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