs in the setter that will minimize the initial time taken to reach normal incubation temperature in the setter. In this case, each setter is having hatching eggs with different stages of embryonic developments.

Requirements for incubation

Requirements for eggs	Setter (1-18 days)	Hatchery (19-21 days)
Temperature	99.5^0 F to 99.75^0 F (37.5^0 C)	97.0^0 F to 99.0^0 F (37.2^0C)
Relative Humidity	55-60%	70-75%
Air supply	Provision in the incubator adequate	Provision in the incubator adequate
Position of egg	Broad end up	Any position
Turning	6-8 turns in any given 24 hrs period	Should not be turned



Candler

It is the source of light illuminating powerful rays which can pass through egg contents to make them transparent for vision.

Candling

It is the visual examination of eggs by holding it in between eye and source of light to evaluate internal egg quality and also to see the progress of embryonic stage.

Candling is done in dark room to get clear visibility of development of embryo inside the egg

How to differentiate fertile and infertile eggs

Fertile egg : (In blastoderm) Central white clear with outer clear ring

In fertile egg : (In blasto disc) Asymmetrical Central outer clear ring is not clear.

Observations during candling

First candling done on 7th day

Examine and determine normal embryo development at 6th or 7th day (preferable 7th day).

- **Fertile egg:** Red spider like radiating movement giving darker shadow.(mass inside & movement of embryos).
- **Infertile egg:** The eggs are clear in appearance
- **Dead embryos:** Mass inside but no embryo movement. (A small spot fixed in position)

Second candling is done on 16th or 18th day of incubation. (Preferable 18th day).

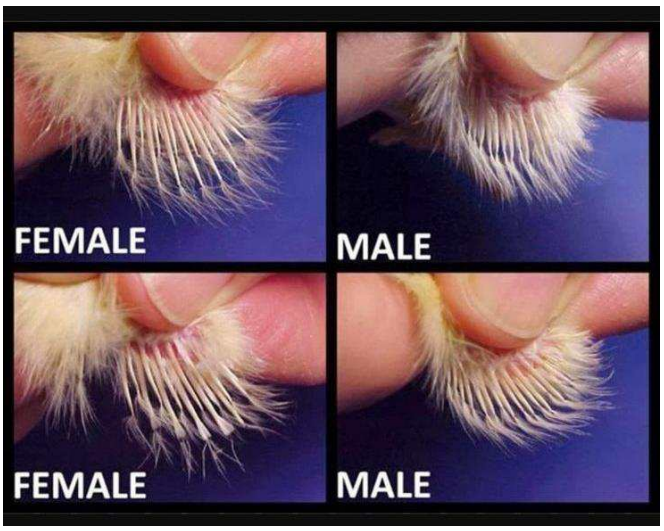
- **Dead embryo:** No blood vessels and no movement of embryo.
- **Live embryo:** Blood vessels and movement of embryo clear under candling.

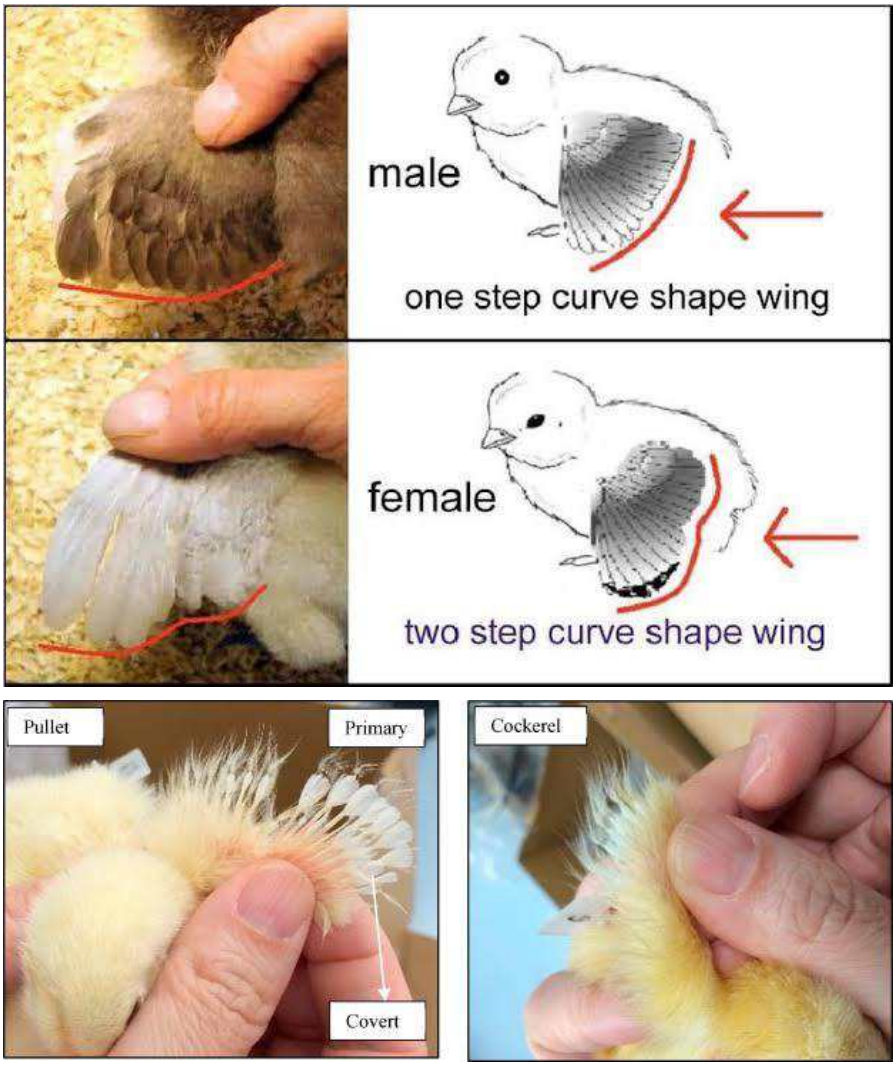
Grading the chicks:

No chick below the minimum standard must be allowed to go to a customer. Some standards for quality are, 1) No chick deformities 2) No unhealed navels 3) Above a minimum weight 4) Not dehydrated and 5) Stand up well.

Sexing the chicks

Layer type day-old chicks are needed to be sex separated either by vent sexing or auto-sexing (feather sexing). In case of meat-type day-old chicks sexing is not practiced.





Vaccination:

Most chicks are vaccinated against Marek's disease in hatchery before delivery. Most common method of vaccination of day-old chicks is by subcutaneous method in the nape of the neck.

Chick delivery

Baby chicks should reach the customer's farm early in the morning. Not only the weather is cooler during this part of the day but the early arrival allows a full day for close observation of the chicks by the caretaker.

Washing and cleaning

Cleaning the hatchery between hatches is of primary importance. The process must be complete. Except for the setters and setter room, every piece of equipment must be thoroughly vacuumed, scrubbed, disinfected and fumigated.

Disposal of waste

Hatchery wastes include infertile and non-hatched eggs and dead and cull chicks that should be disposed in such a manner not to create problem to the neighbors and also not to contaminate the hatchery premises.

MARKETING OF MEAT AND EGGS

Marketing of Meat

- Before 5 days of marketing - avoid medicament
- Before 2hr – allow water and avoid feed
- Transport shrinkage – 4-5%
- Marketing –early morning or evening

Consumer preference in India

- **Branded Chicken & Chicken products** : Less than 1%
- **Chilled or Frozen chicken** : 4% to 5%
- **Live bird sales in wet market** : 95%
- **In 2 quarters (summer i.e., Jan to June)** supply is less than 80% of the demand (due to low growth).
- **Another 2 quarters (winter i.e., Jul to Dec)** supply will be 120% to 150% (due to high body weight) than demand due to better climate advantage and high mean age.
- During winter, less consumption of non-veg due to festival months like Shravan and festival days like Ganesh Chaturthi, Navaratri etc.
- Marketing of live or dressed chickens is the major problem faced by most of the small and medium farmers. They are dependent on traditional traders.
- However, major portion of meat is being marketed through

  Producer Wholesaler Retailer Consumer

Marketing of Eggs

- Marketing of eggs from producer to the consumer.
- Egg prices vary from one market to another and from one season to another.
- In summer, this is sometimes lesser than the cost of production.
- Therefore proper attention has to be given to efficient disposal of market eggs.

Marketing Channels for Eggs

- **Direct marketing:** Producer to Consumer**.** There is benefit to both producer and consumer.
- **Indirect marketing:** Producer to Consumer via -Retailer
- **Integrated marketing:** Producer to consumers via some Collectors (or) Commission agents.
- **Co-operative marketing:** Producer to consumer via cooperative agency.

  Poultry farmers receive some other benefits also from cooperative societies such as :

  1. Cheap and good quality feed
  2. Medicines
  3. Technical advices
  4. Some time's day-old chicks are sold at relatively cheaper price.



DEPARTMENT OF ANIMAL NUTRITION

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CLASSIFICATION OF FEED STUFFS

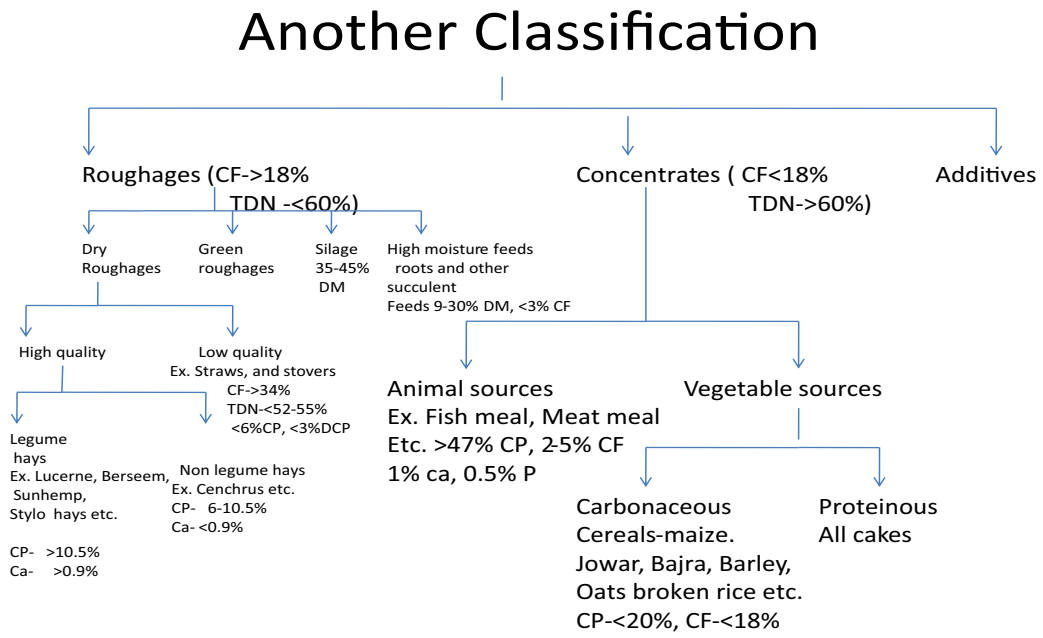
Indian dairy sector is the largest livestock enterprise globally and is unique as it provides livelihood and nutritional security to millions of small and marginal farmers. The diversity in terms of the dairy animals, management, feed resources available and feeding are quite varied and pose a challenge for service providers, the scientists and farmers to cater to the growing demands and provide solutions for ensuring the growth and sustainability of the dairy sector. To get maximum milk yield from the dairy animals, the farmer has to feed lactating animals to their genetic potential to meet all the nutrient requirements like energy, protein, minerals and vitamins. Farmers incur 70-75% of their total farming expenditure on the feeding. Hence, this chapter deals with the scientific feeding of dairy animals with different class of feeds available, nutrient requirements of dairy animals and ration balancing to improve the productive and reproductive performance.

CLASSIFICATION OF FEEDS AND FODDERS

Objective: To know about the various feeds and fodders suitable to prepare the low cost rations to maximize the productive performance

Cattle and buffaloes require five basic nutrients like carbohydrates, lipids, proteins, minerals and vitamins. Each nutrient has its own role in the body. Based on the nutrients' availability in the various feed stuffs, they are classified into different categories.

- Most feeds fall into these categories: (NRC classification)
  - Dry forages and roughages;
  - Pasture, range plants, and green forages;
  - Silages;
  - Energy feeds;
  - Protein supplements;
  - Mineral supplements;
  - Vitamin supplements;
  - Non-nutritive additives.



- **Roughages:**
- They contain >18% CF
- > 35% NDF or cell wall contents
- **Three types of roughages:**

1. Maintenance type: DCP - 3-5%
   eg: Green fodders like Maize, Jowar etc.
2. Non- Maintenance type: DCP- <3%
   eg: straws, stovers & other crop residues
3. Productive type: DCP- >5%
   eg: Legume fodder, legume hays

- **Green Fodder Crops:**

1. Kharif
   Eg: Maize, Jowar, Bajra
   Cowpea, sunhemp, stylo

   Rabi
   Oats, Maize,
   Lucerne, Berseem etc.
2. Annual
   Eg. Maize, Jowar,
   Bajra, Stylo
   Sunhemp etc.

   Perennial
   Hybrid Napier, Para, Guinea
   Cenchrus etc.
3. Legumes

   Stylo, lucerne , Berseem

   Non legumes

   Cereal
   M,J,B.O etc

   Non cereal
   Hybrid Napier,
   Guinea, Cenchrus,
   Para etc.
4. Rain fed

   Maize, Jower, Bazra, Stylo,
   Cenchrus, Guinea, Sunhemp etc.

   Irrigated

   Hybrid Napier, Para,
   Lucerne, Berseem etc.

Dry Forages and Roughages

Examples of feeds in this category are:

Legume hays, Grass hays, Wheat straw, Paddy straw, Jowar stover, Maize stalks, Bajra stover, ragi straw, korra straw, red gram straw, chick pea straw, black gram straw, green gram straw, cotton stalks, castor stalks, sunflower straw, sunflower heads, Maize cobs, cotton seed hulls, peanut hulls, and rice hulls etc.

Concentrates

- **Energy Feeds**
  - Energy feeds primarily include the cereal grains, fruits and nuts.
  - Feeds in this category contain:
    - less than 18% crude fiber
    - and have a protein content of less than 20%.
  - These are fed to to increase the energy density of their diets
- **Medium Energy sources:**
  - Protein and energy are in medium
  - Ex: Brans and chunnies Some times chunnies contain >18% CF and >20% CP
- **Protein Supplements: They have more than 20% CP**
  - Protein supplements include feed from three major sources. They are either of:
    - Plant origin (e.g., soybean meal, cottonseed meal, and corn gluten meal),

- Animal origin (e.g., fish meal, dried skim milk, and tankage) or
- Non protein nitrogen (NPN) sources (e.g., urea, purified amino acids, and ammonium salts).

– Protein supplements are generally expensive feeds.

NUTRIENT VALUE AND LEVEL OF INCLUSION

- The **nutrient composition** of a feed is the amount of specific nutrients contained in the feed. They are expressed as a percentage of the dry matter. The nutrient composition of a feed can be provided from laboratory analysis or a composition table, which will include **dry matter, crude protein, energy** and **minerals.**
- **Dry matter (DM)** is the portion of the feed left after all moisture is removed which contains all the nutrients. The dry matter intake shown in feeding standards or nutrient requirement tables are represent of an amount that can be consumed under normal circumstances. Different feeds contain different levels of dry matter; therefore, it is desirable to balance the ration on a dry matter basis and then convert the various feeds back to an as-fed basis.
- **Crude protein (CP)** may also be called total protein. It is determined by measuring the nitrogen content of feed and multiplying by the factor 6.25 since on average proteins typically contain 16% nitrogen. All the nitrogen-containing compounds are not true proteins. These are called non protein nitrogen (NPN) sources. Many of these NPN compounds are utilized by the rumen microbes in the rumen and can synthesis into microbial protein under optimum conditions. Generally, NPN sources are not used well as protein animals have high protein requirements, such as young cattle with high rates of growth and dairy cattle with high milk yield. True protein sources should be included in the rations.
- **Energy** is not actually a nutrient. It is contained in nutrients such as carbohydrates, fats, etc. There are several methods of measuring the energy values of feedstuffs. Some of these are total digestible nutrients, starch equivalent, digestible energy, metabolizable energy, net energy for maintenance and production. Total digestible nutrients (TDN) are the values most commonly used in simple ration balancing.
- **Minerals** are compounds needed to regulate many metabolic functions in the body. They may be classed as macro or trace minerals depending on the amounts needed. Examples of macro minerals are calcium and phosphorus. Iron, zinc and copper are examples of trace minerals.
- Other important nutrients are vitamins and water.

- **Nutritive value of common roughages (on DM basis)**

Feedstuff	DM	CP	TDN
Dry roughages			
Paddy straw	90	5.13	40
Wheat straw	90	3.3	40
Maize stover	93	2.9	-
Sorghum stover	90	3.1	-
Legume straws	90	10	53

Feedstuff	DM	CP	TDN
Cereal hays	88	3.5	51
Legume hays	88	12	60
Green roughages			
Cereal fodders *(Maize, Jowar etc.)*	25	8-9	55
Green grasses *(Hybrid Napier, Para etc.)*	15-20	8-10	55
Legume fodders	20	18-20	65

Nutritive value of common concentrate feedstuffs (on DM basis)

Feedstuff	% DM	CP	TDN
Maize	90	9.0	80
Jowar	90	11.36	75
Wheat	90	10.4	80
De-oiled Rice Bran	86	14.9	58.0
Wheat bran	90	13.3	65.0
Gram husk	90	6.3	55.0
Gram chuni	90	16	60.0
Tapioca waste	90	2.0	64.0
Molasses	65	3.5	58.0
Ground Nut Cake (exp)	90	45.0	71.0
Ground Nut Cake (ext)	90	52.0	70.0
Til cake (ext)	98	40.0	73.0
Sunflower cake (de oiled)	87	33.0	65.0
Cottonseed cake (decort)	90	41.0	78.0
Cottonseed cake (undecort)	90	39.0	70.0
Coconut cake (ext)	90	21.5	70.0
Mustard cake (ext)	91	35.0	74.0
Soybean meal (ext)	90	46	75.0
Fish meal	90	50.0	65.0
Meat meal	90	50.0	70.0

Mineral supplements

Source	Ca(%)	P(%)
Limestone $CaCO_3$& Oyster shell	34-38	-
Bone meal	29	14
DCP	26	21
Deflourinated rock PO_4	29-36	12-18
$CaPO_4$	17	21
Na_2PO_4	-	22

FEEDING OF HIGH YIELDERS

Objective: To feed the high yielders to meet their genetic potential and to avoid the metabolic disorders

FEEDING ACCORDING TO STAGE OF LACTATION

Nutrient requirements vary with the stage of lactation and gestation.

Five distinct feeding phases can be defined to attain optimum production, reproduction and health of dairy cows:

* **Early lactation** - 0 to 70 days after calving (postpartum), characterised by peak milk production and negative energy balance

* **Peak DM intake** - 70 to 140 days postpartum, milk production starts to decline, DMI continues to increase and cows are in energy balance

* **Mid- and late lactation** - 140 to 300 days postpartum, milk production and DMI decline and cows are in positive energy balance (replenish body reserves)

* **Dry period** - 60 to 14 days before the next lactation, cows non-lactating and 7 months pregnant

* **Transition or close-up period** - 14 days before parturition. Some define this period as 3 weeks prepartum to 3 weeks postpartum

Nutrient requirements of high yielding Dairy Cattle during different phases of lactation

a) Water requirements

- Lactating dairy cows need 60–70 litres of water each day for maintenance, plus an extra 4–5 litre for each litre of milk produced.
- Water requirements increase by 6 lts/day for every 4 ^{0} C raise in air temperatures.
- Lactating cows will drink 150 to 200 litres of water per day in the summer months

b) Crude protein requirements

Stage of lactation	% CP in the ration
Early lactation	16 – 18 %
Mid lactation	14 – 16 %
Late lactation	12 – 14 %
Dry period	10 – 12 %

Undegradable or bypass protein (UIP) should be 35 to 40 per cent of the CP in early lactation and 30 to 35 per cent of CP in late lactation.

Requirements for metabolizable methionine and lysine should also be considered as these are the limiting amino acids for milk production

(c) Roughages: Roughage quality is partly determined by fibre levels. Complete feed of high yielding cow should not contain less than 21% ADF or 28% NDF. More than 80% fibre should come from lush green forage or good quality silage and remaining from quality hay or naturally fermented straw. The recommended roughage to concentrate ratio for high producing cows should be 50: 50, 60:40 and 75:25 in early, mid and late lactation

(d) Fat: Fat plays important role in performance of lactating animals. The BIS specifications have recommended only 3.0 % and 2.5% fat, in type I and type II concentrate mixture, respectively. Whereas NRC feeding standard have recommended 3.0 % fat, in the complete feed for dairy cattle. However, recent reports indicate that, dietary fat upto 5% (complete feed) has direct positive impact on the quantity as well quality of milk.

(e) Salt: 0.5 per cent of the ration DM or 1 per cent of the concentrate mixture.

(f) Urea 3 % of concentrate mixture or 1 per cent of the total dry matter intake.

Ration form: Avoid too fine chopping of forages and concentrates

Minerals and vitamins:

Calcium is one of the most crucial elements in the ration to be considered more carefully. At the beginning of the lactation, the demand of calcium for milk production increases dramatically, leading to the fall in blood calcium levels. This stimulates the secretion of parathyroid hormone (PTH) from parathyroid glands, resulting in activation of Vitamin D_3, which increases the absorption of Ca from intestine and mobilization of bone calcium. But this whole process requires 24- 48 hours, and can't prevent animals from milk fever as more than 60% cases of milk fever occur within 24 hr of parturition. To avoid incidences of milk fever, the best feeding management practice is to provide low Ca (<50g/d) diet during the dry period (last 2-3 weeks of gestation) which should be increased to 100g/d, at least 2 days before parturition. The diet after parturition should have sufficient Mg, essential for conversion of Vit D_3 to 25 H D_3 in liver.

Selenium and Vit E play an important role in lactating cows. Both help to maintain the immune system and reproductive efficiency of the animal. The recommended dose is 0.4- 06 g/ day Vit E and 0.3 ppm selenium/ day. Niacin (Vit B complex) being synthesized in the rumen is inadequate for high yielder. It stimulate feed intake, prevent ketosis and improves milk production and increased milk fat content. The recommended dose is 6g/cow/ day.

Dietary Buffers:

The diet of high yielding cow contains more than 50% concentrate mixture, which results in less salivation and rumen buffering. The easily fermentable grain based concentrate, lead to increased acid production resulting in decreased rumen pH, reduced fibre digestion, depressed feed efficiency and low milk fat percentage. Addition of dietary buffers @1.5% in high concentrate ration can neutralize the acidity in rumen.

Dietary cation anion balance:

Dietary cation anion difference (DCAD) or balance can be used to alter the metabolic status of both dry and lactating cows. DCAD is calculated by subtracting the milliequivalents of positively charged cations, sodium and potassium, from the negatively charged anions, sulfur and chlorine. If more milliequivalents of cations are available, then the charge is positive and if more anions are

present then the charge is negative. Dry cows can benefit from low DCAD resulting in improved bone calcium mobilization and lactating cows benefit from positive DCAD that buffers the acids produced during ruminal digestion.

Bypass nutrients:

The term "Bypass Nutrient" refers to that fraction of the nutrients which gets fermented in the rumen to a comparatively low degree. It then becomes available at the lower part of the gastro-intestinal tract in the intact form for subsequent digestion and absorption. Examples of bypass nutrients include; protected proteins/amino acids, protected fat, protected starch and chelated minerals and vitamins. Protein that is not degraded in the rumen and reaches the small intestine unmodified is called rumen bypass protein. Supplementation of this type of protein can improve productivity in terms of improved efficiency of meat, milk and wool production. Various methods have been used for protecting proteins from rumen degradation, such as heat treatment and formaldehyde treatment. Supplementation of bypass fat in the diet of animals has proven very useful to increase milk yield, FCM yield, efficiency of nutrient utilization, postpartum recovery of the body weight, body condition score, reproductive performance and alleviate problems of negative energy balance without adversely affecting the dry matter intake and rumen fermentation.

CHALLENGE FEEDING

Challenge feeding means the cow with potential of high milk production are to be fed with increased amount of concentrate to challenge them to produce to the maximum. Challenge feeding starts two weeks before the expected date of calving. This challenge feeding will condition her digestive system for the increased quantity of feed to provide sufficient nutrient to initiate lactation on the higher plane. Generally, the animals are started with 1.5 to 2.0 kg concentrate mixture (@0.3 to 0.5% of body weight) on the date 2 weeks before calving followed by an increment of 0.3 to 0.5 kg daily, so that they will be receiving about 1 kg concentrate mixture per 100 kg body weight at calving. This practice is to challenge the cow to reach her maximum milk production potential.

Feeding management tips:

- Feed the cow in several small meals rather than two large ones especially in hot weather.
- Have fresh feeds available in mangers after milking.
- Allow cow access to feed for at least 22 hours of the day.
- Purchase high quality feed ingredients, must get them analysed periodically.
- Minimize drastic changes in the ration.
- Offer minimum mineral mixture before parturition but increase it significantly immediately after parturition.
- Stop milking at least 60 days prior to parturition.

Feeding strategies to be followed during all the phases

1. Protein: 18 to 19% CP (DM basis) in early lactation decreasing to 13% in late lactation. Non-degradable or bypass protein (UDP) should be 35 to 40% of CP in early lactation and 30 to 35% of CP in late lactation. About 30% of CP should be soluble protein (SIP).

2. Metabolizable energy: 11.3 MJ ME per kg of DM or greater in early lactation decreasing to 10.7 MJ ME/kg in late lactation, and 8.5 MJ ME/kg during the dry period.

3. Roughage: Minimum of 1.5 kg of roughage DM per 100 kg of body weight. High quality legume roughage should be the major source of roughage fed during early lactation.

4. Fibre: A minimum of 18% ADF in the dietary DM during early lactation increasing to 21% or more in late lactation. Roughage should provide a minimum of 21% NDF in the dietary DM.

5. Non-structural carbohydrates (NSC): 35 to 40% of the dietary DM.

6. Fat: Maximum of 7% of the total diet DM with no more than 4% from supplemental fat. Limit fat from oilseeds to 2% of the diet DM.

7. Salt: 0.5% of the diet DM or 1% of the grain mix.

8. To reduce the acidosis or stabilise, add sodium bicarbonate as buffer @125 to 250g per animal per day

9. Mineral: Approximately 1% of the concentrate mix should be a calcium- phosphorus mineral mixture.

* Allow constant access to feed
* Minimize stress conditions
* Add water to the TMR, not exceeding 45% moisture in the total diet

FEEDING SCHEDULE: THUMB RULE

Maintenance+ Milk yield

Milk Yield (Lit / day)	Dry matter intake (kg / day)	Concentrate feed (%)	Fodder (%)	Green (%)	Dry (%)
< 5 (low)	7-8	-	100	60-70	30-40
7-10 (Med)	8-9	40	60	60	40
11-15 (Mode)	10-12	50	50	70	30
15-20 (High)	12-14	65	35	70	30
>25 (V High)	14-15	75	25	85	15
>30 (Elite)	16-18	80	20	100	-

Up to 10 lit milk – RDP : UDP = 60 : 40 : Normal ration

> 10 lit milk - RDP : UDP = 55 : 45 (diet manipulation)

> 15 lit milk - RDP : UDP = 50 : 50 (treated cakes, heat, formaldehyde)

> 20 lit milk – RDP : UDP = 45 : 55 (treated cakes, heat, formaldehyde), High quality fodder and legume fodder is must

FEEDING OF CALVES

Objective: To raise the calves scientifically in order to reduce the mortality

As the future productive units of a dairy herd, heifers represent a substantial financial investment in feed and labor. This investment needs to be protected by managing and feeding these heifers so that they grow economically and at an optimal rate in order to calve at 24 and 36 months of age in cows and buffaloes respectively. The first two to three months of life is a critical period to achieving these objectives.

Feeding schedule of Calves up to 3 months of age*:

Age of Calf	Whole Milk	Calf Starter	Good Quality Hay
1-3 days	Colostrum @ 1/10th BW in 3 feeds	-	-
4-7 days**	Whole milk @ 1/10th BW in 3 feeds	-	-
8-14 days	Whole milk @ 1/10th BW	-	-
15-21 days	Whole milk @ 1/10th BW	A little	A little
22-35 days	Whole milk @ 1/15th BW	100 g	Ad lib
Up to 2 months	Whole milk @ 1/20th BW	250 g	Ad lib
2-3 months	Milk is gradually reduced and tapered	500 g	Ad lib

*This schedule is satisfactory to produce a daily growth rate of 0.5kg in crossbred calves

**Milk replacer can be given directly after colostrum feeding or after one week of age

Milk Replacers

Milk replacer powders are reconstituted with warm water and make an excellent and oftentimes economical liquid feed for baby calves. Especially during the first three weeks of life, calves should be fed a milk replacer that contains all milk proteins made from dried skim milk or whey products. Whey products can include whey protein concentrates, dried whey, and delactosed whey. Milk replacers should contain a minimum of 18 to 22% crude protein, 10 to 22% crude fat, and less than 0.5% crude fiber. They should be mixed and fed according to the manufacturer's directions. During cold weather, calves should be fed a milk replacer containing 20% fat, and more milk replacer powder should be fed.

Composition of milk replacer I

Name of the Ingredient	Parts
Dried skim milk	50
Dried whey	30
Dextrose	08
Oat flour	05
Brewers yeast	05
Irradiated yeast	0.26
Trace minerals	0.04
Stabilized Vit. A supplement	1.7
TOTAL	100

Composition of milk replacer II

Name of the Ingredient	Parts
Wheat flour	10
Fish meal	12
Linseed meal	40
Coconut oil	07
Linseed oil	03
Butyric acid	0.3
Citri acid	1.4
Molasses	10
Mineral Mixture	03
Aurofac	0.3
Milk	13
Rovimix	13(g)
TOTAL	100

Composition of Calf starter

Name of the Ingredient	Parts
Maize	31
Rice bran	30
Ground nut cake	18
Soy bean meal	18
Mineral mixture	2
Salt	1
TOTAL	100

Composition of concentrate mixture

Name of the Ingredient	Parts
Maize	20
Jowar	20
Wheat bran	25
Cottonseed cake	16
Groundnut cake	16
Mineral mixture	2
Salt	1
TOTAL	100

The following feeding schedule should be followed for raising calves from 3 months to maturity.

Category	Concentrate(kg)	Roughage (kg)
Indigenous Cattle/buffaloes	1 - 2	Green grass/maize fodder-10 kg or Legumes 1-2.5 kg + Dry fodder -2 kg or Green fodder – 3 kg + Straw – 2 kg
Crossbred	1.6 – 2.0	Green grass/maize fodder or alike fodders 5 -10 kg up to 4 months and 10- 15 kg from 4-6 months.

From 6 - 12 months of age		
Category	**Concentrate (kg)**	**Roughage (kg)**
Indigenous cattle/buffaloes	1-2	Green grass/maize fodder-15 to 20 kg or 15 to 20 kg of Legumes+ 5 kg dry fodder or Green fodder 5 kg + Straw 2 to 3 kg
Crossbred	2.0 – 2.5	Green grass/maize fodder or alike fodders -15 to20 kg

From 1 year to age at conception

Category	**Concentrate (kg)**	**Roughage (kg)**
Indigenous cattle/buffaloes	1 to 2	25 to 30 kg of green maize fodder / or other grasses
Crossbred	1.5 to 2	30 to 35 kg of green maize fodder / or other grasses

BALANCED RATION PREPARATION

Objective: To prepare a balanced ration for dairy cattle as per physiological stage.

A **ration** is the amount of feed an animal receives in a 24-hour period.

A **balanced ration** is the amount of feed that will supply the appropriate amount and optimum proportions of nutrients needed for an animal to perform a specific purpose such as growth, maintenance, lactation or gestation.

Nutrient requirements are the amount of nutrients the animal needs for a specific purpose. They are influenced by many factors, like body weight of animal, sex, growth rate, milk yield, lactation stage, environment and others.

Mechanics of feed formulation:

Ration formulation is matching of the nutrient requirements of the animal with the nutrients present in the feedstuffs of the ration. When rations are formulated by hand, generally they are first formulated for one nutrient.

Then the other nutrients are checked to determine whether the feedstuffs used will meet the requirements or whether alternative feed resources need to be included in the diet. One method is to balance for protein first and then to check energy levels to see if they are met. Next, the ration can be checked for the other nutrients such as calcium and phosphorus.

Characteristics of a balanced ration:

- The ration should be properly balanced and more purposeful and beneficial
- The ration must be palatable
- The ration should have variety of feeds which make it more palatable
- The ration should contain enough of mineral matter
- The ration should be fairly laxative
- The ration should be fairly bulky
- The ration should contain sufficient green fodder

- Avoid sudden changes in the ration
- Maintain regularity in feeding
- The ration should be economical

Impact of feeding balanced ration:

- Increases the milk production and net daily income
- Increases the milk production efficiency
- Increases the rumen microbial protein synthesis
- Increases the immune status of animals
- Decreases the parasitic infestations in animals
- Decreases the enteric methane emission
- Increases the efficiency of feed nitrogen use in milk

Prerequisites of formulating a ration:

- Determine the nutrient requirements of the animals
- List the locally available feed resources
- Mention the nutrient composition of the feed resources
- List the inclusion levels of the feedstuffs
- List the cost of the feed resources

Methods of formulation especially for concentrate mixture or grain mixture:

Concentrate mixtures are feeds or mixtures of feeds that are relatively low in crude fiber and provide energy/protein as the primary nutrient. Usually concentrate mixture contains

Ingredient	**Range (%)**
Cereal grains (Maize/jowar/bajra/wheat/broken rice)	20-30
Oil cakes (Groundnut cake / soybean / cottonseed meal)	15-35
Grain by-products (Rice bran, wheat bran/rice polish)	0-35
Molasses / jaggery	0-10
Common salt	0.5-1
Calcite powder	0.5-2
Mineral mixture and other supplements	1-2 .5

When the number of nutrients specified is small, diet formulation can be adequately carried out through simple calculations. The calculations involved in this type of formulation are simple and few. However, as the number of nutrient specifications and the number of feedstuffs available increases, the mathematics get quite involved and confusing. In such cases, it is appropriate to use computer spread sheets or specialized programs.

1. **Trial & Error method:**

   This is the most commonly used method of formulating ration. It is a type of feed formulation followed in many developing nations of the world. As the name implies, the formulation is manipulated until the nutrient requirements of the animal are matched. When using the trial and error method, one starts with a primary feed ingredient and modifies the fundamental ration formula step by step to compensate for any nutrient deficiencies found in the primary feed.

This method makes possible the formulation of a ration that meets all the nutrient requirements of the animal. Greater control can be had on implementing restrictions and judging inclusion levels. It is a time consuming method involving a lot of calculations and meeting out specifications may not be very precise.

Step 1: Make a list of the ingredients with their nutrient compositions

Available for possible inclusion in the ration to be formulated

Step 2: Fix the requirements of the ration to be composed

Step 3: Proceed to balance the ration as follows:

- Step 3.1: Reserve 2% for minerals / vitamins.
- Step 3.2: Include ingredients a certain minimum percentage of which needs to be incorporated for various reasons.
- Step 3.3: Include ingredients with an energy value higher than that required in the ration to constitute 30%. The priority should be given to those ingredients with the lowest price per unit of energy. It should be careful not to exceed the safe maximum levels for the ingredients.
- Step 3.4 : Include ingredients with protein contents higher than the required level in the ration you want to prepare. To start with, limit the level of inclusion of such ingredients to 18%. Again, priority should be given to those ingredients with the lowest price per unit of protein without exceeding the safe maximum levels.
- Step 3.5 : Now, add the percentage and quantities of the various nutrients and compare the nutrient quantities with requirements of the target class of animal.
- Step 3.6 : Select an ingredient that is a good source of the nutrient (energy, protein) missing the most. The selected ingredient is included to constitute 10% of the final ration. Continue to do the same until you reach 100% by repeating step 3.5 after every addition.
- Step 3.7 : It may be necessary to substitute some ingredients by others in order to obtain proper levels and ratios of the required nutrients. This is usually done when proceeding from 90 to 100%.

2. Pearson square method:

1. Draw a pearson's square for determining the proportions (or) ratio of feeds to be mixed.
2. Partition the feeds as high protein and low protein feeds.
3. Place the percentage of crude protein desired in the center of the pearson's square.
4. Place the average percentage of crude protein present in high protein feeds on the left side upper corner of this square.
5. Place the average percentage of the crude protein present in low protein feeds on the left side lower corner of this square.
6. Take about the diagonal lines in the square.
7. Draw the difference between the figures on the left hand sides and the center figure and place these on the right hand corners of the square, in the direction of diagonal lines.
8. The figures obtained on the right hand side corners are the parts or proportions in which ratio the given feeds should be mixed to obtain the mixture of desired CP percentage.
9. Pass the feeds to be mixed through grinder and then mix the ground feeds in horizontal / vertical mixer.

10. Fill the gunny bags using the shovel (or) directly fill it from the mixer.

11. Label the feed mixture along with the weight neatly, clearly and legibly.

Note: Minerals consisting of bone meal and common salt may also be added in required quantity before grinding and mixing.

Example:

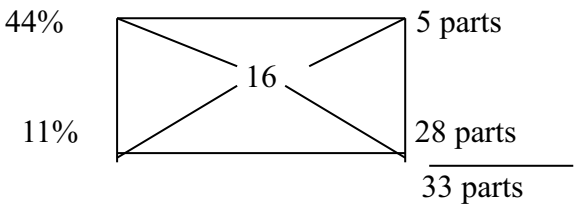
Prepare 100 kg concentrate mixture containing 16 % CP using maize grain, rice bran and ground nut cake consisting of 10, 12 and 44% CP, respectively.

Solution:

Average CP of low protein feeds = Maize + rice bran / 2

= 10 +12 / 2 = 11%.

CP content of high protein feed (ground nut cake) = 44%



ie. 33 kg of mixture will contain 5 parts of ground nut cake

100 kg should contain ? parts of ground nut cake

= 100 x 5 / 33 = 15.15 kg or 15 kg

Therefore,

Amount of low protein feeds = 100 – 15 = 85 kg.

maize= 85 x 10/22= 38.6 parts

rice bran= 85 x 12/22= 46.36 parts

Verification:

Feedstuff	Parts	% CP supplied
Groundnut cake	15.1	15.1 x 44 /100 = 6.6
Maize	38.6	38.6 x 10 /100 = 3.86
Rice bran	46.3	46.3 x 12 / 100 = 5.55
Total	100	16.031 %

3. Algebraic method:

1. Divide the ingredients into two groups i.e; Low protein group and high protein group depending on their protein content.
2. Calculate the average protein content of each group, if there is more than one feed ingredient.
3. Assume that 'X' represents the amount of low protein feeds and 'Y' represents the amount of high protein feeds present in 100 kg of concentrate mixture. That means,

X + Y = 100 ---------- (1)

Note: In case, the amount of mineral mixture and salt to be included in the ration are fixed say 2 and 1% respectively, then this fixed proportion of 3% should be subtracted from the total quantity of conc. Mixture. In such case

$$X + Y = 97 \text{ ----------(1)}$$

1. For example, assume that Average CP content of low protein group is 8 %

   This means, 100 kg of feed will contain 8 kg CP

   Therefore, the amount of CP supplied through 'X' kg will be

   $$= X * 8 / 100 = 0.08 X \text{ kg.}$$

   b. Average CP content of high protein group is 40 %

   This means, 100 kg of feed will contain 40 kg CP

   Therefore, the amount of CP supplied through 'Y' kg will be

   $$= Y * 40 / 100 = 0.40Y \text{ kg.}$$

   c. However, the amount of CP/DCP being supplied through low and high protein feeds should be equal to the desired protein level (say 18%). So,

   $$0.08 X + 0.40 Y = 18 \text{ ---------- (2)}$$

. Calculate the value of 'X' and 'Y' from the above two equations.

6. Now, 'X' and 'Y' representing the amount of low and high protein feeds should be divided equally, depending on the number of ingredients in each group.
7. Check whether the calculated proportion of each ingredient when mixed together is supplying the desired CP content or not.

Example:

Prepare 100 kg concentrate mixture containing 18 % CP using maize grain, wheat bran and linseed cake consisting of 10, 12 and 30 % CP, respectively.

Solution:

Let maize and wheat bran represent low protein group and linseed cake represent high protein group.

Average CP content of low protein group = 10 + 12 / 2 = 11 %

Average CP content of high protein group = 30 %

Assume that 'X' represents the amount of low protein feeds and 'Y' represents the amount of high protein feeds present in 100 kg of concentrate mixture. That means,

$$X + Y = 100 \text{ ---------- (1)}$$

Average CP content of low protein group is 11 %

This means, 100 kg of feed will contain 11 kg CP

Therefore, the amount of CP supplied through 'X' kg will be

$$= X * 11 / 100 = 0.11X.$$

Average CP content of high protein group is 30%

This means, 100 kg of feed will contain 30 kg CP

Therefore, the amount of CP supplied through 'Y' kg will be

$$= Y * 30 / 100 = 0.30Y.$$

c. However, the amount of CP being supplied through low and high protein feeds should be equal to the desired protein level (say 18 %).

So,

$$0.11X + 0.30Y = 18 \text{ ----------(2)}$$

Multiplying equation (1) by 0.3 we get

$$0.3X + 0.3Y = 30 \text{ ----------(3)}$$

Subtracting equation (3) from (2)

$$0.11X + 0.30Y = 18\text{----------(2)}$$
$$0.3X + 0.3Y = 30 \text{ ----------(3)}$$
$$0.19X = 12$$
$$\text{or } X = 12 / 0.19 = 63.16 \text{ or } 63 \text{ parts}$$
$$\text{and } Y = 100 - 63 = 37 \text{ parts.}$$

Therefore,

No. of parts of maize = 63 / 2 = 31.5

No. of parts of wheat bran = 63 – 31.5 = 31.5

No. of parts of linseed cake = 37

Verification:

Feedstuff	Parts	% CP supplied
Linseed cake	37.0	37 x 30 /100 = 11.10
Maize	31.5	31.5 x 10 /100 = 3.15
Wheat bran	31.5	31.5 x 12 / 100 = 3.78
Total	100	18.03 %

NUTRIENT REQUIREMENTS FOR VARIOUS CLASS OF ANIMALS

Formulation of Ration containing roughages and concentrates:

Nutrient Requirements:

The ICAR (2013) feeding standards are being followed at present in India for formulating rations for different categories of livestock.

Daily Maintenance requirements for DM, energy and protein for lactating cattle, buffalo (ICAR, 2013)

BW(kg)	DM(kg)	TDN(kg)	ME (Mcal)	MP(g)	RDP(g)	CP(g)
200	4.32	1.92	6.94	141	220	259
250	5.4	2.28	8.24	167	260	306
300	6.48	2.62	9.47	191	298	351
350	7.56	2.95	10.67	214	335	394
400	8.64	3.27	11.82	237	370	436
450	9.72	3.58	12.94	259	405	476
500	10.8	3.88	14.04	280	438	515
550	11.88	4.18	15.10	301	470	553
600	12.96	4.47	16.15	321	502	591

BW(kg)	DM(kg)	TDN(kg)	ME (Mcal)	MP(g)	RDP(g)	CP(g)
650	14.04	4.75	17.18	341	533	627
700	15.12	5.03	18.19	361	563	663
750	16.2	5.31	19.19	380	593	698
800	17.28	5.58	20.17	399	623	733

DM, energy and protein requirements per kg of milk production in cattle (ICAR, 2013)

Fat %	DM(Kg)	TDN(kg)	ME(Mcal)	MP(g)	RDP(g)	RUP(g)	CP(g)
3	0.450	0.290	1.05	51	44	44	96
4	0.510	0.330	1.20	51	50	37	96
5	0.570	0.370	1.34	51	56	30	96
6	0.640	0.410	1.50	51	62	23	96
7	0.700	0.460	1.64	51	69	15	96

DM, energy and protein requirements per kg of milk production in buffaloes (ICAR ,2013)

Fat %	DM(kg)	TDN(kg)	ME(MCal)	MP(g)	RDP(g)	RUP(g)	CP(g)
4	0.550	0.360	1.29	66	54	60	124
5	0.610	0.400	1.43	66	60	53	124
6	0.670	0.440	1.58	66	66	46	124
7	0.740	0.480	1.73	66	72	39	124
8	0.800	0.520	1.88	66	78	31	124
9	0.860	0.560	2.02	66	85	24	124
10	0.930	0.600	2.17	66	91	17	124

Pregnancy requirements of energy and protein for cattle (ICAR,2013)

Month of gestation	DM*(kg)	TDN(kg)	ME(Mcal)	MP(g)	RDP(g)	RUP(g)	CP(g)
6-7	0.85	0.64	2.30	109	96	56	169
7-8	0.99	0.74	2.67	143	112	85	216
8-9	1.13	0.84	3.05	178	128	113	263

*concentrate having 75% TDN or 2.71 Mcal/kg DM; **Average birth weight of 25kg

Pregnancy requirements of energy and protein for buffalo/day (ICAR,2013)

Month of gestation	DM* (kg)	TDN (kg)	ME (Mcal)	MP (g)	RDP (g)	RUP (g)	CP (g)
6-7	1.0	0.8	2.76	131	115.4	67	203
7-8	1.2	0.9	3.21	172	134.2	101	259
8-9	1.4	1.0	3.66	214	153.0	136	316
9-10	1.5	1.1	4.11	255	171.8	171	373

*concentrate having 75% TDN or 2.71 Mcal/kg DM; **Average birth weight of 30 kg

Nutrient requirements for pre ruminant calves

Age (day)	BW (kg)	ADG (g)	CP	DCP (g)	TDN (g)	ME (Mcal)	Ca (g)	P (g)	Vit A (g)	Vit D (g)
0-15	25	200	114	80	400	1.5	2.5	1.5	1.5	200
16-30	30	300	129	90	500	1.7	3.0	2.0	1.5	250
30-60	40	300	180	125	800	2.4	3.5	2.5	1.7	250
60-90	50	350	215	150	1000	3.6	4.0	3.8	2.0	300

DM, energy and protein requirements of female cattle and buffalo calves

BW(kg)	Weight gain(kg/d)	DM(kg)	TDN(kg)	ME (Mcal)	Total MP (g)	RDP(g)	RUP*(g)	CP(g)
70	0.2	1.6	1.04	3.76	122	191	71(37)	263
70	0.3	1.8	1.16	4.19	151	235	100(58)	335
70	0.4	1.8	1.28	4.63	178	278	127(78)	406
100	0.2	2.9	1.33	4.78	141	220	68(30)	288
100	0.3	2.9	1.46	5.28	168	262	94(48)	357
100	0.5	3.1	1.75	6.23	221	345	142(81)	487
100	0.6	3.1	1.90	6.84	246	385	164(96)	549
200	0.3	4.8	2.34	8.45	219	341	78(18)	419
200	0.4	5.2	2.54	9.17	243	380	93(26)	473
200	0.5	5.6	2.74	9.90	267	418	108(34)	525
200	0.6	5.6	2.95	10.64	291	454	121(41)	575
200	0.7	5.4	3.16	11.39	314	490	133(46)	623
200	0.8	5.4	3.37	12.16	336	525	144(51)	669
300	0.3	6.6	3.11	11.23	264	412	73	485
300	0.4	6.9	3.36	12.12	287	448	79	528
300	0.5	7.2	3.61	13.04	310	484	85	569
300	0.6	7.2	3.87	13.97	332	518	91	610
300	0.7	7.2	4.13	14.91	353	552	97	649
300	0.8	7.5	4.40	15.87	374	585	103	688
300	0.9	7.5	4.67	16.84	395	617	109	725
400	0.4	8.8	4.11	14.83	329	514	91	605
400	0.5	8.8	4.41	15.92	351	548	97	645
400	0.6	8.4	4.72	17.02	372	581	103	684
400	0.7	8.8	5.03	18.15	393	613	108	722
400	0.8	9.2	5.34	19.29	413	645	114	759
400	0.9	9.2	5.66	20.44	432	675	119	795
400	1.0	9.6	5.98	21.60	451	705	124	830
500	0.4	10.5	4.81	17.38	371	579	102	681
500	0.5	10.5	5.16	18.62	392	612	108	721
500	0.6	10.5	5.51	19.89	413	645	114	759
500	0.7	11.0	5.87	21.18	433	677	119	796
500	0.8	11.0	6.23	22.49	453	708	125	832
500	0.9	11.5	6.60	23.81	472	738	130	868
500	1.0	11.5	6.97	25.15	491	767	135	902

*Values in the parenthesis are indispensible requirements of RUP, otherwise growth rate will decrease.

Energy and protein requirements of male cattle and buffalo calves

BW(kg)	Weight gain(kg/d)	DM(kg)	TDN(kg)	ME (Mcal)	Total MP (g)	RDP(g)	RUP*(g)	CP(g)
70	0.2	1.6	1.14	4.13	134	210	78(41)	287
70	0.3	1.8	1.25	4.51	168	262	116(70)	378
70	0.4	1.8	1.36	4.91	201	314	513(97)	467
100	0.2	2.6	1.46	5.27	152	237	71(29)	309
100	0.3	2.7	1.58	5.70	185	289	107(56)	395
100	0.4	2.8	1.70	6.15	217	339	141(81)	480
100	0.5	3.0	1.83	6.60	248	388	174(105)	562
100	0.6	3.1	1.96	7.06	279	436	205(128)	641
100	0.7	3.2	2.08	7.52	309	483	235(150)	718
200	0.3	4.6	2.54	9.16	234	366	80(16)	446
200	0.4	5.0	2.70	9.76	264	412	106(33)	518
200	0.5	5.2	2.87	10.38	293	457	131(50)	588
200	0.6	5.2	3.05	11.00	321	501	154(66)	655
200	0.7	5.4	3.22	11.63	348	544	176(80)	721
200	0.8	5.6	3.40	12.26	375	586	197(94)	783
300	0.3	6.3	3.38	12.18	278	435	77	512
300	0.4	6.6	3.58	12.93	306	478	84	563
300	0.5	6.9	3.79	13.69	333	521	96(4)	617
300	0.6	6.9	4.00	14.46	360	562	113(13)	675
300	0.7	7.5	4.22	15.23	386	603	128(22)	731
300	0.8	7.5	4.44	16.02	411	642	142(29)	784
300	0.9	7.8	4.66	16.81	435	680	156(36)	836
400	0.4	8.8	4.39	15.84	347	543	96	639
400	0.5	8.8	4.63	16.73	373	584	103	687
400	0.6	9.2	4.88	17.63	399	623	110	733
400	0.7	9.2	5.14	18.54	424	662	117	779
400	0.8	9.2	5.39	19.47	448	700	123	823
400	0.9	9.2	5.65	20.40	471	736	130	866
400	1.0	9.6	5.91	21.34	494	772	136	908
500	0.4	10.5	5.14	18.57	389	607	107	715
500	0.5	10.5	5.42	19.58	414	647	114	762
500	0.6	11.0	5.71	20.61	439	686	121	808
500	0.7	11.0	6.0	21.65	464	24	128	852
500	0.8	11.0	6.29	22.70	487	762	134	896
500	0.9	11.0	6.58	23.76	510	798	141	938
500	1.0	11.0	6.88	24.84	533	833	14	980
600	0.6	13.2	6.49	23.44	482	753	133	886
600	0.7	13.2	6.81	24.60	506	791	140	931
600	0.8	13.2	7.14	25.78	530	829	146	975
600	0.9	13.2	7.47	26.97	554	865	153	1018
600	1.0	13.2	7.80	28.16	576	900	159	1059
600	1.1	13.2	8.14	29.37	598	935	165	1100

*Values in the parenthesis are indispensible requirements of RUP, otherwise growth rate will decrease.

Daily energy and protein requirements of cattle/buffalo breeding bull (ICAR,2013)

BW(kg)	DM(kg)	TDN(kg)	ME(Mcal)	MP(g)	RDP(g)	RUP(g)	CP(g)
350	6.5	3.46	12.5	214	335	59	394
400	7.6	3.82	13.8	237	370	65	436
450	8.6	4.18	15.1	259	405	71	476
500	9.7	4.52	16.3	280	438	77	515
550	10.8	4.86	17.5	301	470	83	553
600	11.9	5.18	18.7	321	502	89	591
650	13.0	5.50	19.9	341	533	94	627
700	14.0	5.82	21.0	361	563	99	663
750	15.1	6.13	22.1	380	593	105	698
800	6.5	6.43	23.2	399	623	110	733

Nutrient requirements for working bullocks:

For bullocks, the work has been categorized into 2 types

a. **Normal work** – working for 4 h of ploughing or 6 h of carting

b. **Heavy work** - working for 6 h of ploughing or 8 h of carting

Daily energy and protein requirement of cattle /buffalo working bullocks (light work 4h)

BW(kg)	DM(kg)	TDN(kg)	ME(Mcal)	MP(g)	RDP(g)	RUP(g)	CP(g)
300	6.5	3.70	13.3	210	323	58	380
350	7.6	4.15	15.0	236	363	65	427
400	8.6	4.59	16.6	261	401	72	472
450	9.7	5.01	18.1	285	438	79	515
500	10.8	5.42	19.6	308	474	85	558
550	11.9	5.83	21.0	331	509	91	599
600	13.0	6.22	22.5	353	544	97	640
650	14.0	6.60	23.8	375	577	103	679
700	15.1	6.98	25.2	397	610	109	718

Daily energy and protein requirements of working cattle and buffalo (heavy work 8hS)

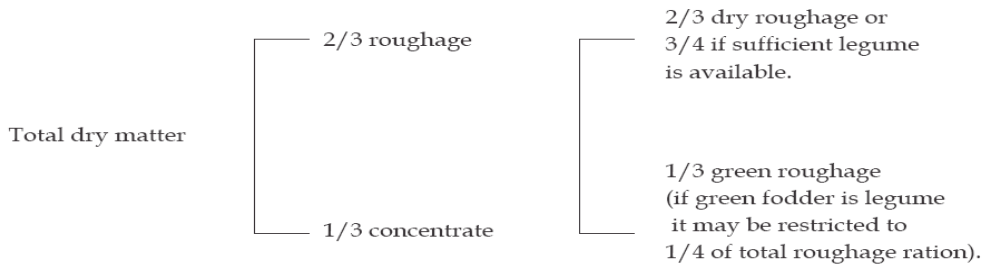
Bw(kg)	DM(kg)	TDN(kg)	ME(MCal)	MP(g)	RDP(g)	RUP(g)	CP(g)
300	6.5	4.93	17.8	229	353	63	415
350	7.6	5.53	20.0	257	396	71	466
400	8.6	6.12	22.1	284	438	78	515
450	9.7	6.68	24.1	311	478	86	562
500	10.8	7.23	26.1	336	517	93	609
550	11.9	7.77	28.0	361	556	100	654
600	13.0	8.29	29.9	386	593	106	698
650	14.0	8.81	31.3	409	630	113	741
700	15.1	9.31	33.6	433	666	119	783

Steps in Ration Formulation:

1. Find out the total requirements of the animal in terms of DM, CP and TDN depending upon the physiological status (pregnancy, lactation, growth, work *etc*.) from the feeding standards.

DM requirement: The total quantity of dry matter the animal can consume per day should be known, so that we can compute the ration in a manner that the entire quantity of the nutrients required is present in the dry matter, the animal is able to consume. Cattle will generally consume 2.0 to 2.5 kg of dry matter per 100 kg body weight. Buffaloes, crossbred animals and heavy yielder consume 2.5 to 3.0 kg dry matter per 100 kg body weight. In mid lactation (10-29 weeks) DM intake has to be increased by 1.7 kg/day. In late lactation (30 weeks onwards) DM intake has to be increased by 4.1 kg / day. In early lactation, the probable DMI may be up to 18 % less than mid lactation.

PARTITIONING OF DRY MATTER



If a cow is weighing 400 kg body weight, the DM requirement will be calculated as follows

Dry matter requirement = $\frac{400 \text{ X } 2.5}{100}$ = 10kg or $\frac{400 \text{ X } 3}{100}$ = 12 kgs.

The dry matter requirement = 10 to 12 kg.

Partitioning of dry matter:

1/3 of DM from concentrate

10 X 1/3 = 3.3 kg or 12 X 1/3 = 4.0 kg}3 to 4 kg Dry matter from concentrate

7 to 8 kg from Roughages----- 1/3 from green roughage = 2 to 3 kg.

2/3 from dry roughage = 4 to 5 kg.

2. By trial and error method, find out the amount of green and dry fodder that should be offered to meet the nutrient requirements of the animal taking into consideration their availability.
3. Calculate the amount of DM, CP and TDN supplied through green and dry fodder.
4. Now, subtract the amount of nutrients supplied through green and dry fodder from the total requirements of the animal to find out the balance of nutrients to be supplied through concentrates.
5. Finally, calculate the amount of concentrate mixture to be offered to the animal to meet the balance of nutrients.

Note: Generally, rations are first formulated for one nutrient (say CP) and then, the other nutrients (say TDN) are checked to see whether the feedstuffs used will meet the requirement or whether alternative feeds need to be included in the ration.

5. Amount of TDN supplied through concentrate mixture

Amount of TDN present in the concentrate mix = 70 %

$$\text{Amount of TDN supplied thru conc. mix} = \frac{4.87}{100} \times 70 = 3.40 \text{ kg}$$

Amount of concentrate mixture required on fresh basis = 5.41 kg

6. Verification:

Nutrients supplied through	DM (kg)	CP (kg)	TDN (kg)
Hybrid Napier	3.3	0.34	1.81
Paddy straw	7.2	0.36	2.88
Concentrate mixture	4.87	0.78	3.40
Total	**15.37**	**1.48**	**8.0**
Actual requirement	**16.0**	**1.48**	**7.62**

Note: The short fall in the TDN requirement can be met by increasing the quantity of paddy straw in the ration.

TOTAL MIXED RATION OR COMPLETE RATION OR COMPLETE FEED

Objective: To prepare the balanced complete diet utilizing the cop residues as roughage sources.

Crop residues and other cellulosic materials are staple ruminant feeds in India. The most abundant residues are the cereal straw of which rice straw forms the bulk. The estimated annual production of cereal straws of which rice straw forms the bulk. The estimated annual production of cereal straw in India is varied from 200-250 million tons. The low nitrogen and mineral content, along with the high lignin and silica content of these roughages influence their low digestibility and cannot meet the maintenance requirement of ruminants. In order to achieve production, concentrates and /or green fodder have to be fed along with the straws. The availability of concentrate supplements are not only inadequate but also expensive. Additionally, any improvement in the nutritional quality of straws will enhance nutrient supply to livestock. In this context, complete diet system is a promising method for improving the utilization of the poor quality fibrous agriculture residues. This system not only ensures improved utilization of nutrients from the agricultural residues but also helps in formulating and processing low cost readymade balanced diet for ruminants. This system also helps in utilizing locally available agriculture residues, agro-industrial by products, animal wastes and also facilitates in the formulation of balanced rations to the land less labourers, marginal and small farmers and the poor. The advantages of formulating a complete diet are associated with reduced feed and labour costs, and optimum utilization of locally available by-products and fibrous agriculture residues. Concentrate to roughage ratios may vary from diet to diet so as to meet the optimum nutrient requirement for production.

Example: Formulate a ration for a cow weighing 400 kg yielding 10 kg of milk/day with 5% butterfat and in **1st** lactation using the following feedstuffs.

Feedstuff	DM%	CP%	TDN%
Hybrid Napier	13.5	10.5	55
Paddy straw	90	5.13	40
Concentrate mixture	90	16	70

* Values of feeds and fodders on DM basis

Solution:

1. Calculation of nutrient requirements of the animal (to be taken from the nutrient requirements tables)

Requirements	DM (kg)	CP (kg)	TDN (kg)
For maintenance	8.64	0.436	3.27
For production (10kg with 5 % fat)	5.7	0.96	3.70
Growth allowance (20 % of maintenance requirement - 1st lactation)	1.72	0.087	0.65
Total requirements	**16**	**1.48**	**7.62**

2. Finding out the amount of nutrients supplied by green and dry fodder

Feedstuff	Amount on Fresh basis (kg)	Dry basis(kg)	CP (kg)	TDN (kg)
Hybrid Napier	25	3.3	0.34	1.81
Paddy straw	8	7.2	0.36	2.88
Total quantity	**33**	**10.5**	**0.7**	**4.69**

3. Balance of nutrients to be supplied through concentrate mixture supplied through

	DM (kg)	CP (kg)	TDN (kg)
Total requirement	16	1.48	7.62
Green & dry fodder	10.5	0.7	4.69
To be supplied thru conc.	5.56	0.78	3.44

4. Amount of concentrate mixture required to meet the CP requirement

Amount of CP to be supplied through concentrates = 0.78 kg

Amount of CP present in the concentrate mix = 16 %

Amount of DM to be supplied through concentrate to meet the CP requirement is

$$= \frac{0.78}{16} \times 100 = 4.87 \text{ kg.}$$

Concept of complete ration:

All feed ingredients inclusive of roughages are proportioned, processed and mixed in to a uniform blend, which is freely available to the animal to supply adequate nutrients. The product is fed as sole source of nutrients.

Processing of complete ration:

Mash:

The different ingredients of diets have to be proportioned as per formula in to 100 kg batches using appropriate scales. The ingredients required for grinding will be ground in a hammer mill. The ground ingredients will come to mixer through screw conveyor and bucket elevator and hopper above the mixer. Later, all the ingredients will be mixed for about 10 minutes and then will be collected in sacks and stored.

Pelleting:

For pelleting, the mash from the mixer will be dropped in to bucket elevator and will be lifted and conveyed into a hopper over the pellet mill. The mash feed will be conveyed from the hopper in to the conditioning chamber will be controlled by wheel valve.

Expander-extruder processing:

This is a system which combines the features of expanding (application of moisture, pressure and temperature to gelatinize the starch portion) and (pressing the feeds through constrictions under pressure). The mash at 12-13% moisture and room temperature will be reconstituted with required quantity of water to get 17-18% moisture in to mixer itself and then sent to the hopper above the expander extruder from which it passes through screw in which it attains 90-95 degree centigrade by the time it comes out of the die openings.

TMR densified blocks:

The making of feed block requires proper processing using a hydraulic press.

Agriculture crop residues used in the preparation of complete rations:

Crop residue	Level in complete ration (%)
Sugar cane bagasse	20
Sorghum stover, Sweet sorghum stover, Sweet sorghum bagasse	20-46
Dry mixed grass	30-75
Sunflower straw	30-50
Sunflower heads	33.5-50
Wheat straw	50
Wood pulp waste	12.5-50
Subabul leaf meal	20-30
Fallen teak leaves	17.5-70
Fallen mango leaves	30-60
Rice straw	40-50
Saw dust	30
Cotton straw	45

Nutrient specifications of complete rations

Nutrient (%)	Growing animals		Maintenance		Lactating animals
	Calves	Lambs	Cattle/ buffalo	Sheep	
Crude protein	9.8-16.0	11.8-12.4	7.2-8.6	9.2-13.6	11.6-16.0
Crude fat	3.1-6.3	3.6-4.0	2.7-4.1	1.5-6.3	3.4-4.1
Crude fibre	19.8-25.1	16.9-19.1	17.3-23.6	12.2-30	17-25
Ca	1.0-1.5	0.9-1.0	0.7-1.5	0.7-1.5	0.7-1.5
P	0.5-0.8	0.4-0.5	0.5-0.8	0.4-0.5	0.5-0.8
TDN	56-63	58-64	53-55	53-55	57-67
Proportion of straw (%)	40-60	40-60	40-70	40-70	30-40

Ingredient composition (%) of complete rations

Ingredient	Complete ration with			
	Mixed grass	Sorghum straw	Wheat Straw	Cotton straw
Dry mixed straw	46			
Sorghum straw		46		
Wheat straw			50	
Cotton straw				45
Tapioca chips	20	20		
Molasses	12	12	13	15
Pea nut meal	10	10	10	10
Caged layer	10	10	15	
droppings(dried)				
Mineral mixture	01	01	01	01
Common salt	0.5	0.5	0.5	0.5
Urea	0.5	0.5	0.5	1.5
De-Oiled Rice Bran				
Wheat bran				
Rice polish				

Effect on milk production:

The milk production of cow fed balanced rations has generally been comparable to those fed on conventional feeding of roughage and concentrate portions of the ration separately.

Growth rate:

Growth performance will be improved by 10-15% in growing calves and lambs, kids.

Cost economics of processing complete rations:

The cost of processing and total cost of the rations need to be calculated taking in to consideration of fixed charges (depreciation on building and machinery, interest on block investment and maintenance) and direct charges (cost of power, labour, operators etc.). The level of agriculture residues used in the ration and fibre characteristics was mainly responsible for variation in the processing costs. The processing costs increased as the roughage level in the complete feed increased.

Advantages of complete feed:

1. An easiest way to give balanced feed to animals
2. An efficient way to deliver nutrients to the animals(least wastage of feed)
3. Feed exercise is time saving as well as labour saving
4. Can prevent the wastage of straw through burning
5. Can reduce environmental pollution
6. There is some reduction in methane emission
7. Improved productive and reproductive efficiency
8. Animals achieve better health
9. Rescue feed during natural calamities
10. Huge scope of extended research on value addition
11. Reduced seasonal variation in feed supply/feed prices/milk prices
12. Better economic returns
13. Complete feed requires lesser space for storage
14. Complete feed is cheaper and easier to transport
15. Feed bank can be set up as a pre-emptive disaster management measure

ALTERNATE FEEDING

Top feeding with Tree Leaves

Objective: To include the tree leaves as alternate feed resources

Large varieties of plant materials which are conventionally not included in the feeds for livestock are used for feeding of cattle and other ruminants during periods of scarcity. Some varieties of tree leaves are conventional feeds for sheep and goats. Certain varieties are also fed to cattle and buffaloes. Leaves of different species have different nutritional characteristics. In general, in the early stages of growth the leaves contain fairly high percentage of crude protein and comparatively low fibre content. As the vegetation advances in age, there is progressive decrease in the protein content and increase in the crude fibre. Tree leaves are generally rich in calcium, but have low phosphorus. The ratio of calcium and phosphorus is generally wide. Due to presence of tannic acid, the digestibility of protein in the leaves is low. A major constraint to livestock production in the tropics is the seasonal fluctuation in forage yield and quality from grasses. There is usually adequate forage of fair to good nutritive value in the wet season, but in the dry season available forage from natural pastures are usually inadequate both in terms of quality and quantity to meet even the maintenance requirements of livestock. Trees and shrubs have been shown to be capable of providing high quality fodder in the dry season. The role of fodder trees and shrubs in the diet of

animals is considered particularly important in countries like India where small land holdings and large ruminant densities result in an especially severe problem of feed availability. Generally these leaves are used for feeding sheep and goat and sometimes to cattle during periods of fodder crisis. Generally, the dry matter content of the various tree leaves varies from 20 to 40%, with 10-15% crude protein on a DM basis. Subabul has higher values of 20 – 23%. Ether extract (EE) fraction is also fairly high compared with grasses and hays. Contain comparatively low percentage of crude fibre compared with grasses and hays. Young tree leaves before flowering have more protein contents than mature leaves after flowering. The crude protein content decreases and the crude fibre content increases with increase in the age of tree leaves. Their fibre is complex and highly lignified at maturity. Palatability, digestibility, and nutritive value of tree leaves decreases as the leaves advance in maturity. The tree leaves contain 8– 33 % CP, 1–19 % EE, 11–50 %CF, 0.2–3.0 % Ca and 0.1–0.3 % P. The digestibility coefficient of dry matter, crude protein, crude fibre, ether extract and nitrogen free extract in tree leaves ranged from 40–75, 28–83, 24–82, 32–65 and 51–85 %, respectively. Calcium content of tree leaves is 2-3 times more than that of cultivated fodders or grasses. The phosphorus content is, in general, low, resulting in a wide calcium to phosphorus ratio. Tree fodders are rich in protein and mineral contents as compared to grasses and thus can be supplemented to low quality grasses.

Deleterious principles

Presence of Anti nutritional factors like mimosine in *Leucaena leucocephala*, triterpinoid derivatives (azadirachtin, nimbidin) in *Azadirachta indica* and phenolics in most of the leaves limit their use as animal fodder. The presence of tannins adversely affects the dry matter digestibility and use of nutrients, and an inverse relationship exists between tannin content and crude protein digestibility. Because of their inhibition of proteolytic and cellulolytic enzyme, protein utilization is affected by inclusion of leaves, however, the inclusion of a limited quantity of tree leaves in animal feed is recommended to improve rumen function and productivity. Level of tannins are higher in the early stages of growth. Some trace minerals, such as fluorine, molybdenum, and selenium, are reported to be present in toxic amounts in some tree leaves.

Nutritive value of tree leaves

S.No	Item/ leaves	DCP %	TDN%
1	Subabul	11.93	51.97
2	Neem	6.19	52.5
3	Mulberry	Tender leaves 23.5 Mature leaves 12.8	48.4
4	Peepal leaves	7.05	48.22
5	Bamboo leaves	9.3	48.8
6	Sesbania leaves	16.89	61.8
7	Acacia	23.0	-
8	Moringa leaves	25.0	58.9

SHEEP AND GOAT

FEEDING BASED ON THEIR PRODUCTION

Objective: To feed the sheep and goats according to their production

It is difficult to describe the feeding and management of the sheep and goat industry around the world

The systems of sheep and goat production

1. Fine wool production
2. Meat production
3. Dual-purpose

Management and feeding systems:

- Village systems
- Extensive systems
- Semi-intensive systems
- Intensive
- Integration with cropping systems

Village system:

- The village system of feeding is of two categories.
- Tethering : 1–5 head are involved in situations where there is intensive crop cultivation.
- Feeding *in situ* the various crop residues available
- In addition, in both systems, kitchen remnants are commonly given.
- A feature of this system is that it encourages goats to remain in the vicinity of the villages.

Extensive system:

Sheep and goat rearing in India is mainly based on extensive grazing system. The performance of sheep and goat under extensive system varies depending on the quality and quantity of herbage available.

- Extensive grazing is common where there is access to grazing and marginal land using family labour involving mainly women and children.
- The flock sizes are larger (1–15 head) and animals, often goats and sheep belonging to several owners, are run together and brought back in the evening.
- Stocking rates are usually in the range of 1–4 head/ha.

Semi intensive system:

- In this system there is usually limited grazing and stall-feeding depending on the availability of time, labour and also feeds.
- It is essentially a part-time operation like the village system.
- The duration of grazing is variable and is about 4–6 hours per day, usually in the late morning or evening.
- The sheep and goats are then housed and given some forages or crop residues. Very seldom are concentrates offered.

Intensive Feeding System:

- Intensive systems are of three categories:
  a. Roughage and concentrates are offered to sheep cafeteria mode
  b. Limited quantity of concentrate is offered along with ad lib roughage
  c. Roughage and concentrate are offered in the form of complete feeds/TMR.

This system can be well adapted to rearing sheep for fat lamb production of desired traits.

- Intensive use of cultivated forages or stall feeding.
- Although goats prefer to browse in comparison to grazing, they are nevertheless quite capable of making efficient use of cultivated pastures for meat or milk production
- Stocking rates of the order of 16–60 sheep, goats/ha are feasible depending on the type of grass used, level of fertiliser application and the presence or absence of legumes (Devendra and Burns, 1983).

Integrated crop feeding system:

- This is a traditional system throughout humid tropical Asia and elsewhere.
- Two types of production systems are common
- These are (i) a semi-intensive system and (ii) integration with tree cropping, notably coconuts, oil palm and rubber.
- Combination of limited grazing and stall feeding
- It is a compromise between very extensive and intensive systems
- The extent of grazing is influenced by the area available and other considerations such as labour and time
- The flock sizes are generally small and not more than 1–8 animals.
- Goats and sheep utilise all available feed resources and include wayside crop residues, stubbles especially from cereal cultivation (maize, rice and wheat)
- Other residues from crop production such as sweet potato (Ipomoea batatas) vines and/or sugarcane (*Saccharum officinarum*) tops
- The level of nutrition is generally low and both species consume whatever is available
- Grazing as they do for not more than 4–6 hours every day

Feeds and fodders for sheep:

The suitable feeds and fodders for sheep are similar to the classes of feed mentioned in the feeding of dairy cattle.

Among the non cereal grasses, the more suitable grasses for sheep and goats feeding are Anjan (*Cenchrus ciliaris)* and Guinea grass (*Panicum maximum*).

Goats relish to take tree leaves. The information on tree leaves is also mentioned under Feeding of dairy cattle.

Feeding different age groups of sheep and Goat

Sheep and goats are ruminant animals. They have a specialized digestive system that efficiently breaks down and utilizes forage and other roughage-based feeds. However, the nutritional needs of sheep and goats vary depending on their age and stage of production.

For lambs and kids (young sheep and goats), a high-quality, highly digestible diet is essential for growth and development.

- Milk or milk replacer is the primary source of nutrition for these young animals, and they should be fed multiple times per day to meet their high energy and protein needs. As they grow, they can be gradually introduced to solid feeds, such as creep feed (a specially formulated feed for young animals), hay, and pasture.

  Creep mixture feeding is a simple way to allow lambs access to extra feed supplements. Lambs usually commence creep feeding around 10 to 14 days of age and the amount consumed is inversely proportional to the amount of milk consumed. Inadequate energy intake by suckling lambs is the major cause of slow weight gains. Great efficiency and lambs weight gains occur if lambs are creep fed. Soybean meal is an important ingredient in creep diets because of its high protein content and palatability. For rapid weight gains, the creep feed must be palatable, contain high energy and adequate protein (14-18%), minerals especially Calcium with an ideal Ca to P ratio of 2:1 and adequate vitamin levels.

  The creep mixture can be formulated as per the procedure mentioned for preparation of concentrate mixture under Feeding of dairy cattle.
- Growing and finishing sheep and goats (raised for meat production) also have specific nutritional needs. They require a diet high in protein and energy to support growth and muscle development. It can be provided through a combination of forages, such as hay and pasture, and concentrates, such as grains and protein supplements. Adult sheep and goats raised for wool production or as dairy animals have different nutritional needs than growing and finishing animals.
- They require a diet high in protein and energy to support milk production and wool growth. It can be provided through a combination of forages, such as hay and pasture, and concentrates, such as grains and protein supplements. Lastly, older sheep and goats have lower nutritional requirements than younger animals. They may require a diet that is lower in protein and energy. They can be maintained on a diet of forages, such as hay, and may not require concentrates.

Feeding schedules for different ages of sheep and goats:

Lambs and Kids: Lambs and kids should be fed a high-energy diet rich in protein, vitamins, and minerals. They can be fed milk replacers or a combination of milk and creep feed. As they grow, the amount of creep feed can be gradually increased.

Model creep feed formula for supplementary feeding of pre-ruminant lambs

Ingredients	Quantity (kg)
Maize	55
De-oiled groundnut cake	10
Soyabean meal	12
Sesame meal	5
Rice bran	10
Molasses	5
Mineral mixture	2
Salt	1
Total	100
Vitamin premix g/100 kg*	

* As per manufacturers recommendation

Weanlings are young sheep or goats that have been recently weaned from their mothers and are transitioning to solid food. They have unique nutritional needs that must be met to ensure healthy growth and development. Once sheep and goats are weaned, they should be fed a diet high in energy and protein to support growth and development. They should be fed a diet that contains at least 18-20% protein.

The ram lambs can bed fed with roughages and concentrates separately or together in the form of chaffed green fodder or good quality silage is more preferable when roughages and concentrates are fed separately for lambs. At least 2 acres of perennial fodder plots with irrigation is required to produce non-leguminous green fodder sufficient enough for meeting the requirements of 100 ram lambs (an average of 3 kg green fodder/day/lamb). Concentrate requirement may vary from 200 to 350 g/day/lamb as shown previously under semi-intensive system to meet the requirements of growing lambs with the average daily gain of 70 to 100 g.

Model least cost concentrate mixture formula for supplementary feeding of post-weaned growing lambs

Ingredients	Quantity (kg)
Maize	45
De-Oiled Cotton Seed cake	7.5
De-Oiled Rice Bran	25
Distillers Dried Grains and Solubles (DDGS)	8
Molasses	10
Urea	1
Calcite powder	1.5
Mineral mixture	2
Salt	1
Total	100
Vitamin AD_3 g/100 kg	10

Yearlings: As sheep and goats reach one year of age, their nutritional needs will change as they approach sexual maturity. They should be fed a balanced diet of energy, protein, and minerals to support growth and development. They should be fed a diet that contains at least 14-16% protein.

Breeding Stock: Breeding stock refers to sheep or goats used for reproduction, breeding, or milk production. Breeding ewes require a diet high in energy and protein to support growth, lactation, and reproduction.

The concentrate mixture can be supplemented to breeding rams @ 0.5 to 0.75% body weight during breeding season depending the body condition of rams and fodder availability in the grazing land.

Lactating Stock: Lactating sheep and goats, also known as ewes and does, have specific nutritional needs that must be met to ensure healthy lactation and milk production. Lactating ewes require a diet high in energy and protein to support lactation and milk production.

Concentrate mixture supplementation to lactating ewes @ 0.75 to 1.25% of body weight depending on the nutrients intake from grazing for first 3 weeks is warranted to increase milk production

Model concentrate mixture formula for supplementary feeding of breeding rams and breeding, pregnant and lactating ewes

Ingredients	Quantity (kg)
Maize	50
De-oiled ground cake	9
Soya bean meal	8
De-oiled rice bran	25
Molasses	5
Calcite powder	1
Mineral mixture	1
Salt	1
Total	100
Vitamin AD_3 g/100 kg	10

Finishing Stock: Finishing stock refers to bringing sheep and goats to a desired weight and condition for market or slaughter. It typically involves providing the animals with a diet high in energy and protein, as well as proper care and management practices. The finishing process for sheep and goats typically begins when the animals are around 6-8 months of age. They have specific nutritional needs that must be met to ensure optimal growth and muscle development

Best feeding practices for feed management of sheep and goats:

Provide a balanced diet: Sheep and goats require a balanced diet that includes a combination of forages (such as hay or grass), grains, and minerals.

Offer fresh, clean water: Make sure that sheep and goats have access to fresh, clean water at all times.

Feed according to the animal's stage of life: The nutritional needs of sheep and goats will change depending on their stages of life, such as pregnancy, lactation, or growth.

Provide enough space: Sheep and goats need enough space to move around and graze. Crowded conditions can lead to competition for food and potential health problems.

Monitor body condition: Keep an eye on the body condition of your sheep and goats, and adjust their diet as needed to maintain a healthy weight.

Provide mineral and salt blocks: To maintain their health, sheep and goats need access to mineral and salt blocks.

Feed during regular hours: It is best to feed sheep and goats at the same time every day.

Provide enough feeder space: Make sure that you have enough feeder space for all of the sheep and goats in your herd.

Provide a variety of forage: Sheep and goats thrive on various forages. Rotating pastures and providing a mix of forage will help prevent overgrazing and improve the health of your animals.

Monitor feed quality: Keep an eye on the quality of the feed you provide to your sheep and goats. Make sure it is fresh, mold-free, and stored properly.

RATION FORMULATION FOR SHEEP AND GOATS

The principles of ration formulations are similar to the feeding of dairy cattle.

Nutrient requirements:

Nutrient requirements of Indian sheep (adult ewe, rams, yearlings) for maintenance (ICAR, 2013)

BW (kg)	Energy in Diet (ME, Mcal/ kg)	DMI (g/d)	DMI (%BW)	TDN (g)	ME (Mcal)	CP (g)	DCP (g)
10	2.0	0.35	3.50	0.20	0.70	38	25
15	2.0	0.48	3.16	0.27	0.95	51	34
20	2.0	0.60	2.94	0.33	1.18	63	43
25	2.0	0.71	2.78	0.39	1.39	75	50
30	2.0	0.81	2.66	0.45	1.59	86	58
35	2.0	0.91	2.56	0.50	1.79	96	65
40	2.0	1.00	2.47	0.56	1.98	107	71
45	2.0	1.10	2.40	0.61	2.16	116	78
50	2.0	1.19	2.34	0.66	2.34	126	84
55	2.0	1.27	2.28	0.71	2.51	135	91
60	2.0	1.36	2.23	0.5	2.68	145	97
65	2.0	1.44	2.19	0.80	2.85	153	103
70	2.0	1.53	2.15	0.85	3.01	162	107

Nutrient requirements of Indian sheep (adult ewe, rams, yearlings) for breeding

BW (kg)	Energy in Diet(ME, Mcal/ kg)	DMI (g/d)	DMI (% BW)	TDN (g)	ME (Mcal)	CP (g)	DCP (g)
15	2.0	0.53	3.53	0.29	1.06	56	38
20	2.0	0.66	3.28	0.36	1.31	70	47
25	2.0	0.78	3.10	0.43	1.55	82	55
30	2.0	0.89	2.97	0.49	1.78	95	63
35	2.0	1.00	2.85	0.55	2.00	106	71
40	2.0	1.10	2.76	0.61	2.21	117	79
45	2.0	1.21	2.68	0.67	2.41	128	86
50	2.0	1.30	2.61	0.72	2.61	139	93
55	2.0	1.40	2.55	0.78	2.80	149	100
60	2.0	1.50	2.49	0.83	2.99	159	106
65	2.0	1.59	2.44	0.88	3.18	169	113
70	2.0	1.68	2.40	0.93	3.36	178	120

Nutrient requirements of Indian sheep for gestation and lactation (ICAR, 2013)

BW (kg)	Energy in Diet(ME, Mcal/ kg)	DMI (g/d)	DMI (% BW)	TDN (kg)	ME (Mcal)	CP (g)	DCP (g)
Gestation							
15	2.4	0.60	4.01	0.40	1.44	77	51
20	2.4	0.75	3.73	0.50	1.79	95	64
25	2.4	0.88	3.53	0.59	2.21	112	75
30	2.4	1.01	3.37	0.67	2.43	129	86
35	2.4	1.13	3.24	0.75	2.72	145	97
40	2.4	1.25	3.14	0.83	3.01	160	107
45	2.4	1.37	3.05	0.91	3.29	175	117
50	2.4	1.48	2.97	0.99	3.56	189	127
55	2.4	1.59	2.90	1.06	3.82	203	136
60	2.4	1.70	2.83	1.13	4.08	217	145
65	2.4	1.81	2.78	1.20	4.33	230	154
70	2.4	1.91	2.73	1.27	4.58	243	163
Lactation							
15	2.4	0.72	4.81	0.48	1.73	92	62
20	2.4	0.90	4.48	0.60	2.15	114	76
25	2.4	1.06	4.23	0.70	2.54	135	90
30	2.4	1.21	4.04	0.81	2.91	155	104
35	2.4	1.36	3.89	0.91	3.27	174	116
40	2.4	1.51	3.76	1.00	3.61	192	129
45	2.4	1.64	3.66	1.09	3.95	210	140
50	2.4	1.78	3.56	1.18	4.27	227	152
55	2.4	1.91	3.48	1.27	4.59	244	163
60	2.4	2.04	3.40	1.36	4.90	260	174
65	2.4	2.17	3.33	1.44	5.20	276	185
70	2.4	2.29	3.27	1.52	5.50	292	196

Daily nutrient requirements of growing Indian sheep (ICAR,2013)

BW (Kg)	ADG (g/d)	ME Level in diet (Mcal/kg)	DMI (kg/d)	DMI (%BW)	Energy requirement		Protein requirement	
					TDN(g)	ME(Mcal)	CP(g)	DCP(g)
5	25	2.40	0.22	4.4	146	0.53	34	23
5	50	2.53	0.24	4.8	169	0.61	46	30
5	75	2.53	0.27	5.5	192	0.69	58	38
5	100	2.71	0.29	5.8	215	0.78	69	46
5	150	2.89	0.33	6.5	260	0.94	93	61
10	25	2.00	0.35	3.5	231	0.83	49	33
10	50	2.00	0.38	3.8	253	0.91	61	40
10	75	2.4	0.40	4.0	276	1.00	73	48
10	100	2.40	0.43	4.3	299	1.08	84	56
10	125	2.40	0.46	4.6	322	1.16	96	64
10	150	2.40	0.49	4.9	344	1.24	108	71
10	200	2.40	0.56	5.6	390	1.41	131	87
15	25	2.00	0.55	3.7	305	1.10	63	42
15	50	2.00	0.59	3.9	328	1.18	74	49

BW (Kg)	ADG (g/d)	ME Level in diet (Mcal/kg)	DMI (kg/d)	DMI (%BW)	Energy requirement		Protein requirement	
					TDN(g)	ME(Mcal)	CP(g)	DCP(g)
15	75	2.00	0.63	4.2	350	1.26	86	57
15	100	2.40	0.56	3.8	373	1.35	97	65
15	125	2.40	0.60	4.0	396	1.43	110	73
15	150	2.40	0.63	4.2	418	1.51	121	80
15	200	2.40	0.70	4.7	464	1.68	145	96
15	250	2.40	0.77	5.1	509	1.84	168	111
20	25	2.00	0.66	3.3	364	1.31	77	50
20	50	2.00	0.71	3.6	394	1.42	87	57
20	75	2.00	0.77	3.8	425	1.53	98	65
20	100	2.40	0.68	3.4	455	1.64	109	72
20	125	2.40	0.73	3.6	485	1.75	120	80
20	150	2.40	0.78	3.9	516	1.86	130	87
20	200	2.40	0.87	4.3	576	2.08	152	102
20	250	2.40	0.96	4.8	637	2.30	173	117
25	25	2.00	0.77	3.1	425	1.53	89	58
25	50	2.00	0.82	3.3	455	1.64	99	65
25	75	2.00	0.88	3.5	485	1.75	110	73
25	100	2.40	0.78	3.1	516	1.86	121	80
25	125	2.40	0.82	3.3	546	1.97	132	88
25	150	2.40	0.87	3.5	576	2.08	142	95
25	200	2.40	0.96	3.8	637	2.30	164	110
25	250	2.40	1.05	4.2	698	2.52	185	125
30	25	2.00	0.87	2.9	483	1.74	100	65
30	50	2.00	0.93	3.1	513	1.58	110	72
30	75	2.00	0.98	3.3	543	1.96	122	80
30	100	2.00	1.04	3.5	574	2.07	132	88
30	125	2.00	1.09	3.6	604	2.18	143	95
30	150	2.40	0.95	3.2	634	2.29	153	103
30	200	2.40	1.05	3.5	695	2.51	175	117
30	250	2.40	1.14	3.8	755	2.73	197	133
35	25	2.00	0.97	2.8	538	1.94	111	72
35	50	2.00	1.03	2.9	568	2.05	122	80
35	75	2.00	1.08	3.1	599	2.16	133	87
35	100	2.40	0.95	2.7	625	2.27	143	95
35	125	2.40	0.99	2.8	659	2.38	154	102
35	150	2.40	1.04	3.0	689	2.49	165	110
35	200	2.40	1.13	3.2	750	2.71	186	125
35	250	2.40	1.22	3.5	810	2.92	208	140

Daily nutrient requirement of growing male goats under tropical conditions*(ICAR,2013)

Body weight(kg)	Body weight gain(g/d)	Daily dry matter intake		TDN kg/d	ME Mcal/d	CP g/d	DCP g/d	Ca g/d	P g/d	Vit A IU	Vit D IU
		Kg	%BW								
5	0	-	-	0.101	0.36	19	11	-	-	-	-
5	25	0.20	4	0.141	0.51	31	20	0.8	0.6	0.4	78
5	50	0.21	4.2	0.181	0.66	42	28	1.1	0.9	0.5	105
5	75	-	-	0.221	0.80	53	37	-	-	-	-
5	100	-	-	0.262	0.95	65	45	-	-	-	-
10	0	-	-	0.169	0.61	33	19	1.2	0.9	0.5	112
10	25	0.36	3.6	0.21	0.76	44	27	1.2	0.9	0.5	112
10	50	0.37	3.7	0.25	0.90	55	36	1.5	1.2	0.6	139
10	75	0.35	3.5	0.29	1.05	67	44	1.9	1.5	0.8	162
10	100	-	-	0.33	1.19	78	53	-	-	-	-
10	125	-	-	0.371	1.34	89	61	-	-	-	-
10	150	-	-	0.411	1.48	100	70	-	-	-	-
15	0	-	-	0.229	0.83	44	25	-	-	-	-
15	25	0.45	3	0.27	0.98	56	34	1.5	1.1	0.7	142
15	50	0.5	3.3	0.31	1.12	67	42	1.9	1.4	0.8	169
15	75	0.5	3.3	0.35	1.26	78	51	2.2	1.7	1	192
15	100	-	-	0.39	1.41	89	59	-	-	-	-
15	125	-	-	0.431	1.56	101	68	-	-	-	-
15	150	-	-	0.471	1.70	112	76	-	-	-	-
20	0	-	-	0.285	1.03	55	31	-	-	-	-
20	25	0.58	2.9	0.325	1.17	66	40	1.8	1.3	0.8	172
20	50	0.60	3.0	0.365	1.32	78	48	2.1	1.6	0.9	199
20	75	0.62	3.1	0.405	1.47	89	57	2.4	1.9	1.1	232
20	100	0.62	3.1	0.446	1.61	100	65	2.8	2.1	1.2	254
20	125	-	-	0.486	1.76	111	74	-	-	-	-
20	150	-	-	0.526	1.90	123	82	-	-	-	-
25	0	-	-	0.337	1.22	65	37	-	-	-	-
25	25	0.68	2.7	0.377	1.36	76	46	2.1	1.5	0.9	197
25	50	0.71	2.8	0.417	1.51	88	54	2.4	1.8	1	224
25	75	0.73	2.9	0.457	1.65	99	63	2.7	2.1	1.2	247
25	100	0.74	3.0	0.498	1.80	110	71	3.1	2.3	1.3	279
25	125	0.71	2.8	0.538	1.94	121	80	3.4	2.5	1.4	307
25	150	-	-	0.578	2.09	133	88	-	-	-	-

Daily nutrient requirement of growing male goats under tropical conditions*(ICAR,2013)

Body weight(kg)	Body weight gain(g/d)	Daily dry matter intake		TDN kg/d	ME Mcal/d	CP g/d	DCP g/d	Ca g/d	P g/d	Vit A IU	Vit D IU
		Kg	%BW								
30	0	-	-	0.386	1.39	75	43	-	-	-	-
30	25	0.77	2.6	0.426	1.54	86	51	2.4	1.7	1	223
30	50	0.80	2.7	0.466	1.69	97	60	2.7	2	1.1	250
30	75	0.83	2.8	0.507	1.83	108	68	3.1	2.3	1.3	273
30	100	0.84	2.8	0.547	1.98	120	77	3.4	2.5	1.4	305
30	125	-	-	0.587	2.12	131	85	-	-	-	-
30	150	-	-	0.627	2.27	142	94	-	-	-	-

Requirement for lactation

The CP and TDN requirements for lactating ewe are 12.08 g/kg $W^{0.75}$ and 63g/kg $W^{0.75}$, respectively.

Requirement for gestation

The CP and TDN requirements for pregnant ewe are 10.05 g/kg $W^{0.75}$ and 52.38g/kg $W^{0.75}$, respectively.

Requirement for breeding

The CP and TDN requirements for breeding ram are 7.38g/kg $W^{0.75}$ and 38.23g/kg $W^{0.75}$, respectively.

Flushing is a reproductive management tool in which a supplement is offered to does 3-4 weeks prior to breeding to increase body weight, ovulation rate and litter size. During flushing, the breeding ewe should be provided 25% extra allowance over and above maintenance requirements. Flushing is effective only when the ewes are undernourished during preflushing period. In well nourished ewes flushing has no additional advantage.

TMRs using locally available feed resources

Feedstuff	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
			% of Inclusion			
Sorghum straw	20	-	25%	-	40	50
Wheat straw	-	20	-	20	-	-
Maize grain	14	10	10	10	20	18
Rice bran	15	-	23	-	-	-
Wheat bran	-	-	-	18	10	08
Maize bran	-	20	-	-	-	-
Rice polishing	14	15	-	11	10	08
Groundnut cake	15	15	11	-	10	08

Feedstuff	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
			% of Inclusion			
Sunflower meal	-	-	10	12	08	08
Cottonseed meal	-	06	-	-	-	-
Linseed meal	08	-	-	-	-	-
Rapeseed meal/Mustard meal	-	-	-	15	-	-
Corn gluten meal	-	-	12	-	-	-
Molasses	12	12	07	12	--	-
Mineral mixture	1.5	1.5	1.5	1.5	1.5	1.5
Common salt	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100
CP%	14	14	14	14	11	10
TDN%	60	65	60	60	59	57

Rations for Sheep& Goats:

1. Growing lamb with body weight of 20kg and ADG 100g
   Non leguminous green fodder 2kg
   Leguminous green fodder 1kg
   Concentrate mixture (18% CP) 200g

2. Lactating ewe with body weight of 40kg
   Non leguminous green fodder 4 kg
   Leguminous green fodder 1kg
   Concentrate mixture (18%CP) 550g

POULTRY FEEDING

Feed formulation is the process of quantifying the amounts of feed ingredients that need to be combined to form a single uniform mixture (diet) for poultry that supplies all of their nutrient requirements. Since feed accounts for 65-75% of total live production costs for most types of poultry throughout the world, a simple mistake in diet formulation can be extremely expensive for a poultry producer.

Feed formulation requires thorough understanding of the:

- Nutrient requirements of the class of poultry (e.g., egg layers, meat chickens or breeders).
- Feed ingredients in terms of nutrient composition and constraints in terms of nutrition and processing.
- Cost and availability of the ingredients.

ESSENTIAL NUTRIENTS

The following six classes of nutrients are essential to life, growth, production, and reproduction in all classes of poultry. Nature supplies most of these essentials in the form of pasture, bugs and insects, gravel, grains and seeds, sunshine, etc. Indoor feeding of young or adult poultry, places full responsibility on the attendant to supply these same requirements in some form or another and in adequate but not excessive amounts.

1. **WATER:** Birds can live longer without food than without water. Lack of a consistent supply of fresh water hinders the growth of young poultry; it leads to low egg production and early moulting in the laying flock.
2. **PROTEIN:** This is usually the most expensive feed material, but the one most likely to bring profitable results if properly used. Protein from animal sources – milk, liver, fish scraps, meat, or meat meal – is more effective in promoting growth and egg production, than protein from most vegetable sources. Grains alone are entirely inadequate in amount and kind of protein. Excess protein has a forcing effect which may be detrimental to poultry of any age.
3. **CARBOHYDRATES:** These are the starchy materials in grains and grain products. Only a starved flock will lack for carbohydrates. They supply fuel and energy, the excess going to form fat in the body or egg.
4. **FATS:** Some fat is present in practically all feed materials. An excess of fat from fish oil or meat and fish products may cause digestive upset in birds, and lead to such disorders as fatty degeneration and "crazy chick disease".
5. **MINERALS:** Calcium carbonate (from limestone or gravel, clam or oyster shells, bone, etc) in the presence of Vitamin D, forms most of the eggshell. Calcium and phosphorous make up a major part of bone; but excess phosphorous (from bone materials) may immobilize the manganese in the diet, leading to crooked bones and slipped tendons in chicks and poults. Salt supplies some essential minerals. Green feed contains small amounts of certain highly important minerals.
6. **VITAMINS:** The naturally speedy growth of young poultry soon reveals any vitamin deficiencies in their rations; hatching of eggs is a critical test of the vitamin content of a breeder diet. Most vitamins commonly lacking in diets are:

i. Vitamin A (from green feed, yellow corn, and fish oils). Vitamin A protects against colds and infections.

ii. Vitamin D (in marine fish oils and synthetic products or formed in body when exposed to ultra-violet rays of sun). Vitamin D aids in laying down of mineral in shell or bone, and in preventing leg weakness and rickets.

iii. Riboflavin (in milk, liver, yeast, green feed, synthetic riboflavin, etc.). Riboflavin promotes the growth of chicks and poults, both in the egg and after hatching; hence it is one of the most important factors in hatchability. Riboflavin prevents nutritional or curled-toe paralysis in young chicks.

Cereal Grains

Maize or corn

Maize is the principal energy source used in poultry diets in most of the countries because of its high-energy value, palatability, presence of pigments and essential fatty acids. It contains highest amount of energy (ME 3350 kcal/kg) among cereal grains. It has 8-13% of crude protein. It has high TDN of 85-90%. Maize has low fibre content and is highly palatable. Extremely low in calcium and deficient in vitamin B12 but fair in phosphorus content. Yellow maize provides carotene and xanthophylls pigments for colouration of egg yolk, poultry fat and skin when it is used at 30% and above in the diet. Maize is an excellent source of linoleic acid which contributes for egg size, and maize protein is mainly deficient in tryptophan and lysine. Damaged, immature, and improperly stored maize having higher moisture content is prone to aspergillus flavus infestation and produces aflatoxin. Supplementation of toxin binders in diet containing damaged maize grain is essential to minimize the risk of mycotoxins problem. Organic acids should be added to the maize while storing, if the moisture content in the grain is higher than 16%. When the maize is used at >30% in pellet diet, supplementation of pellet binders, molasses, rice bran or oil is required for better quality of pellet. Maize can be included up to 70% in poultry ration.

Sorghum / Jowar

Sorghum contains slightly lower energy but more protein than maize (ME 3200 kcal/kg; Protein 10%). Sorghum protein is deficit in lysine, methionine, and arginine. Light coloured sorghum varieties can be used as the principal energy source. Darker varieties, that are bird resistant, can contain tannins in the seed coat and should be used less. Higher levels of tannin in sorghum may reduce the palatability and thereby feed intake. While tannin free sorghum can be used as a sole source of energy in layer diet without affecting egg production, egg weight and energy efficiencies. It can be included up to 30% in chicks ration and up to 60% in the grower and layer rations.

Wheat

Wheat is rich in protein and calcium and but low in fat and energy compared to maize. Wheat is a good source next to maize and sorghum (ME 3100 kcal/kg). Its protein content is highly variable (11-14%). Wheat protein is deficient in methionine and threonine. Wheat contains indigestible non-starch polysaccharides (arabinoxylans) that reduces the performance of poultry. The enzyme, xylanase, may be used when wheat is incorporated in feed at high level. It can be included up to 20% in chick ration and up to 30% in grower and layer rations.

Broken Rice

The ME content of broken rice ranges from 2400- 3250 kcal/kg. Rice is low in protein (7-8%). Rice which is unsuitable for human consumption can be used for poultry at low level. Broken rice is a byproduct of milling. Its quality is much variable and good quality broken rice can be used in poultry feeds. Replacement of maize with broken rice may increase fat deposition in abdominal area. It can be included up to 10% in chick ration and up to 20% in grower and layer rations.

Bajra / pearl millet

They have 8-12% of crude protein and rich tannin content. It can be included up to 30% in chick ration and up to 60% in grower and layer ration.

Ragi / finger millet

Ragi contains slightly less protein, fat, and more crude fibre. The amount of Ca and P are higher in ragi as compared to Maize. High crude fibre and tannin content and possibly lower protein quality are the limiting factors in ragi for its utilization in poultry diets. It can be included up to 30% in chick ration and up to 60% in grower and layer rations.

Plant origin oil cakes:

Cakes have higher protein and fat content while meals have higher protein content but have very less amount of fat.

Proteins:

In general oilseed proteins have a low cystine and methionine content and is variable but usually low cystine content. The high temperature and pressure of the expeller process may denature the protein and reduce its digestibility, with a consequent lowering of its nutritive value.

Fat:

Digestive disturbances may result from uncontrolled use of cakes rich in oil and, if the oil is unsaturated, body fat may be soft and carcass quality lowered.

Minerals and vitamins:

The oil seed meals have a high P content, which tends to aggravate their generally low Ca content. They may provide B-complex vitamins, but they are poor source of carotene and vitamin A.

Groundnut cake:

Groundnut seed contains 35-60% oil and 25-30% crude protein. GNC is most widely used, high protein feed. In expeller variety CP content is 45% and 10% fat. GNC is an excellent source of arginine but deficient in lysine, methionine and cystine. First limiting amino acid is lysine. GNC is poor in Ca and P. Toxic factor present in the GNC is 'Aflatoxin' a metabolite of the fungus Aspergillus flavus, particularly in warm rainy season. The cake tends to become rancid especially in warm moist climate. It should not be stored more than 6 weeks in summer or 3-4 months in winter. Ducklings are highly susceptible.

Soybean meal (SBM):

Normally solvent extracted oil content is 1%. Most of the SBM are de-oiled type. It is one of the best source proteins available for animals. The protein contains all the essential amino acids but concentration of cystine and methionine are sub-optimal. It is an excellent source for lysine, but methionine is the first limiting amino acid. Two grades of SBM: 44% CP and 49% CP. The cake is used for all kinds and poultry.

Mustard oil cake:

Oil content is high 14.1%. Crude protein content is 35%. Ca and P content are very much higher: 0.29% and 0.39%, respectively. The protein is deficient in lysine De-oiled type can be used for poultry up to 10% of the ration. In the case of poultry it is not a good source of protein. It contains a goitrogenic substance which reduces the growth rate in poultry. About 10-15% of this cake can be incorporated in poultry ration.

Cotton seed cake:

Excellent high quality protein feed (about 40%) but low in cystine, methionine and lysine. First limiting amino acid is lysine. The cake can be used in poultry rations if the free gossypol does not exceed 0.03%. The cakes are available in two forms 1. Whole pressed cotton seed cake (un-decorticated) and 2. Dehulled (decorticated), containing less of fibre and more of proteins than the whole pressed type.

Animal origin protein sources:

Fish meal:

Fish meal is produced by cooking fish and pressing the cooked mass to remove most of the oil and water. Protein digestibility of fish meal is 93-95%. Protein content of various fish meal varies over a range of about 50-75% but the composition of the protein is relatively constant. It is rich in all essential amino acids, particularly lysine, cystine, methionine and tryptophan. It contains a high proportion of Calcium and Phosphorus and several desirable trace minerals including Manganese, Iron and Iodine. They are good source of vitamin A, D and B-complex vitamins, particularly choline, pantothenic acid, B12 and riboflavin. Fishmeal is the richest source of Vit B12.

Unconventional poultry feeds

Sunflower meal:

Good quality sunflower meal contains 40-44% high grade protein especially rich in methionine (in decorticated variety). The first limiting amino acid is lysine. In un-decorticated variety has only 20% protein.

Rubber seed cake:

Good quality rubber seed cake contains 30% crude protein, 9-10% ether extract and 5% crude fibre in decorticated variety. Inclusion level is 10% in poultry ration.

Neem cake:

Neem cake contains 34% crude protein while processed cake shows 48% crude protein. Fibre content is only 4.4%. Amino acid lysine and methionine is comparable to GNC. The cake is as such unpalatable. Therefore, it should be mixed with other related feed stuffs.

Karanj cake:

Seeds are available in Mysore, A.P, M.S, M.P, Bihar, W.B and Assam. It is less palatable, contains some polyphenolic compounds which have deleterious effect on growth and production. The de-oiled variety of this cake contains 30% crude protein. It is having 60% NFE and only 6.66% crude fibre. The cake is moderately rich in all essential amino acids such as lysine and methionine.

Meat meal:

Meal is obtained from mammal tissue exclusive of hair, hoof, horn, stomach content and hides trimmings by proper drying and grinding. It is rich in crude protein (50-55%) and ash (21%) with high calcium (8%) and phosphorus (4%). Low in tryptophan and methionine. Meat meal is a good source of vitamin B-complex, especially riboflavin, choline, niacin and cyanocobalamin.

Blood meal:

This is a major slaughterhouse by product. The product is obtained by drying the blood of slaughtered warm-blooded animals. It has 80% crude protein, small amount of ash and oil and 10% moisture. It is poor in Ca and P which make it unpalatable to the animals. This meal is one of the richest sources of lysine and rich source of arginine, methionine, cystine and glycine.

Tapioca chips:

Tapioca chips or flour is a rich source of carbohydrate but low in protein and fat. Tapioca can be used as a partial cereal grain replacer, provided the protein deficiency is rectified. Tapioca chips or tapioca flour has 10% moisture and 90% dry matter. It has got a good nutritive value with 77% NFE, 3.9% crude protein, 11% crude fibre, 0.7% ether extract, 5.6% ash, 0.58% calcium and 0.18% phosphorus.

Level of inclusion of common poultry feed ingredients

Feed ingredients	level of inclusion (%)
Maize	60
Sorghum	30-40
Bajra	10-20
Wheat	50
Rice	40
Rice bran	10-20
De-oiled rice bran	10-20
Rice polish	10-30
Wheat bran	10-15
Tapioca meal	5-15
Molasses	0-5
Maize gluten	0-10
GNC	10-30
Sunflower cake	10-20
Safflower cake	5-15
Mustard cake	0-5
Soybean meal	40
CSC (decorticated)	0-10
Coconut cake	5-10
Fish meal	5-10
Meat meal	5-10
Blood meal	3
Silkworm-pupae meal	6

Feed supplement and additives in poultry

Supplement

Supplements are nutritional substances which are added in the feeds to supply those nutrients which are deficient in ration. The items used in the ration for supply of energy and protein are generally called as feed ingredients. These ingredients may be deficient in some minerals, vitamins, and amino acids. Mineral supplements are added in synthetic forms as organic complex, such as chelated minerals. Vitamin supplements are provided in synthetic forms. Amino acids particularly the limiting amino acids are also commercially available and supplemented in synthetic forms, e.g. DL-methionine, L-lysine, etc.

Additive

Additives are non-nutritive substances added in the feed to improve feed intake, digestion, absorption, and utilization of nutrients for better growth and production performances of birds. There are various types of feed additives which are used for poultry Following are the important feed additives:

1. Antibiotic
2. Probiotic
3. Prebiotic
4. Acidifier
5. Enzyme
6. Emulsifier
7. Toxin binder
8. Antioxidant
9. Herbal growth promoter
10. Colouring pigment

Antibiotic as feed additives

The optimum performance of animal depends upon healthy and disease-free condition if the atmosphere of animal shed is not free from pathogenic organism these organisms are present in body are in sub clinical disease condition. The organisms present in GI tract consume the nutrients and produce toxin causes inflammatory reaction in intestine resulting in to thickening of intestinal mucous membrane. All these effects result in to lowered nutrient availability to the animal which is responsible for poor health growth and production of the animal. Under such condition if antibiotics are given in smaller amount for a period the multiplication of these organism stop and nutrients availability for host increase and harmful effect of toxin is reduced and intestinal mucus membrane become thin, and all these effect leads to better nutrient availability and improved health, growth and production of animal. Due to this reason the antibiotics are used as a feed additive in the ration of poultry and swine. The use of antibiotics as feed additive has a drawback also and because of that reason now days the use of antibiotics as a feed additive has been banned in USA and other countries. In India many antibiotics are banned and only few antibiotics are allowed to be use. The problem is that when the antibiotics are given at subclinical dose for a long period the microorganism develop resistance against these antibiotics and when disease occur these antibiotics cannot act effectively. The antibiotics which are generally used as a feed additive are tetracycline, oxy- tetracycline Aureomycin.

Hormones as feed additives

In the animal body the endocrine glands secrete hormones many of them are responsible for improved growth and better feed utilization. These hormones are STH or GH oestrogens and testosterone and thyroxin. About 50 years back these hormones tried as feed additive to improve the growth of poultry birds. Impact of its beneficial effect of these hormones, they have some harmful effect also in the form of its residual effect. The hormones were generally used in meat animal for better growth. The residues of these hormones are found in meat of these animals & when such meat is consumed by human population harmful effect were seen in human population, so these hormones are now a days are banded.

Probiotics as feed additives

The resistance problem in antibiotics the use is banned as feed additives and probiotics have now been used for improvement of animal health and production. As name indicate probiotics means towards life or in favour of life or with life. The idea of probiotics was initiated with the observed that the people consuming yoghurt which is type of curd regularly consumed by the people in Bulgaria and they have very long-life span. Yoghurt contain live microorganism of lactobacillus species and saccharomyces cerevisiae is the yeast have beneficial effect, so they are called perfectly feed organism. Mode of action of probiotics- these live organisms are non-pathogenic organism and are not harmful in any way for the host animal, when given in large number these organisms blocked the attachment side of pathogenic organism, so pathogens cannot multiply so the animal remain healthy. Secondly the probiotics organisms also produce certain growth producing substances which help the animal for better growth and production.

Prebiotics

Prebiotics are not organism; these are the substance which required by the probiotics organism or in other words these are the substance which promote the growth of probiotic organism for example FOS (fructan oligosaccharide) MOS (mannan oligosaccharide) these are carbohydrate in nature and used as energy source by probiotic organism.

Acidifiers

These are organic acid which are added in the poultry diet for some beneficial effect such as microcidal and microstatic compound because at low pH. many bacteria cannot grow, or they are killed at the early age of chicken when HCl production is not sufficient for protein digestion acidifiers are help to improve protein digestion. Example- Lactic Acid, Propionic acid and Acetic acid are normally used organic acid in poultry diet.

Toxin binders

In poultry feed toxin is the major problem. It reduces the growth and feed conversion efficiency reduces these toxins are generally fungus toxin, the most important fungal toxin is aflatoxin produced by *Aspergillus flavus*, when feed are stored at humid and hot condition. The maize and groundnut cake are most affected. The aflatoxin has growth depressing effect and causes tumour in liver. To protect birds from such toxin certain compound is used which have the properties to adsorbed these toxin, charcoal is very good effect on adsorption of aflatoxin.

Colouring agent

These are particularly used in poultry. Yolk colour is parameter of egg quality and colouring agent is used to make yolk bright in colour which increases the price of egg. The example of colouring agent is yolk –O-gold.

CHICKEN DIETS

The broiler and layer diets are formulated based on Nutrient Requirement of Poultry published by ICAR (2013).

Broiler Chicken Diet

Commercial broilers are generally reared under two or three phases, viz. pre-starter phase (0-7/10 days of age), starter phase (7/10 -21 days of age) and finisher phase (21-35/42 days of age), to achieve 2 to 2.5 kg market body weight. The basic purpose of phasing out is to provide nutrients as per the need depending upon the growth rate and type of growth. Feed conversion ratio (FCR) is an important parameter in broiler production and the FCR values should be in the range of 1-1.1, 1.25-1.40 and 1.4 to 1.55 at 0.5 kg, 1kg and 2 kg body weights, respectively. Concentrations of amino acids, especially of limiting amino acids are important. The first, second and third limiting amino acids in the diets based on maize- soybean meal are methionine (or methionine plus cysteine), lysine and threonine. In the coming times, poultry must look beyond maize and soybean meal because of its availability; cost and maize-soybean production cannot keep pace with the ever-increasing poultry production. So, there is a scope of alternate feed ingredients, which can be used partly to replace maize, are wheat, broken rice, pearl millet, sorghum, etc. Soybean meal is the conventional proteinic supplement in poultry diet, however, different proteinic by-products that can be used replacing soybean meal are groundnut oil meal, mustard or rapeseed meal, maize gluten meal, sunflower oil meal, etc. The meals of animal origin that were commonly used such as fish meal, meat meal, meat cum bone meal, etc. are used in negligible amount due to the availability of commercial synthetic amino acids.

Broiler starter Diets	1	2	3	4	5	6	7	8	9	1	11	12	13	14	15
INGREDIENT COMPOSITION %															
Maize	58.60	44.20	29.00	28.00	14.50	43.50	29.80	44.00	29.50	29.80	44.00	29.50	13.50	58.00	58.00
Sorghum	0.00	15.00	30.00	29.00	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bajra	0.00	0.00	0.00	0.00	0.00	15.00	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	29.54	29.50	15.00	29.50	45.00	0.00	0.00
Soyabean meal	36.40	35.00	35.00	31.00	35.20	35.00	34.50	35.00	0.00	35.00	35.00	35.00	35.00	26.50	16.50
RSM	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CSM (45%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	10.00	20.00
Fat	2.00	2.50	3.00	3.70	4.00	3.20	4.50	3.00	0.00	3.00	3.00	3.00	3.50	2.00	2.00
Fish meal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lime stone powder	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DCP	1.70	1.70	1.70	1.70	1.70	1.90	1.90	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Lys	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.28	0.20
Met	0.14	0.14	0.13	0.14	0.08	0.13	0.14	0.13	0.14	0.14	0.13	0.14	0.14	0.12	0.13
Vit+TM+coccidiosat	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition															
ME,kcal/kg	3007.00	2991.00	2982.00	3001.00	2982.00	2989.00	2993.00	3034.00	2998.00	2993.00	3034.00	2998.00	2985.00	2989.00	2989.00
CP%	22.40	21.90	22.00	22.00	22.10	22.00	22.00	21.90	22.00	22.00	21.90	22.00	22.20	22.20	22.10
Lysine	1.32	1.30	1.31	1.31	1.32	1.31	1.31	1.29	1.29	1.31	1.29	1.29	1.29	1.32	1.34
Met	0.50	0.50	0.49	0.49	0.45	0.49	0.50	0.48	0.49	0.50	0.48	0.49	0.49	0.50	0.51
Ca	0.97	0.97	0.98	0.98	0.99	0.99	0.96	0.96	0.95	0.96	0.96	0.95	0.93	0.98	0.99
Aval P	0.45	0.45	0.45	0.45	0.46	0.46	0.45	0.45	0.46	0.45	0.45	0.46	0.47	0.45	0.45

Add in addition 1). Choline chloride@50gm/100kg. 2). Vit.AB2D3EK Premix@12 gm/100kg 3). B. Complex Vit. Premix25gm/kg 4). Trace min mix@ 100gm/100kg

BROILER FINISHER DIETS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
INGREDIENT COMPOSITION %															
MAIZE	64.20	66.00	47.50	31.00	18.00	47.50	32.00	49.00	32.00	18.00	47.20	30.00	19.00	47.00	30.50
SORGHUM	0.00	0.00	16.00	31.00	46.00	0.00	0.00	0.00	0.00	0.00	15.00	31.00	43.00	0.00	0.00
WHEAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	32.00	46.00	0.00	0.00	0.00	0.00	0.00
BAJRA	0.00	0.00	0.00	0.00	0.00	16.00	31.50	0.00	0.00	0.00	0.00	0.00	0.00	16.00	32.00
SOYBEAN MEAL	30.20	25.00	30.00	26.00	29.00	29.50	29.00	30.00	30.00	29.30	21.50	22.00	21.00	20.50	19.50
RSM	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00
FISH MEAL	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CSM(44%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00
FAT/OIL	2.20	1.70	3.00	3.70	4.00	3.50	4.60	2.80	3.20	3.70	3.00	3.70	4.10	3.50	4.80
LIME STONE POWDER	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DCP	1.50	0.90	1.50	1.50	1.50	1.60	1.60	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
SALT	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
LYS	0.20	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.25	0.25	0.30	0.30
MET	0.12	0.08	0.12	0.10	0.10	0.12	0.12	0.13	0.13	0.13	0.08	0.07	0.07	0.08	0.08
VIT+TM+COCCIDIOSAT	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

BROILER FINISHER DIETS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NUTRIENT COMPOSITION															
ME,kcal	3063.00	3056.00	3054.00	3043.00	3042.00	3045.00	3041.00	3065.00	3056.00	3047.00	3050.00	3033.00	3041.00	3052.00	3034.00
CP%	20.00	20.00	20.00	20.20	19.90	19.90	20.00	20.00	20.20	20.00	20.20	20.40	20.20	20.00	19.80
Lysine	1.16	1.20	1.17	1.13	1.16	1.16	1.17	1.16	1.16	1.14	1.19	1.17	1.15	1.18	1.17
Met	0.45	0.44	0.45	0.45	0.43	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Ca	0.93	1.04	0.94	0.94	0.95	0.93	0.92	0.92	0.91	0.90	0.90	0.95	0.95	0.90	0.87
Aval P	0.40	0.41	0.40	0.42	0.41	0.40	0.40	0.42	0.42	0.43	0.43	0.42	0.42	0.40	0.38

Add in addition 1). Choline chloride@50gm/100kg. 2). Vit.AB2D3EK Premix@12 gm/100kg 3). B. Complex Vit. Premix25gm/kg 4). Trace min mix@ 100gm/100

Broiler Starter Concentrate Diet	10%	15%	30%	35%	40%	50%
Ingredient Composition %						
maize	28.50	4.50	9.25	5.70	3.50	21.40
soybean meal	39.00	72.00	80.00	85.00	89.00	72.00
Ls	12.00	7.50	4.00	3.50	2.80	2.50
DCP	15.00	10.00	5.00	4.20	3.70	3.00
Salt	3.00	2.00	1.00	0.90	0.70	0.60
Lysine	1.50	1.28	0.35	0.40	0.30	0.28
Methionine	1.10	0.80	0.40	0.30	0.30	0.25
Vit+Tm	2.50	1.65	0.83	0.73	0.60	0.50
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition						
ME	1906.00	1908.00	2262.00	2265.00	2289.00	2474.00
CP	22.80	34.90	37.60	39.50	41.00	34.90
Lysine	2.72	3.36	2.69	2.87	2.88	2.43
Methionine	1.44	1.33	1.00	0.92	0.95	0.82
Ca	8.19	5.40	2.95	2.59	2.21	1.19
Aval P	2.71	1.92	1.10	0.97	0.89	0.16
End user - Final diet preparation using concentrate.						
Concentrate	10.00	15.00	30.00	35.00	40.00	50.00
Maize	58.00	60.00	57.00	57.80	58.00	48.00
Soybean Meal	30.00	23.00	11.00	5.20	0.00	0.00
Oil	2.00	2.00	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition						
Me	3034.00	3028.00	3032.00	3034.00	3039.00	3025.00
Cp	22.20	22.00	22.00	21.80	21.90	22.00
Ca	0.98	0.96	1.01	1.01	0.98	1.04
Aval P	0.46	0.46	0.46	0.45	0.46	0.46
Lysine	1.35	1.38	1.32	1.36	1.35	1.38
Methionine	0.49	0.50	0.51	0.49	0.51	0.51

Layer Chicken Diet

Layer chickens are generally reared in three phases viz. starter (0-8 weeks of age), grower (8-20 weeks of age) and layer (20 weeks or above). For meeting the nutrient requirement, particularly that of calcium at onset of lay, pre-lay phase (17/18 – 20 weeks) is recommended. The laying phase is often divided into phase I (20-30 weeks) and phase II (30-45 weeks) and phase III (> 45 weeks). Nutrition and feeding in early part of life influence subsequent laying performance. Modern layers attain sexual maturity (point of lay) at little earlier age (16 week) as a result the birds produce 310-325 eggs per year. The critical nutrients required for optimum laying performance are energy and protein (amino acids). The energy concentration ranges from 2600 to 2850 kcal/kg during starting, 2500-2900 kcal per kg during growing and 2500 to 2800kcal/kg diet during laying phases. Similarly, the requirements of protein for the corresponding phases are 18-20%, 15 to 16% and 15 to 18%. Birds can satisfy energy intake by adjusting their daily feed intake (100-110 g/d/b); however, they are unable to meet their amino acid needs by adjusting feed intake

Layer Chick Diet (0-8 week of age)										
Ingredient Composition %	1	2	3	4	5	6	7	8	9	10
Maize	58	45	31	21	46.5	34	46	30	19	20
Sorghum	0	15	31	47	0	0	15	31	43	17
Wheat	0	0	0	0	0	0	0	0	0	17
Bajra	0	0	0	0	16	31.5	0	0	0	17
Soybean meal	22	22	18	22	22	22	12	12	12	12
Rice bran	17	15	12	7	12	9	14	14	13	4
RSM	0	0	5	0	0	0	5	5	5	5
Fish meal	0	0	0	0	0	0	0	0	0	0
CSM(44%CP)	0	0	0	0	0	0	5	5	5	5
Fat	0	0	0	0	0	0	0	0	0	0
Ls	1	1	1	1	1	1	1	1	1	1
DCP	1.5	1.5	1.5	1.5	1.6	1.7	1.5	1.5	1.5	1.5
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Lys	0	0	0.02	0	0	0	0.1	0.1	0.1	0.1
Met	0.06	0.06	0.05	0.05	0.05	0.05	0.01	0.01	0.01	0.01
Vit+TM+coccidiostat	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100
Nutrient Composition %										
ME,kcal/kg	2811	2793	2776	2805	2774	2729	2807	2759	2736	2800
CP	17.8	17.8	17.9	17.7	17.8	18	17.4	17.6	17.7	17.5
Lysine	0.82	0.82	0.8	0.81	0.84	0.83	0.81	0.82	0.82	0.8
Met	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Ca	0.93	0.94	0.94	0.95	0.92	0.92	0.93	0.94	0.95	0.89
Aval,P	0.42	0.42	0.43	0.42	0.41	0.41	0.43	0.44	0.44	0.41

Add in addition 1). Choline chloride@50gm/100kg. 2). Vit.AB2D3EK Premix@12 gm/100kg 3). B. Complex Vit. Premix25gm/kg 4). Trace min mix@ 100gm/100

Layer Grower Diet (8-20week of age)										
Ingredient Composition %	1	2	3	4	5	6	7	8	9	10
maize	47.00	35.00	26.00	16.00	38.00	30.00	35.00	26.00	14.00	14.00
Sorghum	0.00	16.00	27.00	40.00	0.00	0.00	15.00	26.00	40.00	14.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00
Bajra	0.00	0.00	0.00	0.00	15.00	30.00	0.00	0.00	0.00	14.00
Soybean meal	15.00	16.00	11.00	15.00	15.00	15.00	6.00	6.00	5.00	5.00
Rice bran	35.00	30.00	28.00	26.00	29.00	22.00	31.00	29.00	28.00	26.00
RSM	0.00	0.00	5.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00
Fish meal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CSM(44%CP)	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00
Fat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ls	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.20
DCP	1.30	1.30	1.30	1.30	1.40	1.60	1.30	1.30	1..3	1.30
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Lys	0.00	0.00	0.07	0.00	0.00	0.00	0.10	0.10	0.10	0.10
Met	0.06	0.06	0.05	0.05	0.05	0.05	0.01	0.01	0.01	0.01
Vit+TM+coccidiostat	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition %										
ME,kcal/kg	2635.00	2645.00	2639.00	2636.00	2633.00	2645.00	2634.00	2628.00	2609.00	2602.00
CP	16.10	16.40	16.10	16.00	16.10	16.00	16.10	16.10	15.80	15.90
Lysine	0.71	0.73	0.73	0.70	0.71	0.70	0.72	0.72	0.70	0.70
Met	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32
Ca	0.92	0.92	0.92	0.93	0.91	0.93	0.92	0.93	0.93	0.92
Aval,P	0.41	0.41	0.42	0.40	0.40	0.41	0.42	0.42	0.42	0.42

Add in addition 1). Choline chloride@50gm/100kg. 2). Vit.AB2D3EK Premix@12 gm/100kg 3). B. Complex Vit. Premix25gm/kg 4). Trace min mix@ 100gm/100

Layer Diets >20 weeks of Age										
Ingredient Composition %	1	2	3	4	5	6	7	8	9	10
Maize	59.00	33.00	42.50	45.00	33.00	42.50	45.00	59.00	32.00	42.50
Sorghum	0.00	33.00	21.00	0.00	33.00	21.00	0.00	0.00	32.00	22.00
Bajra	0.00	0.00	0.00	22.50	0.00	0.00	22.50	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Soybean meal	22.50	22.50	22.50	22.50	22.50	22.50	22.50	17.00	16.00	16.00
DORB	9.00	2.00	4.50	0.00	2.00	4.50	0.00	4.00	0.00	0.00
RSM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00
SSM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00
Fat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fish Meal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ls	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
DCP	1.20	1.20	1.20	1.40	1.20	1.20	1.40	1.20	1.20	1.20
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lys	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Met	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.01
Vit+TM+coccidiostat	0.25	0.50	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition %										
ME,kcal/kg	2679.00	2688.00	2685.00	2678.00	2688.00	2685.00	2678.00	2677.00	2652.00	2699.00
CP	17.00	17.00	17.00	16.90	17.00	17.00	16.95	17.10	16.80	15.80
Lysine	0.79	0.78	0.79	0.79	0.78	0.79	0.79	0.77	0.75	0.36
Met	0.34	0.35	0.34	0.34	0.35	0.34	0.34	0.34	0.34	0.36
Ca	3.51	3.52	3.52	3.51	3.52	3.52	3.51	3.51	3.50	0.36
Aval,P	0.35	0.34	0.35	0.34	0.34	0.35	0.34	0.36	0.36	0.36

Add in addition 1). Choline chloride@50gm/100kg. 2). Vit.AB2D3EK Premix@12 gm/100kg 3). B. Complex Vit. Premix25gm/kg 4). Trace min mix@ 100gm/100kg

Layer concentrate Diet	25%	20%	20%	25%	35%	35%	30%
Ingredient Composition%							
Maize	7.00	9.00	11.00	9.00	40.00	25.00	21.00
Soybean Meal	75.00	44.00	51.00	44.00	35.00	25.00	50.00
DORB	0.00	28.00	31.00	28.00	20.45	20.45	15.00
Ls	13.00	12.00	0.00	12.00	0.00	25.00	8.00
DCP	3.00	5.00	5.00	5.00	3.00	3.00	4.00
Salt	1.00	0.80	0.80	0.80	0.80	0.80	0.90
Lysine	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methionine	0.29	0.06	0.05	0.06	0.05	0.05	0.10
Vit+TM	1.00	1.25	1.25	1.25	0.73	0.73	0.83
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition							
ME kal/kg	2065.00	1935.00	2233.00	1935.00	2603.00	1857.00	2224.00
CP	34.70	24.40	28.00	24.30	22.10	16.30	26.50
Lysine	2.18	1.40	1.65	1.43	1.24	0.90	1.58
Methionine	0.85	0.40	0.51	0.46	0.43	0.33	0.54
Ca	5.43	5.51	1.40	5.51	0.91	9.48	3.91
Aval,P	0.68	1.06	1.10	1.06	0.74	0.68	0.87
Concentrate	25.00	20.00	20.00	25.00	35.00	35.00	30.00
Maize	47.00	60.00	59.00	57.00	47.00	50.00	55.00
Soybean meal	0.00	14.00	13.00	12.00	9.50	15.00	9.00
DORB	22.50	0.00	0.00	0.00	0.00	0.00	0.00
Lime stone	5.50	6.00	8.00	6.00	8.50	0.00	6.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition							
ME kal/kg	2541.00	2433.00	2735.00	2681.00	2714.00	2685.00	2726.00
CP	16.10	17.10	17.30	17.10	16.60	17.50	17.30
Ca	3.54	3.48	3.40	3.74	3.60	3.44	3.53
Aval,P	0.38	0.35	0.36	0.40	0.37	0.37	0.38
Lysine	0.87	0.98	0.91	0.90	0.80	0.93	0.93
Methione	0.36	0.34	0.34	0.34	0.33	0.35	0.35

Source: www.nianp.res.in , WWW.poultry producer.com, www.ndvsu.org

SWINE FEEDING

Feed plays a very important role in successful pig production. Feed alone represents about 70-75 percent of the total cost of producing hogs. The productivity and reproductivity of pig farm depend on the quality as well as quantity of feed supplied to the pigs. The quality of the carcass produced for the market determines the profitability of the pig farm. In scientific rearing, a balanced ration contains carbohydrates, proteins, fat, minerals, and vitamins with sufficient cleaned water.

FEEDING SYSTEMS

Pigs are reared under 3 systems.

1. **Scavenging system of production**: Major population comprises indigenous pigs which are reared under free range scavenging system with little or no input.
2. **Semi scavenging system of production**: Indigenous and crossbred pigs are also reared under semi-intensive system where in they are allowed to scavenge whole day and are supplemented with household kitchen or hotel waste, rice bran, wheat bran, and broken wheat *(Dalia)*, press mud etc.
3. **Intensive system of production**: Pigs of exotic breeds, elite cross breeds and small breeds are reared with concentrate feeds, kitchen and hotel waste, cereal by products, vegetable wastes, root crops like boiled sweet potatoes, rhizomes etc.

TYPES OF RATIONS

There are four types of rations for pig.

a). Creep ration.

b). Starter ration.

c). Grower ration.

d). Finisher ration

RATION	TO BE FED TO
Creep Ration	Introduced at 7-10 days of age up to 21 days
Starter Ration	From 22 day to 60 days
Grower Ration	From 2 months to 5 months of age
Finisher Ration	After 5 months to 8 months of age

Quantitative Feed requirement:

Age (Months)	Approximate weight (Kg)	Amount of feed per pig per day (Kg)
1-2	12.00	0.50
2-3	18.00	1.00
3-4	26.00	1.25
4-5	36.00	1.50
5-6	48.00	2.00

Water requirement of pig:

Age/ type of pig	Water requirement per day (Liters)
8-12 weeks	3.5
13-18 weeks	6.00
19-24 weeks	7.50
25 weeks and above	8.00
Pregnant gilts (3 months prior farrowing)	16-20
Lactating/ nursing sows	20-25
Boars	20-25

NUTRIENT REQUIREMENTS IN SWINE

General guidelines

Swine / Pigs require many nutrients for their maintenance, growth, and production.

1. **Carbohydrates**

- Pigs can utilize crude fibre to a lower extent.
- The utilization of fibre by the pigs depends on age and weight of pigs and characteristic of non-fibrous portion of the ration.
- For growing and finishing pigs 5-6% crude fibre level in their diet is recommended.
- In sows, 10-12% level of CF in diet can be well tolerated.

2. **Fat**

- When high fat diets are fed to pigs there is deposition of excessive fat inside the body.
- If this feed fat contains higher concentration of short chained fatty acids (ex. Soybean and groundnut) there is a production of soft pork which is not desirable.
- Pigs fed on rations containing 0.5% fat, make a satisfactory gain and stores normal amount of body fat.
- However, the practical level of fat inclusion is higher than this i.e. about 4%.

3. **Protein**

- In Swine/Pig feeding it is important to provide good quality protein in the ration.
- All essential amino acids should be present in right quantity and proper balance.
- Even if one essential amino acid is lacking or is in excess it will cause marked reduction in the feed intake which will affect the growth and production.
- A combination of animal and vegetable protein in pigs diet will provide all essential amino acids in proper proportion.

4. **Mineral**

- In practical swine ration it is routine practice to add 0.5-1% limestone and 0.5% di-calcium phosphate/bone meal.
- As per the NRC 0.5% common salt is recommended in rations of all classes and ages of pigs.
- Iodine need of pig is 0.2 mg/kg diet which should be supplied in the form of iodised salt.
- Requirement of copper is 6mg/kg diet.
- Requirement for Manganese is 10mg/kg diet.
- Requirement for zinc is 50mg/kg diet.

5. Vitamins

- Vitamin K is synthesized in the intestine of the pigs by microorganisms in adequate amount and hence has no practical importance.
- Deficiency of B-complex may occur under practical conditions in pigs raised on feeds like cereal grains without much inclusion of green forage.
- Liberal supply of good quality legume fodder hay, dairy products will take care of vitamins of B-series.
- Vitamin C is synthesized in the body and hence not of practical importance.

FEEDING VARIOUS CATEGORIES OF PIGS

1. Feeding of Pregnant Sows:

- During pregnancy restricted feeding (2-3Kg) is to be practiced preventing excessive fat deposition.
- A daily gain of 250-300 g in pregnant sows throughout the gestation period is satisfactory.
- Three or four days before farrowing, the ration should be made more laxative by addition of more wheat bran.
- Meeting the nutritional requirement during the gestation period is very important as deficiency of nutrients as Calcium, Phosphorus and Vitamin A may have bad effect on foetal development.

2. Feeding of Lactating/ nursing Sows:

- The requirements of the lactating sow are greater than those during gestation period.
- Daily 2 to 3 Kg ration for maintenance coupled with additional 200 to 500g of ration for each sucking piglet is to be given to the sow till weaning of the piglets.

3. Feeding of Boars:

- Breeding boars should be kept in a thrifty condition.
- Protein in boar ration should be about 16 percent.
- Boar should not be too fat as it weakens leg and breeding ability.
- Boar should be given regular exercise to keep in good health.

RATION FORMULATION

1. **Fix/ leave slack space:** 2 kg for nutritive (mineral mixture, salt) and non-nutritive feed additives, added at later stage while balancing the ration.
2. **Fix level of cereal by-products i.e. DORB**: 07 kg, 20 kg and 25 kg for pig starter, pig growth meal and pig finisher feeds, respectively.
3. **Fix level of animal protein source i.e. Fish meal:** 10 kg, 7 kg and 5 kg for Pig starter, Grower, and Finisher meals, respectively.
4. **Calculate proportion of Energy feed and Vegetable protein through Pearson square method**
5. **Balance ME content:** First calculate ME supply from above ingredients (already worked out from above steps), if there is shortage it can be meet out by addition of animal fat, vegetable oil or maize grain depending on the cost availability.

6. **Balance Available phosphorus:** Available P is considered as 30 % of the total P content present in vegetable sources i.e. grains, grain byproducts, oil seed cake/meal. Total P present in animal sources and inorganic mineral supplements is considered as 100 % available P. Calculate available P supply from the above feed ingredients, total it. If there is shortage can be meet out by addition of desired quantity of DCP (Di calcium phosphate).
7. Balance Calcium Content: First calculate Ca supply through above feed ingredients and DCP and total it. If there is any shortage it can be meet out by addition of desired quantity of limestone powder/other calcium supplement
8. **Check Crude fiber level:** calculate CF contributed by different feed ingredients, total it and compare with recommended Max. CF levels given in the feeing standard, it should not be higher than that level. This can be maintained by using good quality DORB (CF, Max. 12 %) and GNC (CF, Max. 11 %), or even then if, CF level is slightly higher, supplementation of fiber digesting enzyme preparations may be recommended.
9. Finally total, quantities of feed ingredients and each nutrient, it should match with the recommended nutrient levels given in the feeding standards.
10. Vit AB2D3 and B-complex are necessarily added @ 25 g/100 kg each.

Requirements of Pig Feeds [IS 7472: 1986(Clause 3.3)] BIS 1986

Nutrients	Pig starter/ Creep feed	Pig growth meal	Pig finishing/ Breeding meal
CP (%)	20 (17.80)	18 (16.00)	16 (14.20)
ME (Kcal/kg)	3360 (2990)	3170 (2821)	3170 (2821)
Ca (%)	0.6 (0.53)	0.6 (0.53)	0.6 (0.53)
Available P (%)	0.6 (0.53)	0.4 (0.36)	0.5 (0.45)
CF (%)	5.0 (4.45)	6.0 (5.34)	8.0 (7.12)

Note: All values are based on moisture free basis (100 % DMB), while values in Parenthesis are converted to 89 % DMB (as fed basis)

Chemical composition of feed ingredients

Feed ingredient/ supplement	DM (%)	CP (%)	EE (%)	CF (%)	ME (Kcal/kg)	Ca (%)	P (%)
Maize	89	9.0	3.8	2.20	3340	0.02	0.28
GNC (Expeller)	90	40	7.3	13.0	2600	0.16	0.56
DORB	91	13.5	0.6	12.0-14.0	2200	0.07	1.50
Fish meal	91	42	5.0	1.00	2400	3.73	2.43

Problem 1: Formulate 100 kg pig starter ration as per BIS (1986) using Maize, DORB, GNC (expeller), Fish meal, Mineral mixture, Salt, Vit. AB2D3 and B-complex

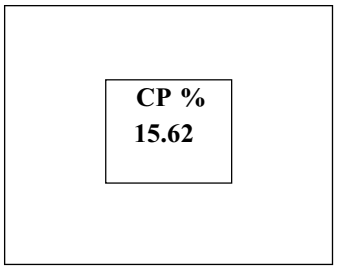
Step 1: leave slack space**:**	**02 kg**
Step 2: Fix level of cereal by-products i.e. DORB	**07 kg**
Step 3: Fix level of fish meal	**10 kg**
Total Quantity fixed	**19 kg**

Now calculate CP supply from above quantity	**CP (kg)**
Slack space 02 kg ……	**0.00**
Fish meal 10 kg =	**4.20**
DORB 07 kg –	**0.95**
	5.15

CP required to be supplemented through 81 kg [(100 (qty. to be prepared) - 19 kg (qty. already fixed)] is 12.65 kg [17.8 (required CP) – 5.15 kg (CP supplied by qty. of ingredients fixed)] Therefore, CP desired in percentage will be 12.65/81x100 = 15.62 %.

Step 4: Calculate proportion of Energy feed and Vegetable protein through Pearson square method

Maize :CP 9 % 24.38



GNC: CP 40% 6.62

Total 31.00

Ingredients	Qty (kg)	CP (%)	ME (Kcal/kg)	Av. (P %)	Ca (%)	CF (%)
NR, Pig starter (BIS 1986)	-	**17.80**	**2990**	**0.530**	**0.530**	**4.45**
DORB (CF 12 %)	07.00	0.95	154	0.105	0.005	0.84
Fish meal	10.00	4.20	240	0.243	0.373	0.10
Maize	63.70	5.73	2178	0.178	0.013	1.40
GNC (expeller)	17.30	6.92	450	0.097	0.028	2.25
Av.P. and Ca through. ingredients	--	--	--	0.357	0.420	--
MM + salt + other additives	02.00	**--**	**--**	MM *	MM*	--
Total	**100.0**	**17.80**	3022	Fulfilled	Fulfilled	4.59

Proportion of maize in the remaining quantity (81 kg) = 24.38/31x81 = 63.70 kg

Proportion of GNC in the remaining quantity (81 kg) = 06.62/31x81 = 17.30 kg

Note:1. Available P = 0.105+0.178+0.097= 0.380 x 0.3 = 0.114 (30 % of 0.380) + 0.243 = 0.357

2. MM* (mineral mixture normally contains Ca 20-22 % and P, 9-12 %, in addition to this it also contains essential trace minerals, therefore addition of 2 % will take care of Ca & Av. P and TM); Vit. AB2D3 and B- complex are added @ 25 g/100 kg.

Note: Similarly, by following above steps, you can formulate rations for Growing and Finisher pigs. Results are given below: -

Ingredients	Qty (kg)	CP (%)	ME (Kcal/kg)	Av. (P %)	Ca (%)	CF (%)
NR, Pig grower (BIS 1986)	-	**16.00**	2831	**0.360**	**0.530**	**5.34**
DORB (CF 12 %)	20.00	02.70	440	0.300	0.014	2.40
Fish meal	07.00	02.94	168	0.170	0.261	0.07
Maize	58.29	05.25	1947	0.163	0.015	1.28
GNC (expeller)	12.71	05.08	330	0.071	0.020	1.65
Av. P & Ca thr. ingredients	--	--	--	0.330	**0.310**	--
MM + salt + other	02.00	--	--	MM *	MM*	--
additives						
Total	**100.0**	**15.97**	2885	Fulfilled	Fulfilled	**5.40**

Note 1: Available P = 0.300+0.163+0.071= 0.534 x 0.3 = 0.160 (30 % of 0.534) + 0.170 = 0.330

2. MM* (mineral mixture normally contains Ca 20-22 % and P, 9-12 %, in addition to this it also contains essential trace minerals, therefore addition of 2 % will take care of Ca & Av. P and TM); Vit. AB2D3 and B- complex are added @ 25 g/100 kg.

Ingredients	Qty (kg)	CP (%)	ME (Kcal/kg)	Av. P (%)	Ca (%)	CF (%)
NR, Pig finisher (BIS 1986)	-	**14.20**	2821	**0.450**	**0.530**	**7.12**
DORB (CF 12 %)	25.00	03.38	550	0.375	0.018	3.00
Fish meal	05.00	02.10	120	0.122	0.187	0.05
Maize	59.50	05.36	1987	0.167	0.012	1.31
GNC (expeller)	08.50	03.40	221	0.048	0.014	1.44
Av. P & Ca thr ough. ingredients	--	--	--	**0.299**	**0.231**	--
MM + salt + other additives	02.00	**--**	**--**	MM *	MM*	--
Total	**100.0**	**14.24**	2878	Fulfilled	Fulfilled	**5.80**

Note 1: Available P = 0.375+0.167+0.048= 0.590 x 0.3 = 0.177 (30 % of 0.590) + 0.122 = 0.299

2. MM* (mineral mixture normally contains Ca 20-22 % and P, 9-12 %, in addition to this it also contains essential trace minerals, therefore addition of 2 % will take care of Ca & Av. P and TM); Vit. AB2D3 and B- complex are added @ 25 g/100 kg.

Replacement of some of the feed ingredients can be made as follows:

I. Maize - can be replaced by broken rice, wheat, sorghum, and barley.
II. GNC - can be replaced by Linseed cake, Sesame cake, Soyabean cake.
III. Fish meal – can be replaced by Skim milk powder.
IV. For feeding young piglets skimmed milk, butter milk, dried whey, cheese may be fed.

- Similarly, slaughterhouse and meat processing plants by products can be easily used to form cheap and highly nutritive feed for pigs.
- Poultry dressing plants or hatcheries waste materials also can be fed.
- Fish meal, fish residue meal which is the main source of high-quality protein, Ca and P. it can be used up to 5% of the ration.
- Brewery waste can be included up to 15% and rice bran up to 75% of the ration.

FLUSHING

- After weaning, the sow should be flushed, i.e. put on a more nutritious ration so that they may gain weight from 0.5 to 0.7 Kg daily and then mated during the next heat period.
- This can be practiced by feeding extra allowance of grains of about 0.5- 0.7 Kg per day before breeding. It is needed to increase energy level in the diet for increasing ovulation rate in gilts and sows (ovulation rate is related to the chances of getting more piglet in next farrowing).

GARBAGE FEEDING:

- It is cost effective way of feeding vegetable market waste, hotel waste and kitchen waste can reduce cost of feeding. Green pastures can also be used as a fodder.
- Care to be taken while feeding Garbage: meat pieces should not be fed because they can spread diseases and may block the throat. Fermented waste and stored food should not be fed because they may cause salmonellosis which might cause deaths. Cooked garbage is preferred which prevent many diseases and reduce cost of feeding.

References:

1. www.veterinaryassam.govt.in
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CULTIVATION OF FODDER CROPS

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CULTIVATION PRACTICES OF NON-LEGUMINOUS PERENNIAL FODDER CROPS

NAPIER BAJRA HYBRID

Napier or Elephant grass (*Pennisetum purpureum*) is native to tropical Africa. It is widely grown in tropical and sub-tropical areas, from sea level to 2000 m above mean sea level (AMSL). The grass is valued for its high herbage yield, competitive vigour and persistence, palatability and good herbage quality. It grows best at high temperatures. **Yields are reduced with low air temperature and plants cease to grow at below 10^{0}C**. It normally grows in areas with annual rainfall of over 1000 mm, but is also seen in semi–arid areas. It can withstand drought and easily recovers with onset of rain.

It's production is higher on fertile soil but can grow on almost any soil. It cannot tolerate flooding or water logging but can grow reasonably well on drained soils.

Hybrid Napier is developed by crossing napier grass with bajra (pearl millet or can dlemillet).

A number of varieties are evolved. NB-21 is the earliest and popular variety. Others of recent origin include Co-1, 2, 3, 4, 5 & 6, IGFRI-3, **APBN-1**, 2 (released by APAU) and Super Napier (*Packchong*1) etc.

Land is thoroughly ploughed and leveled. Then it is laid into ridges and furrows with a spacing of 50 cm. Planting can also be done on spacing of 50 cm.

Being a sterile hybrid, it is propagated by stem cuttings or rooted slips. Planting can be done at any time if irrigation is available except during winter months, but it is best done in February. June-July planting is preferred for rainfed conditions.

Stem cutting should have two nodes. Cuttings are made from moderately mature stems. Cuttings are placed into the soil at angle of 45^0 so that one node is pushed into the soil and one remains above the soil surface. The basal end should be placed down. Rooted slips are prepared from uprooting a clump, dividing it into slips with few roots and small stem portion. While planting, the root potion is placed in the loose soil and soil is compacted. It is followed by irrigation. The spacing for pure crop of Hybrid Napier is 50 x 50 cm. A spacing of 100 x 50 cm is practiced when it is inter cropped with other crops, particularly hedge lucerne. This crop needs adequate irrigations. Irrigation interval can be 15-20 days during winter and 8-10 days during summer.

The field should be kept weed free till establishment of the crop. Once the canopy is well developed, it can suppress the weeds very well. Inter cultivation can be done in this crop.

The first **cut is taken 60-75** days after planting and subsequent cuts at 45-50 days interval. Totally 5-7 cuts can be taken in one year.

The average yield of green fodder is 150-250t/ha/yr with crude protein content of 8 - 9 %. NB Hybrid **contains good amount of oxalates** and continuous sole feeding may lead to nutritional disorders. However, this problem is never felt under normal existing feeding conditions.

Inter culture twice a year helps to maintain good growth and yields. The field may be replanted with the grass after 3-4 years. When the clump becomes too large, a technique called as quartering can be practiced to reduce the size of the clump which aid sin maintaining the green

fodder fields. Quartering is a practice in which tillers in ¾ area of the clump are dug carefully and removed leaving tillers in 1/4 area of the clump intact.

Large and vigorous legumes capable of withstanding the competition from NB Hybrid are normally used for inter cropping. Hedge Lucerne (*Desmanthesvirgatus*) can be used for inter cropping in1:1 ratio. Otherwise, inter cropping with cowpea can be done after each cut by dibbling the seed in the inter spaces.

Hybrid Napier is always fed in the green form or conserved as silage. It is not converted into hay because it looses the palatability. Chaffing is necessary to utilize the green fodder more efficiently.



PARAGRASS

It is a perennial with prostrate shoots freely rooting at nodes forming dense cover. It is suitable for cultivation in humid areas. It is grown in seasonally flooded valleys and lowlands and can withstand water logging and long term flooding. It cannot be grown on dry lands, in arid or semi-arid areas. It is sensitive to cold and makes little or no growth during winter months in sub-tropical regions of India.

Water-logged soils are best suited for this crop. It can be grown on sandy soils also, provided water supply is sufficient.

Seed setting is very poor in this grass. It is propagated **exclusively by stem cuttings.**

It can be planted at any time in South India, but June-July planting is best under rain fed conditions and February under irrigated conditions. There are no improved varieties of this grass. The field is well prepared by puddling (ploughing with standing water) and leveled. The shoots are used as planting material. Stems with 2-3 nodes are planted in 45-60 cm rows at 20 cm spacing. The stems are pressed into wet soil leaving the two ends sticking up.8-10 quintals of stem cuttings are needed for planting one hectare.

Initially the plant sends surface runners that root at the nodes. Erect shoots are produced only after the field is completely covered by the runners.

Liberal manuring is necessary for high yields. Sewage water or cattle shed washings are ideal for this crop. Or else, apply 20-25t/ha of FYM every year. 25-30kg N/ ha is applied after each cut.

Once in a year, apply 60 kg P_2O_5/ha for better and sustained growth. The crop needs liberal irrigations at fairly close intervals. The land should always be kept moist. Weed control is not important because of the high competitive vigour of the crop. During establishment one or two hand weedings may be given. The first cut is taken 75-80 days after planting and the subsequent cuts at 40-45 days interval. Totally 6-9 cuts can be taken in a year with an average green fodder yield of 80-100 t/ha. The grass is fed in the green form. It is not suitable for conservation either as hay or as silage. While feeding in green form, the mature culms are often rejected. So, chaffing is needed for mature grass. The grass contains lot of moisture (more than 85%) and is highly palatable, but it is low in the nutritive value with 6-8% crude protein. Though some inter cropping systems with legumes are suggested, it is widely grown as pure crop.



GUINEA GRASS

Distributed in South and Central America, West Indies, South East Asia. Introduced in India in 1793 and is the oldest among the grasses introduced in India. It is a tall, densely tufted perennial with numerous shoots arising from short rhizomes. A fully grown plant attains a height of 1.8 to 2.7 m under favourable conditions. Leaf blades are about 60 cm long and 2.5-3.8 cm broad and light green in color. The in florescence is an open panicle, about 30 cm long and 10-13 cm across. Very popular grass and widely grown in many parts of India. Thrives well in warm, moist climate. Thrives well on fertile, well drained, medium loam soils. Cannot be grown in waterlogged conditions. Land is prepared by 2-3 ploughings followed by3-4 harrowings.



Varieties

Queens land common – Bunchy type growing to150 cm height with finer leaves, stem nodes are hairy.

Makueni - Drought resistant, grows to a height of 1m

Gattonpanic - Resistant to nematode attacks.

Hamil - Tall variety (3-3.5m) of guinea grass. It is robust, smooth with dark foliage.

Coloniao Guniea - Hairless, has thick flashy stems, hence very palatable. Equally taller that of hamil.

Sabi - Possess bluish leaves, grows to a height of 1.5 m and drought resistant.

The whole clump is dug up with the roots to a depth of one foot and divided into several parts. The small slips are then used for planting usually after topping the foliage. The slips are planted 90-122 cm apart between rows and between plants. The slip rate 12,350 per hectare.

FYM of 168-224 kg/ha and 40:20:12 kg of NPK/ha should be applied in February and again in June - July. Liberal irrigation should be given immediately after planting. Irrigation interval is 10 – 15days.

Weeding should be done once or twice during the period of establishment. First cut can be taken at 6-8 wks after planting. Fodder is palatable when the grass is 60-90 cm tall. Preferable to cut before flowering. Green fodder yield is 100t/hain 5-6cuttings in a year.

It can be grown as an inter crop in orchards and other tree plantations as it can thrive in shade.

Cultivation practice	**Hybrid bajra Napier**	**Paragrass**	**Anjangrass**	**Guinea grass**	**Rhodes grass**
Varieties	APBN-1, CO-1, CO-4, CO-5, CO-6 Phulejayanth, BNH-10	--	IGFRI-3813	Hamili, Makuni, DGG-1	
Soils	All types of soils	Water stagnated soils, black soils	Well drain soils, light and black soils ,grass lands and waste lands	Well drain soils, light and black soils	Well drain soils, light and black soils
Sowing time	Kharif : June-Aug, Summer: Jan-feb	Kharif : June-Aug, Summer: Jan-feb	June -July.	Rainy season	June- july
Seed rate kg/ac	32000 two node stem cuttings or root slips per acre	20000 rooted slips	3-4kg seed for broad casting	2-2.5 kg seed for broad casting	1.5 to 2kg seed

Cultivation practice	Hybrid bajra Napier	Paragrass	Anjangrass	Guinea grass	Rhodes grass
Spacing	60 X 60 cm	50 X 50 cm	50 X 50 cm	50 X 50 cm	50 cm
Recommended dose of fertilizers(NP K kg per acre)	FYM 10 tones 20:20:12 NPK Apply 20kg nitrogen after every cut	FYM 5-10 tones Apply 20kg nitrogen after every cut	FYM 5-10 tones Apply 20kg nitrogen after every cut	FYM 5-10 tones Apply 20kg nitrogen after every cut	FYM 5-10 tones Apply 20kg nitrogen after every cut , gypsum in saline soils
Harvesting time	1st cut 70-90 days after sowing subsequent cuts 45 DAS	1st cut 70 days after sowing subsequent cuts 40 DAS	1st cut 80-90 days after sowing subsequent cuts 45 DAS	1st cut 70-50 days after sowing subsequent cuts 40 DAS	1st cut 60 days after sowing subsequent cuts 40 DAS
Green fodder yield tonnes/ acre	Total 6-8 cuts per acre per year, 120 – 150 tonnes per acre	Total 10-12 cuts per acre per year 60 – 80tonnes per acre	16 tonnes in 4-6 cuts per year per acre	80-100tonnes	6-8 tonnes
Other information	Susceptible to Cold (exept super napier) Due to present of oxalates it should be mixed with other grass *Crude protein content:8-10 %	*Crude protein content:3-5%	Drought resistance Suitable for wasteland and grass lands (life span 10-15years) Crude protein content:5-6%	Comes well in shade (inter crop in orchards) condition, Crude protein 6-8%	Suitable in saline soils

CULTIVATION PRACTICES OF NON - LEGUMINOUS ANNUAL FODDER

MAIZE OR CORN

Maize is not found in wild state. Origin appears to be Mexico. For long time it is exclusively grown for grain but in the last 90-100 years it is also grown for forage. Grain is an important ingredient for poultry feed. Mostly dent types (angular grain concave on the top) are grown for forage. The male inflorescence is called TASSEL and female as COB. It required 600-900 mm rainfall in the growing season. It is grown on a variety of soils, but well drained fertile soils are best suited.

Maize is mostly grown as *Kharif* crop i.e., sowing in June-July. In South India it makes best growth in *Rabi* and also in Summer. It can be grown through out the year.

Varieties

All varieties (composites, synthetics and hybrids) developed for grain production can also be used for fodder production. Usually tall varieties are preferred for fodder.

African tall, J-1006, Vijaya composite, Ganga-5, are some important fodder varieties. APFM -8,12 and22 are developed at ANGRAU.

Thorough land preparation is required. Land can be made into flat beds or ridges and furrows Seed rate and spacing for fodder crop are 50-60 kg/ha & 30 x 10 cm. In case if it is grown for grain, seed rate and spacing for grain cropare15 kg/ha & 60 x 20 cm.

Maize is usually dibbled in rows behind the plough to a depth of 5cm. If the field is already laid into ridges and furrows at a spacing of 60 cm, seeds are manually dibbled at a spacing of 10 cm on either side of the ridge.

Maize responds very well to fertilizer nitrogen. Fertilizer dose can be 120:60:40 of NPK (kg/ha). K is applied for balancing the crop nutrition. N is applied in two equal splits i.e., half as basal (before sowing) and half at knee high stage(35 days after sowing).

Maize is sensitive to stagnant (water logged) conditions in the initial stages and sensitive to moisture stress from knee high stage onwards. Hence, the crop should be free from water logging in the seedling stage and later should be given adequate irrigations. During *rabi* and summer, irrigations can be given at7-10 days interval. Maize responds very well to irrigation.

The fields should be kept weed free at least up to knee high stage. Two inter cultivations coupled with hand weeding at 20 and 40 days after sowing will be effective. Chemically weeds can be controlled by pre emergence application of atrazine@1.0kga.i/ha. For green fodder, maize is harvested from tasselling stage on wards and up to milk stage of grain maturity.

Maize does not contain any harmful chemical and it can be fed to animals at any of its growth stages. In India it is used as green fodder and also asstover (by-product from grain crop). In western countries, it is mainly used for silage making.

We can get only single cut from maize. The average green fodder yield will be 40-50 t/ha and the dry matter yield will be 10-15 t/ha. Staggered sowing should be practiced for long period supply of green fodder. Maize can be inter cropped with legumes like cowpea or lab-lab. Usually 2:2 ratio is adopted.



Fodder Maize

SORGHUM or JOWAR or GREAT MILLET

Sorghum is believed to be indigenous to Africa, although India and China are claimed to be the home of certain varieties of sorghum. It is cultivated mainly for grain and also for fodder. In USA, certain types with sweet and juicy pith are grown for manufacturing syrup. These syrup types are also used as forage sorghums, in preference to those with dry pith.

Sorghum is a drought resistant crop. It thrives in tropical climate with a temperature range of 25-35^{0}C. It is not suited to higher elevations (more than 1200m). It can be grown under an annual rainfall of 300-350 mm. It can be grown on any soil except on very sandy soils. Sorghum is a short day plant and 10 hours photo period results in earliest flowering. It is mostly grown in *kharif* season as rain fed crop and during summer under irrigation. There is a special season called *Maghi* for sorghum in parts of Andhra Pradesh. It is less suitable for *Rabi* season.



Varieties: All the grain types and hybrids can as well be grown for fodder purpose. Usually varieties with thin stemand more leafy nature are used for cultivation as fodder.

Some of the common fodder varieties are P.C-6, P.C.-23, M.P. chari, U.P. chari -1, and 2, CSV-30F, *Madikattu Jonna*. APFS-3 and 5 are developed by ANGRAU. All these varieties are single cut types. Some multicut hybrids are CSH24MF, CSH20MF

SSG 59-3 is developed by crossing sudan grass (Sorghum sudanense) with sorghum. It is called as sweet sudan grass. It is a multicut variety. Derivatives of such inter specific hybrids combine the desirable features of both sorghum and sudan grass such as low HCN content, quick growth, better regeneration capacity, apart from high yield potential. There are some multicut hybrids such as HaraSona, X-988, Safed Moti, Jumbo, MFSH-8, CoFS29, 32etc which are produced and marketed by private organization. Some varieties of sorghum are developed for dual purpose i.e., for both grain and fodder, and are tall in nature. PSV-56 and APDS-1 is an example for dual purpose sorghum. Perennial fodder sorghum varieties are COFS29 and COFS31 released from TNAU(Coimbatore)

Thorough land preparation is required for this crop. The seed rate is 20- 25 kg/ha for bold grain types and 10 kg/ha for SSG 59-3. The recommended spacing is 30 x 10 cm and the depth of sowing is 2-5 cm. The recommended dose of NPK fertilizers is 80:40:40 kg/ha. Entire dose of P and K is applied as basal i.e., at the time of sowing and N is applied in two equal splits, half as basal and half at 30 days. For multicut varieties 30 kg N/ha should be applied after each cut. As sorghum is drought resistant, it can be irrigated once in 8-12 days during summer depending upon soil type.

The crop should be kept weed free for the first 30-40 days. Atrazine@0.5-0.75kg a.i /ha as pre-emergence herbicide applied 2-3 days after sowing can effectively control most weeds of sorghum fields. Striga, a partial root parasite is a problem in some areas. *Striga asiatica* and *Striga hermonthica* are the most important and wide spread species. Striga can be controlled to some extent by crop rotation or by using trap crops and also by spraying 2, 4-D.

Sorghum plants contain HCN in the form of Dhurrin (a Precursor for HCN) particularly in the early stages. It is dangerous to animals when it exceeds 750 ppm. Usually hay & silage are free from HCN and SSG 59-3 is also free from HCN. Sorghum can be harvested after flowering stage for green fodder. Average yield of green fodder is 35-40 t/ha for single cut types. For multicut varieties it is about100 t/ha in 3-4 cuts. Finely chaffed sorghum stover, popularly called as *KUTTI* is widely used by the dairy farmers in and around Hyderabad. Sorghum is used as green fodder and is also conserved as hay and silage.

BAJRA or PEARL MILLET

Distributed in Africa, Southern Europe, USA, Australia and Indian sub continent. The plant is erect, annual culms are one to many, robust often 1.8-2.4m tall. Inflorescenee is panicle, stiff spike like and very dense varying in length from10 cm to 91 cm.

It is an outstanding summer growing fodder crop for the dry farming areas because of its drought and heat tolerance and it can adapt to wide range of soil and climatic conditions.

It is a short day species. Black soil, clay and red chalk soils are suited. Cultivation with a country plough to prepare the tilth and to support the weeds is sufficient

Varieties

Moti Bajra, Giant bajra, APFB-2, Rajco, Bj104, 530, Hb3, 4, 5 are grain hybrids suitable for fodder production.

Can be sown at any time of the year in all seasons, if irrigation is available. Sowing can be done by broadcasting or dribbling in rows or furrows. Seed rate of 6-20 kg/ha with row spacing of 25-30 cmapart is ideal. For broad casting method, the seed rate will be double that of row sowing. NPK requirement is 54-96:36:27 kg/ ha. FYM of 20 t/ha is to be applied. Irrigation to the young plants during fast active growth phase Is necessary because the seedlings are highly sensitive for dry spells.

Pre-emergence treatment with Atrazine@0.5 kg ai /ha or 1 kg of 2,4-D/ha about 5-6 wks after sowing should be done to remove the weeds at the initial stages of crop growth.

Harvesting can be done at 50% flowering stage. The yield of green fodder is 20-40t/ha.

Legumes like cowpea, greengram, blackgram, horsegram can be used as crop mixtures.

OATS

It is native of Europe and distributed in Asia, USA, USSR, Canada, Poland, France, Germany, UK. In India oats are grown in northern parts as *rabi* crop. The fodder oats may be erect or spreading annuals. The leaves are about 25 cm long and 1-5 cm wide. The grains are long, hairy at the apex. It as an ideal fodder as a green chop, silage and hay mostly covering the lean periods of the year. Commonly grown as a winter crop in the temperate areas. Grows well in all types of soils. Requires well prepared and firm seedbeds. Two ploughings followed by two harrowings are sufficient.

Varieties

kent variety, UPU – 212, Weston II, FSO29, Flamings gold, OS–6, Algerian, EC – 1185. IC- 4263,Radaretc.

Seed rate is 75-80 kg /ha for small seed varieties and 100-125 kg/ha for bold seed varieties. Transplantation of 4 weeks old seedlings can be practiced with a row spacing of 25-30 cm. FYM requirement is of 25 t/ha. The requirement of NPK is 32:16:12 kg/ha. One pre-sowing irrigation is required. Subsequent irrigations can be provided for every four weeks interval. 2, 4-D @1.5kg a i/ha isto applied as weedicide at 2-3 wks after sowing. Harvesting is done at pre-flowering or 50% bloom stage. Yield of green fodder is35-45t/ha.

CULTIVATION PRACTICES OF LEGUMINOUS PERENNIAL FODDER CROPS

LUCERNE OR ALFALFA

It is perennial legume well adapted to warm temperature and cool subtropical regions. The origin is believed to be south west Asia. This crop withstands the hot climate remarkably well. Lucerne is much in demand as lucerne meal or to a lesser extent for grazing (pasture). It is also grown in tropical countries at altitudes of 500 to 1000 m and above.

It needs well drained loamy soil, rich in lime with neutral pH. It cannot thrive on alkaline soil, but can be grown on acid soil with liberal dressing of lime. It cannot tolerate wet or damp areas.

Varieties: Anand -3, Co-1, RL–88, LH– 84, T-9 etc.Annual types include varieties such as an and1and 2

The sowing period for lucerne is September to November. The optimum period is October to mid November. Thorough land preparation is required to obtain good tilth. Crop can be sown on flatbeds. The seed rate is 10 kg/ha and sowing should be done in solid rows with a row spacing of 25 cm. Sowing should not be too deep. To attain uniformity in sowing, the seed is mixed with equal quantities of fine sand or soil before sowing. To ensure complete germination, sometimes it is advocated to soak the seed over night and shade dry it before sowing. After this, the seed should be inoculated with suitable *rhizobium* culture. For this inoculation, jaggery solution is prepared by boiling jaggery(100g) in water (250 ml). Cool it and add the *rhizobium* culture (200g) to the solution. Later this is mixed with the seed (4 kg)in a seed treating drum. This seed (4kg) is sufficient to sow one acre.

Lucerne has a high requirement of phosphorus, potassium, calcium and sulphur. It responds well to FYM application. About 20t/ha of FYM should be applied every year. Then it rogen, phosphorus, potassium requirement of the crop every year is 20-30 kg N: 100 kg P_2O_5:40 kg K_2O /ha. Phosphorus should be applied in the form of single super phosphate and nitrogen as ammonium sulphate. Micro nutrient deficiencies are common in lucerne. Boron, manganese, molybdenum, iron and zinc deficiencies are seen in this crop. In order to avoid these deficiency problems, it is always advised to apply FYM regularly every year.

Water requirement of this crop is quite high. Initially irrigations are given every week and later at 10-12 days interval. The crop requires 15-18 irrigations in a year.

The crop requires thorough weeding in the initial stages. As the crop is sown in lines, weeds can be controlled easily either using manual labour or implements like push hoes, etc. For chemical weeds control. Pendimethalin @ 0.75-1.0kg a.i.,/ha can be applied 2-3days after sowing as pre-emergence. The crop needs weed free conditions through-out the year. So weeds have to be controlled by adopting periodical hand weeding.

Dodder (*Cuscuta*sp) a partial stem parasite on lucerne is big menace. Dodder plants should be carefully removed along with the host plant and burnt. Dodder plants should not be allowed to set seed. It contaminates the lucerne seed and spreads to new areas. The seed can live in soil for very long periods. Crop rotation can reduce the problem to some extent. Always use good seed of lucerne for sowing that is free of dodder seed. While adopting crop rotation, trap crops such as green gram, blackgram,etc, should be grown which help to minimize the problem of cuscuta.

First cut in lucerne can be taken 50-60 days after sowing, subsequent cuts are taken at 20-25 days intervals. Totally 8-10 cuttings may be obtained in a year with 60-70 t/ha of green fodder yield. The crop can beretained for 3-4 years on the same field.

Seed production in lucerne is also important. A cut for fodder is taken in the last week of February. After attaining the normal canopy development the crop is subjected to moisture stress by with holding one irrigation, to discourage vegetative growth and encourage profuse flowering. After complete flowering, normal irrigations should be restored. The crop is highly cross pollinated and as such insect activity is more important. Do not spray any chemicals during this period. The blue flowers. gradually turn to green pods that are spiral in nature. When 2/3 of pods turn brown, crop is cut near the base, left to cure for few days and then threshed. The seed yield is usually low (150-200kg/ha).

Lucerne is very rich in crude protein (18-21% on dry weight basis). Lucerne, like many other legumes, also contains saponins (alkaloid) and continuous sole feeding with green fodder of lucerne may lead to the problem of bloat in ruminants. It is always advised to mix with non-legume fodder for feeding the livestock.

Lucerne is a important green for horses, rabbits and milch cattle. It is conserved as hay. A nutritious, protein rich animal diet namely lucerne meal is prepared in western countries utilizing the hay.



STYLOSANTHES

Two important species are widely cultivated–*Stylosanthes hamata* and *Stylosanthes scabra*.

Origin of stylo is Brazil. Stylo is an erect growing perennial forage legume. Grows 0.6 – 1.8m tall. Stem is coarse, hairy and becomes woody with age. Leaves are trifoliate with leaflets long, rather narrow, varying in size and color. Pods are single seeded. Seeds are yellowish brown, kidney shaped. Crude protein14-18%.

It is used extensively in agro-forestry systems mainly in horti-pastoral system that combines well with perennial grasses like guinea grass. Stylo is adapted to tropical climate and tolerant to low fertility, drought and poor drainage soils. It grows well on sandy soils and shallow rocky soils. Tolerant to acidic soils. Land should be thoroughly ploughed and made into a plain land. Seed rate is 4-5 kg/ha

Stylo grows well in areas with rainfall of minimum 800 mm. Requires irrigation at regular intervals. Weeding is a bit easy in stylo based pastures because it tolerates weed problem.

First cut can be taken at 55-60 days after sowing when sown in monsoon, 65-70 days when sown during winter and subsequent cuts at 35-40 days interval. 14-16t green forage /ha/yr obtained 4-5 cuts.



Cultivation practice	Lucerne	Stylo	Hedge lucerne
Varieties	**Annuals**: Anand-1 Anand-2 Perennials: RL-88,T9, co1& anand 3	Hamata, siyabiyana, scrabraguanensis	Velimasal
Soils	Black soil with well dain soils	All type soils (sandy, light, acidic waste lands and grass lands) except water stagnated soils	All type soils,Well drain soils,
Sowing time	October – December	June-july and Aug,	June -july.
Seed rate kg/ac	For green fodder: 6kg for seed 3kg	Broad casting 6-8kgs Row plantation 4-5kg	3kg transplanting, 4-5kg row planting (50cm)

Cultivation practice	Lucerne	Stylo	Hedge Lucerne
Spacing	30 cm between rows	15 X 30 cm	50 X 50 cm
Recommended dose of fertilizers(NPK kg per acre)	FYM 8-10 tonnes 18:32:16 NPK Apply 10kg nitrogen after every cut	FYM 5-10 tonnes 12:25:12 NPK Apply 10kg nitrogen after every cut	FYM 5-8 tonnes Apply 8:24:12 NPK apply 10kg nitrogen after every cut
Harvesting time	1st cut 55-60 days after sowing subsequent cuts 25-30 DAS	1st cut 60-70 days after sowing subsequent cuts 60 days after every cut	1st cut 90 days after sowing subsequent cuts 50 days after every cut
Green fodder yield tonnes/ acre	Total 8-10 cuts per acre per year, 30-32 tonnes per acre Dry fodder:7-8t	Total 12 –14tonnes per acre. Under irrigated 25t	50 tonnes in 4-6 cuts per year per acre
Other information	***Crude protein content:18-20 %** Weed control spray Pendimithalin @5ml per litre of water with in 48 hrs of sowing.	***Crude protein content:14-18%.** Drought resistance, with stand water stagnation and shade. Seed treatment with hot water will improve germination%	Suitable for sheep and goat, can be grown with hybrid napier as inter crop(1:1) Crude protein 15-18%



Hedge Lucerne

CULTIVATION PRACTICES OF LEGUMINOUS ANNUAL FODDER CROPS

BERSEEM OR EGYPTAIN CLOVER

It is a widely cultivated legume fodder in sub-tropical conditions, or in winter in tropics. It is an annual crop. This crop requires cool temperatures, but is highly susceptible to frost. High temperatures can suppress growth but stimulate flowering and seed formation.

It cannot tolerate water logging. It grows on all soil types, but heavy soils are good. It can tolerate soil salinity and alkalinity.

Varieties: Mescawi, Varada, JB-1, 2 & 3, UPB-103.

Thorough land preparation is required. Later small sized beds are formed. Beds are flooded with 5 cm of water and berseem seeds, soaked in water overnight are broadcast in the standing water. For uniform distribution seed is mixed with equal quantity of fine earth or soil. This is called wet method of sowing. Berseem can also be sown line other crops adopting dry method of sowing.

The optimum time of sowing is October. The seed rate is 20-30kg/ha for broadcast sowing.

Before sowing the seed is inoculated with Rhizobium culture. The fertilizer requirement is 25:30:40kg of NPK/ha. The entire dose of fertilizers is applied basally at the time of sowing. This crop may show deficiency symptoms of trace elements like Boron (B) and Molybdenum (Mo). As such, B in the form of borax @ 1.0kg/ha, Mo in the form of ammonium molybdate@1.0-1.5 kg/ha is applied basally. This practice results in increased forage yields. Application of farm yard manure@10-15t/ha should be a regular practice for better growth of berseem.

Water requirement of this crop is high compared to oats and lucerne. This crop requires frequent irrigations. Initially irrigations are given at weekly intervals, later at 8-10 days during winter and 6-7 days during hot weather period.

Weed control in this crop is difficult because of broadcast sowing. This crop requires at least one hand weeding. Dodder (*Cuscuta* sp.) is a problem in this crop. In case of infestation with cuscuta the field should be kept free of this weed by repeated hand weedings. Chicory (Chicoriumintybus) is an associated weed of berseem fields. Admixture of chicory seed with berseem seed is most common. Feeding chicory plants causes scouring in animals. Seed of berseem should not be collected when the field is infested with chicory. Always use weed free seed of berseem to avoid the problem of chicory. Pre-sowing removal of chicory seed by 10% common salt solution is a simple and effective technique to separate the chicory seed from berseem seed. If the soil if infested with chicory, pre-sowing irrigation to germinate the chicory seed followed by cross-harrowing is beneficial to reduce the weed problem. After this operation, normal sowing of berseem can be done.

Berseem is ready for cutting in 50-60 days and subsequent cuts are taken at 35-40 days interval. Totally 4-6 cuts can be obtained. In early summer, the cutting interval can be 25-30 days. The average green fodder yield is 45-55t/ha overall the cuttings. The last cut is allowed to flower and seed is collected. Berseem is a self pollinated crop. Cross pollination is also important. The average seed yield is 500-600 kg/ha.

Crude protein content of berseem fodder is17-18% on dry weight basis.

Berseem is usually grown as pure crop. In north India, it is usually rotated with crops like cotton, chillies, sugarcane etc. Inter cropping is rarely seen. In case of early sowing it is inter cropped with rapeseed and also oats.

It is mainly fed as green fodder. Continues sole feeding with early morning dew on it may lead to the problem of bloat in animals. Berseem can be conserved as hay, but great care is needed to prevent loss of leaf. During the process of hay making there will be heavy leaf fall because of the differences in the drying of leaf and stalk. Berseem is not suit able for silage making.

HORSE GRAM

It is a low spreading sub erecting manual with alternate trifoliate leaves, partially climbing in nature and reaching to a height of 30-50cm.

Flowers are creamy yellow in color. The seeds are 4-7 in a pod, brown to black or mottled with a hard spiny seed coat.

Makes an excellent forage for all livestock particularly for milch animals. It requires optimum temperature of 20-30°C and rainfall of 900mm. The crop cannot withstand water logging conditions. In India It is cultivated in lights and y soils, red loams and black cotton soils with gravel.

Varieties–BR-10, BR-5, NO-35 and DB-7

Seed rate is 45kg/ha with row spacing of 30cm. Does not need much manuring. Supplementation of super phosphate@50kg, nitrogen@30kg and phosphoric acid 60kg will enhance the fodder yield. Requires irrigation at regular intervals for every 15 days. Harvesting is done at flowering time, normally in about 4.5 months after sowing. Yield is 25-30 t/ha green fodder. The seed yield is 3.5-6.5q/ha. It is usually cultivated as mixed crop with bajra .

COWPEA OR LOBIA

It is an annual her band has different growth habits like bushy or trailing or climbing nature. The seeds are also of different sizes and colors. This crop is grown in tropics, sub- tropics and warm temperature regions.

It is grown for feeding in green form, for grazing, for hay making or for ensiling in mixtures with sorghum or maize.

It can be grown in all the three seasons. It is suitable for year round cultivation.



Varieties: Russian giant, Bundel lobia1 and 2, EC-4216, UPC-5286 and locals.

Cowpea is sown at a row spacing of 30 cm adopting a seed rate of 30-40 kg/ha.When it is sown by broadcasting, the seed rate can be as high as 100kg/ha. Nitrogen, phosphorus and potassium fertilizers are applied @25-30:60:30-40kg/ha, all at the time of sowing. Inoculation with rhizobium culture is important if the crop is grown for the first time.

Summer crop needs irrigation at 12-15 days interval. The crop is seldom weeded because it has highest weed smothering efficiency. For green fodder, it can be cut at 60-70 days, usually at 50% flowering stage. Only one cut is taken from this crop. The average green fodder yield is 30-35 t/ha with a crude protein content of 17- 18% on dry weight basis. Usually it is sown as an inter crop with maize, sorghum or bajra in 2:1 or 2:2 ratios.

SUNNHEMP

It is an erect, shrubby annual. It is grown for fibre, green manuring and also as fodder. The fodder can be fed either green or dry. However, it is most commonly used after conserving in the form of hay. This crop can be grown on a wide variety of soil, but heavy, water logged and saline soils are not suitable. It is grown in *kharif* and *rabi* season. In parts of Andhra Pradesh (Krishna and West Godavari) it is grown after paddy (relay cropping system). It is converted in to hay and stacked in alternate layers with paddy straw.



Varieties: All locals, laxmi (developed at A.R.S., Mudhole) and K-12 yellow.

The seed rate is 30-40kg/ha and when the crop is sown by broadcasting, the seed rate can go up to 90-100kg/ha.

Usually fertilizers are not used. However, 40-50kg P_2O_5 /ha can be applied as basal in the form of single super phosphate. It is grown with residual soil moisture after paddy and *kharif* crop is rain fed. Weeding is seldom practiced. The average green fodder yield is 20-25t/ha.

PILLI PESARA

It is a popular legume in delta regions of Andhra Pradesh. It is useful as fodder and also for green manuring. It comes up well on all soil types. It is usually grazed (pasture legume). Commonly it is grown as a relay crop after paddy.

As a permanent pasture it can be sown by broad casting seed@25-30kg/ha and rational grazing is practiced and animals are allowed only after the pods have set seed in the first year.

The average green fodder yield is15-20t/h

Cultivation practice	Sorghum	Maize	Pearl millet	Oats	Cowpea
Varieties	**Single cut** P.C-6, P.C.-23, M.P. chari, U.P.chari -1, and 2, CSV-30F, **Multicut varieties** SSG 59-3 Hara Sona, X-988, Safed Moti, Jumbo, MFSH-8, CoFS 29, 32 **Multicut Hybrids** are CSH24 F, CSH20 F	**African tall**, J-1006, Vijaya composite, Ganga-5, are some important fodder varieties	**Multicut varieties** Motibajra Gaintbajra, BAIF bajra	Kent, OS-6, RO 19	Vijaya UPC-5286, Bundel lobia-1, Bundel lobia-2
Soils	All types of soils	All types of soils. Well drain soils much suitable	Well drain soils, light and black soils	Well drain soils, light and black soils	Well drain soils, light and black soils
Sowing time	Kharif : June-Aug, September. Rabi: Oct-Nov. Summer: Jan-April	Kharif : June-July, Rabi: Oct-Nov. Summer: Jan-Feb	Kharif : June-July, Rabi: Oct-Nov.	October november	Kharif : June-July, Rabi: Oct-Nov. Summer: Jan-Feb
Seed rate kg/ac	12-15	20-25	5-7	25-30	15-18
Spacing	30 X 10 cm	30 X 10 cm	30 X 10 cm	25 cm	30 X 10 cm
Recommended dose of fertilizers(NPK kg per acre)	FYM 4-5 tones Rainfed crop:24:16:12 Irrigated: 40:16:12 NPK Apply 8kg nitrogen after every cut	FYM 4-5 tones Rainfed crop:24:16:12 Irrigated: 40:16:12 NPK	FYM 4-5 tones Rainfed crop:24:16:12 Irrigated: 40:16:12 NPK	24:16;12 at time of sowing	Nitrogen 8 Phosporous 16
Harvesting time	First cut at 50% flowering time. Subsequent cuts 45 days after first cut	Milky grain or dough grain stage or 75 days to 85 DAS	First cut at 50% flowering time. Subsequent cuts 30 days after first cut	50% flowering time. 60-65 DAS	50% flowering time. 60-65 DAS
Green fodder yield tonnes/ acre	Single cut: Irrigated:14-16 Irrigated:18-20 Multicut: 1st cut 16-18 subsequent cuts 8-10	Irrigated:14-16 Irrigated:20-25	Irrigated 6-8 Irrigated: 12-14 Multicut 32t/ac/3cuts	12-15	Irrigated 8-10

Cultivation practice	Sorghum	Maize	Pearl millet	Oats	Cowpea
Other information	For weed control spray Atrazine @3g per liter of water as pre emergence weedicide *Crude protein content:7-6%	Seed treatment with capton or Thiram @3g per kg seed For weed control spray Atrazine @4g per liter of water as pre emergence weedicide *Crude protein content:8-10%	Crude protein content: 8-10%	Suitable for low temparatu re areas of Telangana	Weed control spray Pendimithal in @5ml per litre of water with in 48 hrs of sowing

YEAR ROUND FODDER PRODUCTION PLAN (CONTINUOUS SUPPLY OF GREEN FODDER)

To make a whole year fodder plan we have to know about the requirement of the animals according to season, the fodder crop which is available in a season, the approximate yield of the fodder per acre or hectare. To make the planning better we have to choose leguminous fodder and multi cut varieties of fodder. The animal requirement is very necessary to calculate, because fodders are main feed of the animals. The fodder requirement varies with the age and production status of the animal. The maintenance requirement can be only fulfilled from fodders. For stall fed animals the key role is to feed ad-libitum. A buffalo or cattle one animals unit requires 0.5-0.6 acre land for fodder cultivation in a season. The requirement of green fodder will vary according to the live body weight of the animal. On an average 8-10 % of live weight of the animal is to be provided in the form of green fodder. An adult Cattle weighing 400 kg body weight will consume 32-40 kg green fodder. Out of the total requirement of green fodder one third of green fodder is to be provided as leguminous fodder and remaining two third is to be provided as non leguminous fodder. For an example a mini dairy with 10 Cows and 5 calves will require green fodder as follows

10 Cows x 35 kg/day x 365 days = 127.75 tonnes.

05 Calves x 20 kg /day x 300 days = 30.00 tonnes.

Totally approximately 150 tonnes /year.

Leguminous fodder : 50 tonnes

Non leguminous fodder : 100 tonnes.

To produce the above quantity of green fodder the land area is to be worked out based upon the type and variety fodder crops that are cultivated.

Eg : Co5 variety yields 150 tonnes /acre/year Lucerne yields 80 tonnes / acre means two third acre is to be allotted for production of Co5 grass and 60 cents are to be allotted Lucerne to get sufficient fodder to meet the requirement of 10 cattle with its 5 followers

FODDER PRESERVATION

Fodders are very important source of livestock feeding. Due to change in the weather the availability of fodder is drastically reduced, so the production of animals also reduced. In India

there are two periods of fodder shortage i.e., May – June and October – November. However very large amount of fodder is produced before these two periods such as February to April and July to September. In these days surplus fodder can be preserved as a hay and silage making, so it shows the year round fodder supply.

HAY MAKING

The fodder which is harvested during growing period and preserved by drying and used during the days of feed shortage. The fodder is harvested during optimum stage of maturity. The principle involved in hay making is to reduce the water contents of fodder from 65 – 85% to 20% or less. In India Lucrne and Barseem are suitable leguminous fodder crops for hay making. In hilly area natural grass pasture also can be harvested for hay making.

METHOD OF HAY MAKING

The fodder crop which is used as hay making should be mowed as early as possible after reaching early bloom stage of maturity and as circumstances allow.

Efforts should be made to select the rain free weather for harvesting. Minimum of 2 – 3 days are required for good drying weather are necessary for hay curing. So weather forecasts are very necessary in hay making. Conditioning of harvested fodder crop can reduce the drying period. In this procedure fodder is passed to set of rollers to crack open the stems thus facilitate drying. To avoid excessive shattering losses and over exposure to sun harvested fodder should be raked before complete drying. To facilitate drying turning of windrow is done. When the fodder is sufficiently dry baling should be done. Round and square bales can be made. Store the bales in the damp proof store house.

CHARACTERISTICS OF GOOD HAY

Leafiness: the hay which has high leave to stem ratio is considered good.

Color: the desirable color of hay is bright green, brown color is undesirable.

Aroma: the aroma from hay should be pleasant.

Moldiness: hay should not be moldy,

ADVANTAGES OF HAY MAKING

In hay most of the moisture is has been removed so there is low transport cost.

Good quality hay leads to desirable DMI by animals.

The fodder which is surplus in the season can be conserved and used in the days of feed shortage.

DISADVANTAGES OF HAY MAKING

1. Hay making requires optimum weather conditions.
2. The digestive and crude protein value of hay is not sufficient for maintenance plus production.
3. If it is not sufficiently dry and is stored, it can be damaged by fire.
4. If hay is containing excessive moisture the mold can grow on it.
5. If fodder is improperly harvested then the loss of leaves can occur. So most nutritious part of fodder is loss.
6. If the harvested fodder or hay is given excessive exposure to sunlight then it causes loss of nutrients as carotene.
7. If harvested fodder or hay is rained during the drying period then water soluble nutrients are loss.

SILAGE MAKING

Silage making means preservation of chaffed cereal green fodder in anaerobic condition by way of fermentation method. In anaerobic condition (no air inside pit/tank),with the help of micro organisms, sugar contained in green fodder is converted in to Lactic acid ,which help to preserve the green fodder for longer duration.

How Silage is prepared?

During the silage making process, the pasture is cut when the grasses contain the highest nutrient levels. This level is attained just before they are fully mature. The reason why it is cut just before they are fully mature is that all forms of preserved grass, such as hay and silage, will have lower amounts of nutrients than fresh pasture, so everything must be done to make the end product be as nutritious as possible. During Silage preparation, the grass is allowed to wilt in the field for a few hours to reduce the moisture content to around 60-75% as this is the optimum level. If the grass is left out longer, it may get too dry, or it may get rained on – and both these will reduce the efficiency of the fermentation.

Process in silage making

1. Selection of forage crops and their maturity stage

The optimum dry matter for crop harvesting for silage depends on the stage of harvesting (Table 1). Most of crops are harvested at 50% flowering to dough stage when the moisture content varies between 18-22%. After overnight wilting the dry matter content become 30-35% which is proper dry matter content for ensiling.

2. Steps in silage making

Silage making involves four major steps viz., harvesting and transportation, chaffing, filling and compaction and covering of silo.

2.1. Pit making:

Firstly, a silage pit has to be dug for storing silage. The pit size may be determined based on the amount of silage to be stored. A pit with a dimension of 1 metre wide x 1 metre length x 1 metre depth can store 500 kilograms of silage. The location of pit should be free from water stagnation. The pit should be surrounded on all sides with thick plastic sheet. Pit can also be constructed using bricks and cement.

2.2. Preparation of fermentation mixture:

For preparing 1 ton silage, the following materials are required.

Jaggery or Molasses – 1 Kg

Salt – 1 Kg

Mineral Mixture – 1 Kg

DCP (Di-Calcium Phosphate) – 1 Kg

LAB (Lactic Acid Bacteria)

Urea – 1 Kg

Mix all of the above into a drum by adding water

2.3. Harvesting and transportation of crop (ensiling):

Harvesting at proper stage but delay in transportation may lead to loss of excess moisture results in haylage (DM 70-80%)



2.4 Chaffing:

It has to be chaffed into small pieces preferably 2-4 cm length using a chaff cutter. This improves the packing density which favours the growth of lactic acid bacteria, naturally present in crops. Add the fermentation mixture in small quantities as the fodder is loaded to chaff cutter. Position the chaff cutter so the chaffed fodder directly falls into the silage pit. Level the chaffed pieces evenly and press it hard so that all air comes out. Pressing and removing air is very important.



2.5. Filling of silo and compaction:

Chaffed material should be spread evenly over entire surface of silo (the structure) and then compacted through trampling (in case of small silo). In case of large silo (trenches) the compaction can be done using tractor. It helps in rapid evacuation of air from the silo, thus checks the aerobic respiration and nutrient loss.



2.6. Properly sealing and covering of silo pit:

It should be done in such a way that neither air enters in to the silo nor the gas comes out from the silo. It is better to use polythene sheet but care should be taken that entire surface of polythene sheet should be covered with straw or any other dried material up to 6-8 inch thickness to avoid the damage of polythene sheet by dog, cat or other animals. Make sure water does not enter the pit during rains. The silage will be ready in 45 to 60 days, depending on the types of material used. The silage of thin stem crop like oat becomes ready in 45 days while thick stem crops like maize, sorghum and bajra become ready in 60 days. Ideal silage is golden yellowish green colour with good aroma. After completion of incubation period the silo is opened for feeding. The whole silo should not be disturbed and it should be opened from one place/corner to avoid the loss of moisture and nutrients. Depending on the type of animal, stage of production and availability of silage it can be supplemented in the ration (5-25 kg per animal) of animal during lean period. After opening the pit, silage should be used within 30 days.



Steps in Silage making

Essential fodder crops for silage making-

To prepare best quality silage, cereal green fodder like Green fodder maize, Fodder sorghum, Bajara, Hybrid Napier, Sugar cane tops, Oat, Marwel etc. are required. Preference for cereal green fodder (monocotyledons) is due to it has more sugar content than protein, as sugar is utilised in fermentation process to make lactic acid by microorganisms. These cereal fodder crops have hard stem, which takes more time for drying in making hay of these crops, so it is better to use these kinds of crops for making silage than hay.

Benefits of silage making

Silage is storage system of green fodder which keeps all parts of fodder in appropriate condition for feeding than any other system of storage of fodder. Silage requires less space for storage as it is pressed in pit/tank than hay making. For daily cutting, transporting & chaffing of fodder in traditional way requires more labour and time but in case of silage, fodder cutting, transport, chaffing is done at one time only, so it is less labour and time consuming practice.

Land under fodder cultivation is emptied, and immediately it is used for plantation of other crops. So farmers' can take more crops in same land in a year against traditional way where land is reserved for fodder until all crops is harvested. Silage is prepared in closed and air tight condition so

there is no danger of fire. (In hay making, dry fodder is stocked & exposed for fire like situation) Due to lactic acid in silage, it is easily digestible to animals, so energy required for digestion is used for other purposes like milk production.etc. Silage is tasty and flavoured, so it increases appetite of dairy animals. Important thing behind to adopt silage is in scarcity it provide supply of fodder to dairy animals. Situations like drought, high rainfall and scarcity of fodder, farmers may use silage for feeding to dairy animals. (Rain fed area where shortage of green fodder is for March to June & in high rainy area or water logged lands, it is impossible to cultivate or harvest fodder) Due to treatment of additive for silage, farmers can supply energy, mineral and vitamins to dairy animals.

Use of silage-

After 8-10 weeks, silage is ready as feed for animals. Open pit/tank initially from one side of for use. If it is not in use, then cover it carefully with plastic film so that air will not go inside in silage. Initially fed animals with 5-6 kg silage by adding it with chaffed green fodder to develop taste to animals. Once animal likes sweet-sour taste of silage; it will eat it with good liking.

Quality of Silage-

Mould- If silage while filling pit/tank, not well pressed; there will be growth of mould.

Odour- Good quality silage has sweet & sour taste.

Colour- Good quality silage has faint green or brownish colour. Rotten silage has black colour.

pH- Good quality silage has pH of 3.5 to 4.2.

AZOLLA CULTIVATION

Introduction

Azolla is the most promising aquatic plant for livestock feed due to its ease of cultivation, productivity and nutritive value. It was also examined and suggested that one hectare of Azolla can yield 540–720 kg of protein per month use as a feed for fish, swine, and poultry. Because of its composition, azolla is one of the most affordable and effective feed substitutes for livestock, since its high protein and low lignin content allow for easy digestion by the animals.

Azolla is very rich in protein (25-35%), Calcium (67 mg/100g) and Iron (7.3 mg/100g). The comparative analysis of the nutrient content of azolla vis-à-vis other fodder source is depicted in the following table.

Table: Comparison of biomass and protein content of Azolla with other fodder

S.No	Item	Annual production of biomass (MT/ha) Dry	Dry matter content (MT/ha)	Protein content (%)
1	Hybrid Napier	250	50	4
2	Kolakattao grass	40	8	0.8
3	Lucerne	80	16	3.2
4	Cowpea	35	7	1.4
5	Subabool	80	16	3.2
6	Sorghum	40	3.2	0.6
7	Azolla	**1000**	**80**	**24**

Source : Dr P Kamalasanan et al. 2004 "Azolla -A sustainable feed substitute for livestock", Spice India

Cultivation process

Azolla fodder plot setup is simple and doesn't require special knowledge; farmers may do it themselves with ease. If set up in backyard, the area should be levelled and lined with bricks. The side of the plots should be raised to enable the water to stand. Alternatively, the fodder plot can be in a pit with depth of 0.2 m. A polythene sheet is spread over the bed in such a way that 10 cm of standing water can be maintained. Width of the bed is maintained at 1.5 m to enable the cultural operation from both sides. Length can be changed according on the unit's needs for feed. For a pair of cows, 2- 2.5-meter-long beds each with an area of around 8 sq m can meet 50% of the green fodder requirements.

Once the bed of size 2.5 m x 1.5 m is ready, about 15 kg of fine sieved soil is spread over the bed, which will provide nutrient to the azolla plant. About 5 kg of pre-decomposed (2 days) cow dung is mixed with the water, which provides carbon source for the azolla. About 40 g of mineral mixture is added to the azolla bed. The solution is fortified with micronutrient of desired quantity. This not only takes care of the micronutrient requirement of azolla but also the cattle when it is fed with the azolla. Sufficient water is added to make the water level of the bed to 10 cm. Production of azolla scientifically and on a continuous basis requires cement concrete tanks of size 2 m long, 1 m wide and 0.5 m deep. Due care should be taken so that water can stand in the tank. Ten or more tanks can be constructed in one place covering an area of 25 sq. m.

Soil is distributed evenly across the bottom of the tank. The depth of soil layer should be about 10 cm. Cow dung is to be added at the rate of 1 to 1.5 kg per sq m of the tank area (2 to 3 kg of cow dung per tank). Single Super Phosphate (SSP) is to be added at the rate of 5 g per sq m of the tank area every week (10 g SSP per tank). Fill the tank with water till the water collects to a height of 10 to 15 cm above the soil. Allow the soil particle to settle down. Allow the tank to stand overnight. On the following day, spread around 200 g of fresh Azolla inoculum over the surface of the water. It takes about 2 weeks for Azolla to form a mat over the water surface.

Maintaining the water level in azolla tank is important, particularly in the summer season. One possible solution to reduce excessive ambient light is to cover the tank with a shade net. Additionally, this keeps dew from forming on the Azolla plants during the winter. After agitating the water in the azolla bed, approximately 1.5 kg of mother culture of azolla seed material brought from azolla mother nursery is spread uniformly over the bed. The azolla seed's source needs to be carefully considered. Azolla will cover the whole bed at first, and in seven days it will form a thick mat. It should provide 10 kg of azolla in seven days at most. 50% of the necessary amount of green fodder. During the initial seven days azolla is not harvested. Water level is maintained by applying water everyday. After the seventh day, 1.5 kg of azolla can be harvested every day. Azolla should be harvested in plastic trays with sieve. Harvested azolla should be washed in fresh water before it is fed to the cattle. Washing is necessary to remove the smell of cow dung. Azolla harvested can be mixed with the commercial feed in 1:1 ratio. Cow dung and mineral mixture removed by azolla mass has to be supplemented at least once in seven days after harvest. A mixture made of cow dung, mineral mixture, soil and water should be added once in seven days. After every 60 days, soil is removed from the bed and another 15 kg of fresh fertile soil is added into the bed to avoid nitrogen build up and also provide nutrient to the azolla. Fresh inoculation of azolla after removing soil and water should be made at least once in six months repeating the whole process afresh.

Precaution

- Azolla should be harvested regularly to avoid overcrowding.
- Temperature is an important factor for good growth. It should be around 35 degrees Celsius. The fodder plot is to be covered with a plastic sheet in cold regions so as to reduce the impact of cold weather.
- Places with direct and adequate sunlight should be preferred. A shady place yields less.
- pH of the medium should be between 5.5 to 7. 6. Suitable nutrients such as cow dung slurry, micronutrients should be supplemented as and when required.








LIVESTOCK PRODUCTS TECHNOLOGY

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MILK PRODUCTS

CLASSIFICATION OF DAIRY PRODUCTS

A number of products are manufactured from milk. These products are being made and consumed in India since ancient time. Indigenous milk products provide the means of preserving precious milk solids and surplus milk for a comparatively longer time than the fluid milk whose shelf life under Indian tropical conditions is only 5-6 hours at ambient temperature. The chilling facilities for preserving raw milk are highly inadequate and legally no chemical preservative can be added to milk for this purpose. In this situation conversion of milk into milk products is the best option, because methods of preparation are simple, don't require costly equipment and suits the rural conditions. For better understanding of the nature of the products, indigenous milk products can be conveniently classified into five major categories.

I. Concentrated/partially desiccated products

The products are made by concentrating the milk by using heat energy. Moisture percent in milk gets reduced due to evaporation of vapours of the product. Based on extent of heat treatment product characteristics such as smell, colour, aroma and texture imparted to the products.

Eg: Khoa, Rabri, Basundi

II. Heat and acid coagulated products

These are the coagulated products obtained upon addition of acidulant(s) to heated milk. Extent of removal of moisture controls the texture. Eg: Paneer, Chana.

III. Frozen products

These products should be either frozen or refrigerated.

Eg: Ice cream, Kulfi etc

IV. Fat rich products

These products are rich source of milk fat Eg: Ghee, Makkhan (desi butter), Malai etc.

V. Fermented products

Lactic cultures are used to ferment the milk at specific temperature and for specific duration. Dahi is the well known product since from ancient time and mistidahi is popular in eastern region. Eg: Dahi, Shrikhand, Butter milk etc.

METHODS OF PREPARATION OF MILK PRODUCTS

KHOA

Materials required:

- Karahi (pen)
- Gas stove
- Whole milk (cow or buffalo)
- Iron or stainless steel stirrer cum scraper

Procedure:

- Take appropriate amount (about 5kg) of milk (preferably buffalo milk) in a karahi.
- Put the karahi on direct fire and allow the milk to boil.
- Stir the milk vigorously and constantly in a circular motion with the help of a milk stirrer cum scraper.
- Scrap the contents occasionally to avoid the sticking of milk to the surface of karahi.
- Observe the formation of viscous mass of milk protein.
- Mark the abrupt change in colour.
- Continue the heating with greater speed of stirring cum scraping action.
- Note the change of viscous mass to a semi solid/pasty consistency, which later on begins to dry up.
- Observe the final product (khoa) when it begins detaching from surface of the karahi and starts sticking together.
- Remove the karahi from the gas stove.
- Work the content up and down into single compact masses. The product so prepared is known as khoa-pat, which is rich in protein.

PANEER

Materials required:

- Buffalo milk
- Milk container
- Heating device
- Citric acid solution (1%)
- Hoop
- Pressing Machine
- Refrigerator
- Packaging materials Fresh buffalo milk

Standardization (6% fat)
↓
Heating (90°C)
↓
Cooling (70°C)
↓
Addition of coagulant (1 to 2 % citric acid)
↓
Coagulation (70°C)
↓
Draining
↓
Hooping
↓
Pressing
↓
Packaging
↓
Storage

ICE CREAM

Materials required:

(a) Ingredients:

(For manufacturing 100 kg ice cream with 10% fat, 11% serum solids, 14.5% sugar and 0.3% stabilizer).

- 13.4 kg sweet cream (40% fat and 5.4% serum solids).
- 3.9 kg skim milk powder (0.5% fat and 97% serum solids).
- 67.9 kg whole milk (6.8% fat and 9.6% serum solids).
- 14.5 kg sugar (sucrose).
- 300g sodium alginate
- Vanilla essence
- Edible colour

(b) Equipment:

- Ice cream plant (Pasteurizer, Homogenizer, surface cooler, ageing vat, freezer, deep freeze).

Selection of ingredients
↓
Figuring of mix
↓
Making of mix (SMP, Cream, sugar, stabilizer, emulsifier)
↓
Pasteurization of mix (68°C/155°F for 30 min.)
↓
Homogenization of mix (I stage – 2500 psi)
(II stage – 500 psi)
↓
Cooling and ageing the mix (0 to 4°C/32 to 40°F)
↓
Freezing the mix (-4 to -5°C/23 to 25°F)
↓
Packaging of Ice-Cream
↓
Hardening and storage of Ice-Cream (-23°C to -29°C/-10°F to -20°F)

GHEE

Materials required:

- Whole milk or curd (Dahi)
- Churning device (Mathani), cream separator.
- Karahi (Pan)
- Gas stove
- Khunti
- Pot.

Traditional method

- Take milk in a karahi (Pan) and put it on fire flame.
- Heat milk at or below boiling point for 30 minutes.
- Allow to cool the milk and add starter culture @ 1% when the temperature reaches to 30°C.
- Put the inoculated milk at 30-37°C for 12-16 hr for curd setting.
- Transfer the curd in a fairy large vessel and put a churning device inthe vessel.
- Agitate with the churning device unevenly in alternate direction.
- Continue this process until the makhan separates out and forms a lumpy mass.
- Add adequate amount of water to separate makhan clearly from rest of the contents.
- Take out of mass of makhan and rinse with plenty of water.

Pre-stratification method

Butter left undisturbed at 80°C to 85°C/15 to 30 min.

↓

Stratifies into three layers

↓

Top layer – floating denatured curd particles
Middle layer – fat
Bottom layer – butter milk (6 to 7 % SNF)

↓

Removal of butter milk mechanically without disturbing top & middle layers

↓

Temperature of 2 layers raised to clarifying temperature of 110°C to 120°C

↓

Separation of Ghee

DAHI

- Materials required:
- Starter culture
- Incubator
- Cow milk, Buffalo milk or mixed milk
- Milk Container
- Plastic cups/stainless steel containers
- Refrigerator

Starter culture:

The bacteria that can be used in starter culture are:

1. *Streptococcus lactis sp. Lactis*
2. *Streptococcus cremoris*
3. *Leuconostockdextranicum*
4. *Lactobacillus bulgaricus*
5. *Lactococcus lactis sp.*

The mixed cultures consisting of *Lactococcus lactis sp. lactis*, *Streptococcus cremoris* and *Lactococcuslactis* are also being used in curd preparation. These cultures provide uniform and good quality curd. This combination also improves the nutritional and therapeutic quality of the product.

Milk

↓

Pre-heating (40°C)

↓

Standardization

↓

Heating (60°C)

↓

Homogenization (176 kg/sq. cm.)

↓

Heat treatment (80-90°C for 15-30 min)

↓

Cooling (22-25°C)

↓

Inoculation with starter culture

↓

Distribution in containers

↓

Incubation (22-25°C for 16-18 hr)

↓

Dahi (curd)

↓

Cooling & Storage (5°C)

MEAT AND POULTRY PRODUCTS

Meat is the most valuable livestock product and for many people serves as their first-choice source of animal protein.

Advantages of meat consumption:

1.It is the important source of biological value protein.

2.It is also the Important sources of iron, zinc, vitamin B12.

Function of Iron, Zinc and Vitamin B12:

Iron: It reduces the iron deficiency, helps in blood formation.

Zinc: It improve eimmune system. Also helps in reproduction and body development.

Vitamin B12: Boosts up nervous system, RBC formation and brain development.

3.Meat releases energy in our body 142- 294 kcal / 100g.

4.It also contains several types of nutrients such as protein, fat, vitamin, minerals, lipid, carbohydrate, amino acids, water etc.

The classifications of meat products are diverse and are based on criteria such as the types of raw materials that compose them, the structure of their mass, whether or not they are embedded, whether or not they undergo heat or some other process. The basic classification of various type of meat products is

1. Emulsion based products
2. Enrobed products
3. Traditional meat products.

1. Emulsion meat products

Meat emulsion include products like sausages and nuggets. They are produced from comminuted or finely homogenized meat using a bowl-chopper.

Method of preparation

Lean meat minced twice through 6mm plate and fat through 4mm plate in a meat grinder

(or)

Meat mincer can be used for mincing

↓

Shift the minced meat into bowl chopper for emulsification

↓

Then add fat (oil) (meat: fat = 65%:15%)

↓

Run for 1 minute at low speed

↓

Then add salt (2%), texturized soy protein (10%), condiments (6.5%) and dry spices (1.5%)

↓

Mix well and run for 1 minute at low speed and 30 seconds at high speed

↓

Remove the emulsified meat from bowl chopper into a bowl

The emulsion was tightly filled in separate stainless steel nugget boxes and are cooked without pressure for 40 minutes and allowed to cool for 15 minutes without opening the lid.

↓

Internal temperature must reach 72°C

↓

After that, the lids of nugget boxes were opened and thus the meat blocks obtained were cooled in refrigerator at 4± 1 ^{0} C and then cut into 2x1x1 cm size for rectangular shape of nuggets

↓

Cooled and served

And this Protein is consumed in two ways:

Kitchen style food, which is eaten by cooking

Processed meat products such as pasta, meat ball, pizza, burger etc.

II. Enrobed products

It is a Process of making further processed products by applying edible coating to the products it includes breading and battering

METHOD OF PREPARATION OF EGG BONDA

Cut The 4 Boiled Eggs Into 2 Halves

↓

Take ¾ Cup Besan/Chick Pea flour in a bowl

↓

Add 1 table spoon cut green chilli,2 teaspoons coriander,1/4 tea spoon cumin,1/2 teaspoon chilli powder,1/2 tsp chat masala,1/4 tsp garam masala,1/2 tsp roasted cumin powder,1/4 tsp turmeric powder, salt as per taste

↓

Add the water and mix well

↓

Add little amount of baking soda

↓

Heat the oil in a pan, then dip the eggs in batter & fry them in oil

III. Traditional meat products

QUAIL EGG PICKLE

Method of preparation

Place the quail eggs in a saucepan and cover them with cold water. Bring the water to a boil over medium-high heat.

↓

Once boiling, reduce the heat to low and simmer for about 3-4 minutes. Then, remove the eggs from the heat and transfer them to a bowl of ice water to cool quickly.

↓

Once cooled, peel the eggs and set them aside.

↓

In a saucepan, combine the white vinegar, water, sugar, salt, minced garlic, mustard seeds, black peppercorns, dried red chilies (if using), bay leaf, turmeric powder, and paprika or chili powder.

↓

Bring the mixture to a boil over medium heat, stirring occasionally to dissolve the sugar and salt. Once boiling, reduce the heat and let it simmer for about 5 minutes to allow the flavors to meld.

↓

Gently add the peeled quail eggs to the simmering brine. Make sure they are fully submerged in the liquid. Allow the eggs to simmer in the brine for about 5-7 minutes.

↓

After simmering, remove the sauce pan from the heat and let the eggs cool in the brine for about 15-20 minutes.

↓

Using a slotted spoon, carefully transfer the quail eggs to clean, sterilized jars. Pour the brine over the eggs, making sure they are completely covered.

↓

If there's not enough brine to cover the eggs, you can make additional brine using the same proportions of vinegar, water, sugar, and salt.

↓

Seal the jars tightly and let the quail eggs pickle in the refrigerator for at least 24 hours before serving. The longer they marinate, the more flavourful they will become.

CHICKEN PICKLE

Method of preparation

1kg deboned breast meat

↓

Wash thoroughly with water after cutting into pieces

↓

Add little bit of salt and turmeric powder into meat pieces and mix well

↓

Keep it for 10 to 15 minutes

↓

Wash thoroughly with water

Fry the pieces in a pan under high flame without oil to remove moisture

↓

Prepare instant masala mix and fresh ginger garlic paste

↓

Then fry the chicken breast pieces in heated groundnut oil till they become brownish red, remover the breast pieces from oil after frying under high flame

↓

In the same oil add ginger garlic paste (2 to 3 table spoons) fry it, then add almonds, instant masala mix and 1 tea glass of red chilli powder

↓

Fry all the ingredients for 1 minute in oil

↓

Add fried chicken breast pieces into oil

↓

Add ½ to 3/4th tea glass of salt

↓

Mix thoroughly for 1 minute and turn off the flame

↓

Add 3/4th tea glass of lemon juice

↓

Allow it to cool

↓

Packaging in air tight containers

PORK PRODUCTS

HAM

Method of preparation

Select the leg portion of healthy pigs

↓

Legs are Trimmed &deboned

↓

Curing Ingredients Salt:Sugar: nitrate mixed

↓

Thoroughly in the ratio of 8:3:3 respectively for every 100kg of legs

↓

Divide the curing ingredients into two portions 1st portion is applied on sides, flesh &skin of legs

↓

Legs are stored at 5 to 1°c in refrigerator

↓

After 24 hrs 2nd portion of cure applied similarly on semi cured legs,curing further continued at refrigeration temperature with RH of 80 to 90% about 2 days

↓

Legs placed skin side down during curing period

↓

At end of curing legs are soaked in warm water (40°c) for 2hrs to remove excess salt. The surface salt is removed through scrubbing of edges& skin surface of legs

↓

Cured legs then smoked in smoking chamber for 24 hrs at 65 to 70°c

↓

Smoked ham left in smoking chamber for further period of 12 hours for cooling, shaping & ageing

↓

Cured& smoked ham is finally transferred into refrigerator & retained for further ageing

↓

Ham thus prepared is sliced & served as such after frying

SAUSAGES

Method of preparation

Grinding (or) mincing
↓
Mixing
↓
Chopping and emulsifying
↓
Stuffing
↓
Linking and tying
↓
Smoking and cooking
↓
Chilling
↓
Peeling and packaging

HAM PICKLE

Method of preparation

Prepare the vegetables by dicing the onions, bell peppers, carrots, and celery into small pieces. Set aside.

↓

In a large saucepan, combine the white vinegar, granulated sugar, mustard seeds, ground turmeric, celery seeds, ground cloves, ground allspice, and ground cinnamon. Stir well to combine.

↓

Place the saucepan over medium heat and bring the mixture to a simmer. Stir occasionally to dissolve the sugar and spices.

↓

Once the mixture is simmering, add the diced ham and vegetables (onions, bell peppers, carrots, celery, and pickles) to the saucepan. Stir well to coat everything in the vinegar and spice mixture.

↓

Season the mixture with salt and pepper to taste. Adjust the seasoning according to your preference.

↓

Allow the mixture to simmer gently over medium-low heat for about 10-15 minutes, or until the vegetables are tender but still slightly crisp.

↓

Once the vegetables are cooked to your liking and the flavors have melded together, remove the saucepan from the heat and let the ham pickle cool to room temperature.

↓

Once cooled, transfer the ham pickle to clean, sterilized jars. Make sure to pack the mixture tightly into the jars, leaving a little space at the top.

↓

Seal the jars tightly with lids and store them in the refrigerator. The ham pickle will continue to develop flavor as it sits, so it's best to let it chill for at least 24 hours before serving.

DEVELOPMENT OF MEAT COOPERATIVE MODEL ON PAR WITH MILK

MEAT TRACEABILITY

Introduction

Meat traceability refers to the system of tracking meat products from their origin through the entire supply chain to the final consumer. This system ensures that every stage of the meat's journey is recorded and traceable, from farm to fork. Traceability is crucial for food safety, quality assurance, and consumer trust, providing transparency and accountability throughout the meat production process.

Importance of Meat Traceability

1. **Food Safety**: Ensures contaminated products can be quickly identified and removed from the market, preventing foodborne illnesses.
2. **Quality Assurance**: Helps maintain high standards in meat production by tracking and verifying the conditions under which the meat was produced.
3. **Consumer Confidence**: Provides consumers with information about the origin and handling of the meat, enhancing trust in the product.
4. **Regulatory Compliance**: Meets legal requirements set by government agencies to ensure safe and ethical food production practices.
5. **Market Access**: Enables producers to meet international standards, facilitating export and trade.

Components of Meat Traceability

1. **Identification**: Each animal or batch of meat is given a unique identifier (e.g., ear tags, RFID tags, barcodes) that can be tracked throughout its lifecycle.
2. **Data Collection**: Information is recorded at every stage, including birth, rearing, feeding, medical treatments, slaughter, processing, and distribution.
3. **Data Management Systems**: Advanced software systems and databases store and manage traceability data, enabling real-time tracking and historical data retrieval.
4. **Labeling**: Labels on meat products provide information about the origin, processing, and other relevant details, making it accessible to consumers and stakeholders.
5. **Verification and Auditing**: Regular checks and audits are conducted to ensure the integrity and accuracy of the traceability system.

Technologies Used in Meat Traceability

1. **RFID (Radio-Frequency Identification)**: Tags attached to animals or meat products transmit data wirelessly, allowing for easy tracking and identification.
2. **Barcodes and QR Codes**: Used on packaging to provide detailed information about the product that can be scanned by retailers and consumers.
3. **Blockchain**: A decentralized ledger technology that ensures secure and immutable recording of transactions and data, enhancing transparency.
4. **GPS Tracking**: Monitors the movement and location of livestock during transportation.
5. **IoT (Internet of Things)**: Sensors and devices that collect real-time data on environmental conditions, animal health, and more.

Implementation Challenges

1. **Cost**: Implementing advanced traceability systems can be expensive, particularly for small-scale producers.
2. **Data Integration**: Ensuring seamless data exchange and integration across different stages and stakeholders can be complex.
3. **Compliance**: Keeping up with varying regulations across regions and countries requires constant monitoring and adjustments.
4. **Education and Training**: Ensuring that all participants in the supply chain are properly trained to use traceability systems effectively.

Global Standards and Regulations

1. **ISO Standards**: ISO 22005 provides guidelines for the design and implementation of traceability systems in the food and feed chain.
2. **EU Regulations**: The European Union has stringent traceability requirements for meat, including Regulation (EC) No 178/2002, which mandates the traceability of food, feed, and food-producing animals.
3. **US Regulations**: The USDA's Animal and Plant Health Inspection Service (APHIS) and the FDA have regulations that require traceability in the meat supply chain.
4. **Codex Alimentarius**: Internationally recognized guidelines developed by FAO and WHO to ensure food safety and quality, including principles of traceability.

Future Trends in Meat Traceability

1. **Enhanced Consumer Access**: Increasing use of apps and online platforms where consumers can trace the journey of their meat products.
2. **Artificial Intelligence (AI)**: Utilizing AI for predictive analytics and improving the efficiency of traceability systems.
3. **Sustainability Tracking**: Incorporating data on environmental impact and sustainability practices into traceability systems.
4. **Global Harmonization**: Efforts to standardize traceability systems and regulations internationally to facilitate easier compliance and trade.

Conclusion

Meat traceability is a vital component of modern food safety and quality assurance systems. It encompasses a range of technologies and processes designed to provide transparency and accountability throughout the meat supply chain. While there are challenges to its implementation, ongoing advancements and increased consumer demand for transparency are driving improvements and innovations in the field.

BY PRODUCT UTILIZATION

Domesticated animals are slaughtered for the purpose of human consumption. Normally 30 - 40 % of the animal is utilized for food (meat, edible offals, processed meat) and the remaining 60-70 % of the carcass constitute carcass by-products. Efficient utilization of meat by-products through proper collection and processing is important for the profitability of the meat industry. If the animal by-products are not efficiently utilized, of course, a valuable source of potential revenue is lost, and the added and increasing cost of disposal of these is incurred by the industry. Today, the cost of the live animal often exceeds the selling price of its carcass, therefore the value of the by-products must pay the expenses of slaughter and generate the profit for the meat slaughtering operation.

Advantages of by-products utilization:

1. Protection of the environment from pollution and improvement of environmental sanitation. Blood, trimmings, condemned offals attract flies, rats, stray dogs etc. causing public nuisance, spread of diseases, obnoxious odor following decomposition and breeding ground for micro-organisms. Hence, hygienic disposal checks the pollution and the ill results.
2. Better returns to the livestock producer. Production of value added secondary by-products has significant influence on livestock pricing
3. Augments the supply of highly nutritive feed for healthier and more productive livestock. Meat meal is rich in protein whereas bone meal is a rich source of phosphorus.
4. Development or setting up of secondary rural industries. Small-scale industries based on animal by-product particularly tanneries, glue, brush, pet food, stock feed and fertilizer industries are in existence.
5. Employment generation as the conversion of primary by-product to secondary by-product is a labor intensive process.
6. Increase crop production- The inedible offals can be converted into nitrogenous fertilizer and can be applied to improve the yield of fields, garden and plantation.

Prerequisites for profitable processing of by-products:

a. Adequate supply of raw material

b. Availability of cheap and satisfactory storage facilities for perishable material

c. Development of practical commercial process for manufacturing derived or secondary by-products and availability of suitable equipments and chemicals

d. Availability of potential market outlet for the new proposed product.

e. Technical training of personnel for proper and scientific functioning.

Nutritive value:

a. Edible meat by-products contain many essential nutrients. Some are used as medicines because they contain special nutrients such as amino acids, hormones, minerals, vitamins and fatty acids.

b. The vitamin content of organ meats is usually higher than that of lean meat. Kidney and liver contain the largest amount of riboflavin (1.697-3.630 mg/100g), which is 5-10 times more than lean meat. Liver is the best source of niacin, vitamin B12, B6, folic acid, ascorbic acid and vitamin A. Kidney is also a good source of vitamin B6, B12, and folic acid. A 100g serving of

liver from pork or beef contributes 450% - 1100% of the required daily intake (RDA) of vitamin A, 65% of the RDA of vitamin B6, 3700% of the RDA of vitamin B12 and 37% of the RDA of ascorbic acid.

c. Lamb kidneys, pork liver, lungs, and spleen are an excellent source of iron, as well as vitamins. The copper content is highest in the livers of beef, lamb and veal. They contribute 90-350% of the RDA of copper (2 mg/day). Livers also contain the highest amount of manganese (0.128-0.344 mg/100g). However, the highest level of phosphorus (393-558 mg/100g) and potassium (360-433 mg/100g) in meat by-products is found in the thymus and Pancreas (sweetbreads).

d. With the exception of brain, kidney, lungs, spleen and ears, most other by-products contain sodium at or below the levels found in lean tissue. Mechanically deboned meat has the highest calcium content (315-485 mg/100g).

e. Many organ meats contain more polyunsaturated fatty acids than lean tissue. Brain, chitterlings, heart, kidney, liver and lungs have the lowest level of monounsaturated fatty acids and the highest level of polyunsaturated fatty acids. There is three to five time more cholesterol (260-410 mg/100g) in organ meats than in lean meat, and large quantities of phospholipids. Brain has the highest level of cholesterol (1352-2195 mg/100g) and also has the highest amount of phospholipids compared to other meat by-products. The high cholesterol content of many other organ meats, and the possible accumulation of pesticides, drug residues and toxic heavy metals, are other reasons for limited consumption

S.No.	Primary by-product	Secondary by-product
1	Hide / skin	Leather, collagen sheets
2	Hide / skin trimmings	Glue
3	Bones	Bone meal, gelatin, dog chew bone morphogenic protein
4	Bristles	Brushes
5	Wool	Warm garments, lanolin
6	Feathers	Feather meal, decorative items, shuttle cock
7	Blood	Blood meal, albumen, haemoglobin, serum, plasma , fibrin
8	Intestine	Sausage casings, instrument strings, surgical sutures, tennis racket guts
9	Horns	Keratin, artifacts
10	Hoofs	Keratin, hoof meal, neat's foot oil
11	Intestinal contents	Manure
12	Condemned offals, meat , carcasses	Meat cum bone meal, offal meal, technical fat
13	Pancreas	Insulin ,Glucagon
14	Lung	Heparin

S.No.	Primary by-product	Secondary by-product
15	Liver	Liver extract ,liver meal
16	Edible offals (lung, liver, spleen)	Pet foods
17	Stomach	Trips
18	Calf stomach	Rennin
19	Adrenal gland	Adrenalin
20	Brain	Cerebro sides, cholesterol
21	Poultry combs	Hyaluronidase
22	Fat (tallow, lard)	Soap industry, textile industry
23	Thymus	Deoxyribonucleic acid
24	Manure	Fertilizer, biogas, power generation
25	Condemned offals, carcasses (low risk material)	Offal meal, carcass meal, technical fat ,feed supplement , pet foods

MILK PRESERVATION TECHNIQUES

Methods of Preservation of Milk and Milk Product

Milk preservation techniques are crucial for maintaining the quality, safety, and nutritional value of milk and its products. Various methods are employed to eliminate or inhibit the growth of spoilage-causing microorganisms, ensuring that milk remains safe and enjoyable to consume. Here's a detailed overview of these techniques

Removal of Micro-organisms:

It is difficult to efficiently eliminate organisms after they have entered milk. High-speed centrifugation eliminates 99% of bacteria's spores and half of their vegetative cells, as well as some protein. This method is not widely employed in the commercial sector**.**

USE OF HEAT

Thermisation

Thermisation involves heating milk to a mild temperature of 57 - 68°C for 15 - 20 seconds, followed by rapid cooling to less than 6°C. This method is effective against spoilage-causing bacteria but does not eliminate pathogens like Listeria monocytogenes. Its primary purpose is to reduce the growth of psychrotrophic bacteria and extend the shelf life of milk.

Pasteurization:

Pasteurization is done with 3 methods.

- Low Temperature Long Time: the process of heating every particle of milk or milk products to at least 63°C and maintaining that temperature for at least 30 minutes.
- High temperature short time: when milk is pasteurized at 72°C for 15 seconds, followed by rapid cooling.
- Ultra-High Temperature: UHT processing keeps the milk at 138°C for at least 2 seconds.

Objective of Pasteurization

- To destroy pathogenic organisms that may be present in milk.
- To enhance the keeping quality of milk and milk product.

Sterilization

Sterilization can be accomplished by the use of heat, chemicals, irradiation, high pressure, filtration, or a combination of these methods.

Steam under Pressure

Evaporated milk is canned and then heated under pressure using steam. As a result, milk should be heated to 93 to 100°C or higher to destroy resistant bacterial spores. Sealed cans of evaporated milk are processed for approximately 115 to 118 minutes, yielding a commercially sterile product.

Use of Low temperature

Most dairy products require the use of low temperature except canned milk and dry milk.

Refrigerated Milk*:*

- For the production of milk of good quality, it is essential to cool the milk after it is withdrawn from the cow
- Raw milk for pasteurization must be chilled to 1°C or below within 2 hours after being drawn and held at that temperature until processed.
- Milk is chilled throughout storage on the farm, as well as in the truck or tank during delivery to the receiving station.

Freezing:

- Ice cream and other frozen dairy desserts are frozen as a part of the manufacturing process. They are stored at low temperatures in the frozen state, where microbial multiplication is impossible.
- Pasteurized whole milk has been frozen at about -28 to -29°C and stored at a frozen state.

Drying:

- Dry products are produced by eliminating varying percentages of water from whole and skim milk.
- Enough moisture is removed to inhibit organism development.
- Whole milk powder should not include more than 5% moisture.

Aseptic Processing and Packaging

Combining UHT processing with sterile packaging to produce shelf-stable milk.

- **Process:** Milk is sterilized by UHT treatment and then packaged in sterile containers in a sterile environment.
- **Shelf Life:** Aseptic milk can last for several months unrefrigerated until opened.

Use of Preservatives

- Sorbic and propionic acid, or their salts, are authorized in cheese and yogurt to prevent mold development on their surfaces and extend their shelf life.
- They are also included in some hard cheeses and processed cheeses to avoid mold growth on the surface.
- Added sugar acts as a preservative in sweetened condensed milk.
- Hydrogen peroxide mixed with a light heat treatment is used for the pasteurization of milk to eliminate specific types of bacteria.

Fermentation

Fermenting milk to produce products like yogurt, kefir, and cheese.

- **Yogurt:** Milk is fermented with bacteria (Lactobacillus bulgaricus and Streptococcus thermophilus) at 43°C (110°F) for several hours. Yogurt can last 1-3 weeks in the refrigerator.
- **Kefir:** Milk is fermented with kefir grains containing bacteria and yeast. Kefir can last up to 2-3 weeks in the refrigerator.
- **Cheese:** Different cheeses have varying shelf lives, from a few weeks to several years, depending on the type and aging process.

Additional Methods

Other preservation techniques include:

- Dehydration: Removing water from milk to create powdered milk, which can be reconstituted later.
- Use of Preservative Agents: Adding substances like vitamins and minerals to extend shelf life.
- Microfiltration: Filtering milk to remove bacteria and other particles.
- Bactofugation: Using centrifugal force to separate bacteria from milk.
- Ohmic Heating and Microwave Heating: Applying electrical energy to heat milk.
- Pulse Electric Field and High-Pressure Process (HPP): Using electric fields or high pressures to kill bacteria.
- Ultrasound and UV Radiation: Employing sound waves or ultraviolet light to sanitize milk.

Each preservation method has its advantages and limitations, tailored to meet specific requirements for shelf life, nutritional retention, and cost-effectiveness.

MEAT PRESERVATION TECHNIQUES

Meat is a highly perishable commodity due to nearly neutral pH (low acid food), high moisture content and rich nutrients. Meat is a very good medium for microbial growth, hence unless it is stored or processed at proper temperature. The organisms, which are already present in meat, utilize the nutrients available and in the process they produce certain metabolites, gases and foul smelling compounds which we refer to as the spoilage. The products of bacterial growth are harmful to the human being. Food is spoiled by bacteria, mould, yeast and fat oxidation. Unless proper preservation methods are adopted, deteriorative microbial activity, enzymatic and chemical reactions along with physical changes are bound to occur. Efforts should be made to attain asepsis by avoiding contamination as much as possible.

Principles of Preservation

1. Prevention of delay of microbial spoilage:

   This can be done by 4 methods.

   (a) Keeping out the microbes (asepsis) avoid contact with meat, hygienic practices during processing.

   (b) Removal of microbes e.g. Filtration or removal of affected part on centrifugation or sedimentation.

   (c) Hindering the growth activity of microorganisms – By preservation at low temperature, by

drying, making anaerobic condition or by addition of chemicals.

(d) Destruction of microorganisms by heating, irradiation.

2. Prevention of delay of self autolysis / decomposition of the food

(a) Destruction or inactivation of food enzyme e.g. by (blanching) mild heat treatment

(b) Prevention of chemical reaction e.g. oxidation of fat prevented by antioxidants.

3. Prevention of mechanical damage to the meat \ caused by insects or handling.

Various methods employed to prolong the shelf-life of meat are :

1. Chilling / Refrigeration
2. Freezing, AFD,IQF
3. Curing
4. Smoking
5. Thermal processing (cooking)
6. Canning
7. Dehydration
8. Irradiation
9. Use of chemicals

These methods are also used in combination of one to two methods for more efficacy e.g. curing and heating, curing and smoking, freezing and irradiation.

Preservation By Cold

Preservation of foods by cold is one of the most widely used methods. The principle is extraction of heat from the meat, thus cooling the meat to a temperature below surrounding temperature.

There are two different methods of cold preservation

1. Chilling 2. Freezing.

Chilling / Refrigeration

This is the most widely used method of preservation for short-term storage of meat because chilling or refrigeration slows down the microbial growth and enzymatic as well as chemical reactions. Storage of fresh meat is done at a refrigeration temperature of 2 to 4°C.

Preservation by freezing

Freezing is a method of choice for the long-term preservation of meat. It stops the microbial growth and retards the action of enzymes. Freezing is usually done at temperature below -18^{0}C. This temperature is sufficient to prevent growth of all organisms and thus multiplication is stopped.

Vacuum packing

This is a process in which primal cuts of meat are placed in a gas-impermeable form of plastic (polythene, nylon/ polythene, polyester / polythene) laminate bags at 2-4°C and a pH of 5.5-5.8.

Curing

Preservation of meat by heavy salting is an age-old practice. It was applied as a thumb rule because refrigeration facilities were not available.*Curing* may be defined as the addition of *salt* (NaCl) and *nitrate/nitrite* or *nitric oxide* to the meat, which results in a conversion of the meat pigments, predominantly myoglobin, to the nitroso or cured form.

Smoking

Meat smoking was known to man as an aid in preservation for a long time. It is now well-known that smoke contains a large number of degradation products of wood such as aldehydes, ketones, organic acids, phenols etc., which exert bacteriostatic effect besides imparting characteristic smoky flavour.

Thermal Processing

Unlike refrigeration of meat that slows or stops microbial growth, thermal processing as a preservative method is employed to kill the spoilage microorganisms. Two temperature regimes as pasteurization and sterilizations are generally used. Pasteurization refers to moderate heating in the temperature range of 58°C to 75°C. Sterilization refers to severe heating at temperatures above 100°C whereby all spoilage microorganisms in meat are killed or their microbial cells are damaged beyond repair.

Dehydration/ Drying

Drying is one of the oldest methods for preservation of foods. It is not most widely used method for preservation of variety of foods. Drying will reduce the available moisture from the food, thus growth and multiplication of bacteria or microbes will be hindered.

Removal of water from meat concentrates the water-soluble nutrients making them unavailable to the microorganisms. The extent of availability of water to microbial ceil is expressed as water activity (a_w). Dehydration lowers the water activity considerably to prevent the growth of spoilage organisms. Sun drying of meat chunks as a means of preservation was practiced even in ancient days but rehydration of such meat chunks used to be limited. Mechanical drying process involves the passage of hot air with controlled humidity but here also there is difficulty in rehydration.

Freeze drying or lyophilization, accelerated freeze drying (AFD) :- Refers to removal of water from frozen foods based on the principle of sublimation. (Conversion of solid phase in to vapour phase without intermediate phase of liquid). Freeze drying of meat is a satisfactory process of dehydration preservation due to better reconstitution properties, nutritive quality and acceptability.

Irradiation

Radiation is the emission and propagation of energy in the material medium. Electromagnetic radiations are in the form of continuous waves. These are capable of ionizing molecules in their path. These radiations can destroy the microorganisms by fragmenting their DNA molecules and causing ionization of inherent water within microorganisms. Since microbial destruction of food takes place without significantly raising the temperature of food irradiation is many times referred as cold sterilization among radiation, alpha, and Beta- rays are charged particles and have limited use in food irradiation.

Chemicals

In addition to the above mentioned preservation techniques, there are many chemicals which prevent microbial growth in foods and act as preservatives. Several organic acids have been generally recognized as safe (GRAS) for use as chemical preservatives. Citric acid, propionic acid, benzoic acid, sorbic acid and their salts are effective mold inhibitors. Acetic acid and lactic acid prevent bacterial growth, whereas sorbate and acetate are capable of arresting the growth of yeast in foods.

Antibiotics:

Antibiotics like Chlortetracycline, Oxytetracyclines, Nisin and Natamysin have been used to increase the storage life of meat at chilling temperatures.

Antioxidants

These are the substances, which delay, retard or prevent the development of rancidity of fat or other deterioration due to oxidation. Common antioxidants used are butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT). The maximum permissible level in meat is 160-200 ppm.

READY TO EAT MEAT PRODUCTS

Introduction

Ready-to-eat (RTE) meat products are pre-cooked, processed, and packaged meat items that require no additional cooking before consumption. They cater to the growing demand for convenience foods and include a wide variety of products such as sausages, deli meats, cured meats, and more.

Packaging Technology

The packaging of ready-to-eat meat products plays a crucial role in preserving the freshness and extending the shelf life of the products. Two notable packaging technologies are Modified Atmosphere Packaging (MAP) and Vacuum Skin Packaging (VSP).

MAP: This technique extends the shelf life and preserves the freshness of food without the use of preservatives or chemical additives. It uses a mixture of pure oxygen, carbon dioxide, and nitrogen to fill the food package, reducing the oxygen level inside the package and inhibiting microbial growth. MAP is cost-effective, prevents spoilage, and enhances the taste and smell of packaged meals, contributing to customer satisfaction and loyalty.

VSP: This technology secures the food tightly within the package without causing damage to the container. The film and the tray are perfectly enclosed, creating a seal that guarantees the freshness of the meal. VSP is particularly useful for preserving the shelf life of ready-to-eat meals, ensuring they remain fresh and ready to consume

RETORTING

Known as autoclave/sterilizer, is a retort is a pressure vessel used to "commercially sterilize" food. Retorting is thermal processing of low acid foods prone to microbial spoilage in hermetically sealed containers to extend their shelf life. The goal is to obtain commercial sterilization by application of heat and pressure. Process done at temperatures at or above 250°F or 121°C. Batch retorts are widely used. Food safety & commercial sterility is measured by the inactivation of target organism. General heat resistant organisms taken into consideration are *Clostridium botulinum*. Exposure time and temperature is determined by certain calculation parameters such as D Value, Z value and F_0 value. There are batch and continuous type retort.

Types of Ready-to-Eat Meat Products.

1. Smoked Meats:
    - Examples: Smoked sausages, smoked turkey, smoked brisket.
    - Processing: Exposed to smoke for flavor and preservation, often fully cooked.
2. Sausages and Hot Dogs:
    - Examples: Frankfurters, bratwurst, kielbasa.
    - Processing: Ground meat mixed with spices, stuffed into casings, cooked, and sometimes smoked.

3. Deli Meats:
    - Examples: Salami, bologna, pastrami.
    - Processing: Often a combination of curing, cooking, and/or smoking.
4. Fermented Meats:
    - Examples: Pepperoni, chorizo, salami.
    - Processing: Fermented and sometimes dried to develop flavor and preserve.

Processing Methods

1. Cooking:
    - Methods: Boiling, baking, roasting, grilling.
    - Purpose: To ensure the meat is fully cooked and safe to eat. Cooking also enhances flavor and texture.
2. Curing:
    - Ingredients: Salt, sugar, nitrates/nitrites.
    - Purpose: Preserves meat by drawing out moisture, inhibiting microbial growth, and adding flavor.
3. Smoking:
    - Types: Hot smoking (cooking), cold smoking (flavoring).
    - Purpose: Adds a distinct smoky flavor, helps in preservation, and can also cook the meat.
4. Fermentation:
    - Microorganisms: Lactic acid bacteria.
    - Purpose: Develops unique flavors, preserves the meat, and enhances shelf-life.
5. Drying:
    - Methods: Air drying, dehydration.
    - Purpose: Removes moisture to prevent spoilage and extend shelf-life.
6. Packaging:
    - Types: Vacuum sealing, modified atmosphere packaging (MAP).
    - Purpose: Extends shelf-life, maintains freshness, and prevents contamination.

Safety Considerations

1. Microbial safety:
    - Hazards: Pathogens such as Listeria monocytogenes, Salmonella, E. coli.
    - Controls: Proper cooking, curing, and smoking processes, along with stringent hygiene practices.
2. Chemical safety:
    - Hazards: Residual nitrites/nitrates, chemical contaminants.
    - Controls: Regulated use of additives, adherence to safety standards.
3. Allergen control:
    - Common Allergens: Soy, dairy, gluten used as fillers or flavorings.
    - Controls: Clear labeling, separation of allergen-containing ingredients during processing.

4. Packaging integrity:
    - Risks: Physical contamination, packaging defects.
    - Controls: Quality control checks, use of high-quality packaging materials.
5. Shelf-life stability:
    - Factors: Temperature control, light exposure, oxygen levels.
    - Controls: Cold chain management, use of preservatives, appropriate packaging.

Conclusion

Ready-to-eat meat products offer convenience, variety, and nutritional benefits. Their development involves sophisticated processing techniques to ensure safety, quality, and extended shelf-life. By adhering to stringent safety standards and utilizing advanced packaging methods, RTE meat products meet the growing consumer demand for quick and nutritious meal options.

DEVELOPMENT OF FUNCTIONAL MILK AND MEAT PRODUCTS

Introduction:

Functional foods (sometimes referred as physiologically functional foods, nutraceuticals, designer's foods or pharma foods) can be defined as those that provide the consumer with an identified health benefit above basic nutritional value. The principles in the development encompass incorporation of different "functional" substances or microorganisms ranging from probiotics and prebiotics, phytosterols, minerals, vitamins to bioactive peptides. Also, the production of innovative functional dairy products has focused on incorporating food byproducts as source of bioactive compounds, thereby reducing the waste in the food chain and offering new ways to diversify the production of dairy foods.

The application of milk or dairy products as a vehicle for preparation of functional products is an excellent strategy that can lead to rapid improvement of the nutritional status of the population due to several advantages: milk is centrally processed and therefore quality control can be effectively implemented, it is widely consumed regularly in predictable amounts by people of different age groups and the cost is affordable by the target population.

Key Functional Ingredients for Milk:

1. **Pro-biotics**:
    - **Sources**: Lactobacillus, Bifidobacterium strains.
    - **Benefits**: Improve gut health, boost immunity, and may help in preventing gastrointestinal disorders.
2. **Pre-biotics**:
    - **Sources**: Inulin, oligosaccharides.
    - **Benefits**: Promote the growth of beneficial gut bacteria, enhance digestion, and improve calcium absorption.
3. **Omega-3 Fatty Acids**:
    - **Sources**: Fish oil, flaxseed oil, algal oil.
    - **Benefits**: Support cardiovascular health, brain function, and anti-inflammatory effects.
4. **Vitamins and Minerals**:
    - **Examples**: Fortification with vitamins D, A, B12, and minerals like calcium and iron.

- **Benefits**: Prevent deficiencies, support bone health, and boost overall nutritional profile.

5. **Plant Sterols and Stanols**:
   - **Sources**: Added during processing.
   - **Benefits**: Help reduce cholesterol levels, support heart health.

Processing techniques for Functional milk products:

1. **Fortification and Enrichment**:
   - Adding vitamins, minerals, and other functional ingredients to enhance nutritional value.
   - Example: Vitamin D-fortified milk to support bone health.
2. **Fermentation**:
   - Producing fermented milk products like yogurt and kefir enriched with probiotics.
   - Example: Probiotic-rich yogurt to improve gut health.
3. **Microencapsulation**:
   - Protecting sensitive ingredients (e.g., omega-3 fatty acids) during processing and storage.
   - Example: Microencapsulated fish oil in milk to prevent oxidation and maintain stability.
4. **Ultrafiltration and Nanofiltration**:
   - Techniques to concentrate proteins and remove lactose.
   - Example: High-protein, lactose-free milk products.

KITS FOR IDENTIFICATION OF PRESERVATIVES/ADULTERATIONS IN MILK

The development of kits for detecting preservatives and adulterants in milk has been a significant area of research and innovation due to the widespread issue of milk adulteration. These kits are designed to ensure the safety and quality of milk by identifying harmful substances that may be added to it. Here are five key points about this development:

1. **Technological Innovations**:

   Recent advancements have led to the creation of rapid and user-friendly detection kits that can be used in the field or at home. These kits often utilize colorimetric tests, enzyme-linked immunosorbent assays (ELISA), and lateral flow immunoassays, which are similar to pregnancy tests. These methods provide quick and reliable results without the need for sophisticated laboratory equipment.

2. **Types of Adulterants Detected**:

   Detection kits are designed to identify various common adulterants, including water, starch, detergents, urea, melamine, formalin, and synthetic milk. Some kits are also capable of detecting antibiotics and other preservatives like hydrogen peroxide and carbonates that may be added to extend the shelf life of milk or enhance its appearance and taste.

3. **Commercial Availability**:

   Several companies and research institutions have commercialized milk testing kits. For example, the Indian company FSSAI (Food Safety and Standards Authority of India) has developed the "Milk Adulteration Test Kit" that can detect multiple adulterants. Other

examples include the Charm Sciences MRL-3 (for antibiotic residues) and the Lactoscan MCC (for various adulterants).

4. **Regulatory and Safety Standards**:

The development and use of these kits are often driven by regulatory bodies aiming to enforce food safety standards. In many countries, regulatory authorities mandate regular testing of milk by producers and processors. These kits help ensure compliance with safety standards set by organizations such as the FDA (Food and Drug Administration) in the USA, EFSA (European Food Safety Authority), and others.

5. **Impact on Public Health**:

The deployment of detection kits has significantly improved the ability to monitor and ensure the safety of milk supplies. This has direct implications for public health, reducing the risk of food borne illnesses and exposure to harmful substances. It also helps in maintaining consumer confidence in dairy products and supports the dairy industry's efforts to provide safe and quality milk.

Overall, the development of milk detection kits represents a crucial step in safeguarding public health and ensuring the integrity of dairy products in the market. Detecting adulterants in milk is crucial for ensuring food safety. Here are some methods and developments related to detecting milk adulteration:

1. **Common Milk Adulterants and Detection Techniques**:

Qualitative Detection: Chemical reactions can be used for qualitative detection of common milk adulterants. For instance:

- **Hydrogen Peroxide**: Add 2 ml of milk to a test tube and mix with 0.5 ml of NaOH (2%), 0.5 ml of sodium hypochlorite (2%), and 0.5 ml of phenol (5%). Heat the mixture in a boiling water bath for 20 seconds. The appearance of a blue color indicates the presence of hydrogen peroxide as an adulterant.

Quantitative Detection: Quantitative detection methods are more complex and diverse. They depend on the nature of the adulterants:

- **Foreign Protein**: Liquid Chromatography (LC) and Enzyme Linked Immunosorbent Assay (ELISA) are commonly used techniques.
- Species Adultration: Polymerase Chain Reaction (PCR) and Polyacrylamide Gel Electrophoresis (PAGE) are used to detect milk from different species as adulteratnts in mil of a particularspecies.

2. **3D Paper-Based Milk Adulteration Detection Device**:

- Researchers have designed a three-dimensional (3D) paper-based microfluidic device to simultaneously detect multiple chemical adulterants in milk. This device comprises a top cover, a bottom cover and a middle layer with transportation and a detection zone.

3. **Ready-to-Use Kits**:

- The National Dairy Development Board (NDDB) has developed and commercialized ready-to-use kits for detecting commonly used adulterants in milk. These kits are useful at both the dairy and household levels.

4. **Mid-Infrared Spectroscopy**:

- Recent advances include using mid-infrared spectroscopy to detect and quantify adulterants, milk dilution, pathogenic bacteria, veterinary drugs and hazardous substances in milk

FRAUDULENT SUBSTITUTION OF MEAT

Adulteration of meat involves substitution of costly or superior quality with cheaper, undesirable or inferior quality meat. It is a fraudulent practice that is objectionable on the grounds of health, religion and economics. The substitutions generally practised are mutton for goat meat (Chevon), beef for buffalo meat, rabbit meat for chicken etc. The instances of dog or cat meat or even veal as goat meat have also come to light.

Recognition of Fraudulent Substitution or Adulteration

1. Physical Methods
    i. General Appearance: Colour, consistency, odour
    ii. General characteristics of the body fat: Colour, consistency, quality etc.
2. Anatomical Methods
    i. Dentition
    ii. Bone percentage of carcasses
    iii. Rib numbers and their degree of curvature
    iv. Characteristics of long bones
3. Histological Methods
    I. Muscle fibre length ii. Muscle fibre diameter

    The diameter and number of muscle fibers, determined by a fibreoptic microscope, can also lead to species identification.
4. Chemical Methods
    i. Composition of meat - Composition of meat Muscular fat content varies according to the meat species. The intramuscular fat in mutton is higher (13.3 per cent) as compared to beef (2.6 per cent), buffalo meat (0.9 per cent), chevon (3.6 per cent) and pork (4.4 per cent). Vitamin A is present in beef and mutton but absent in buffalo meat, chevon or pork.
    ii. Myoglobin content- Myoglobin content Horse flesh contains maximum myoglobin content (0.71 per cent), much higher than the musculature of other animals.
    iii. Glycogen content- Glycogen content Horse flesh is richer in glycogen as com- pared to most food animals.
    iv. Composition of body fat - Refractive index: Horse fat has higher refractive index (53.5) than ox (less than 40) and pig (less than 50) fat.
    v. Iodine number: lodine number of horse fat (70-85) is higher than even lard (50-70), whereas iodine number of ox and sheep fat is 35-46.
    vi. Carotene content: Buffalo fat is white due to absence of carotene whereas cow fat is cream to yellow in colour due to carotene content.
    v. Fatty acid analysis: Horse fat contains 1-2 per cent linoleic acid whereas other fats contain less than 0.1 per cent linoleic acid.
5. Immunological/Serological Methods
    i. Precipitation test
    ii. Double immuno-diffusion test
    iii. Single radial immuno diffusion test
6. Electrophoretic Methods
7. Polyacrylamide disc electrophoresis
8. Polyacrylamide gel electrophoresis
9. Sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE)
10. Iso-electric Focusing
11. Enzyme-Linked Immuno Sorbent Assay (ELISA).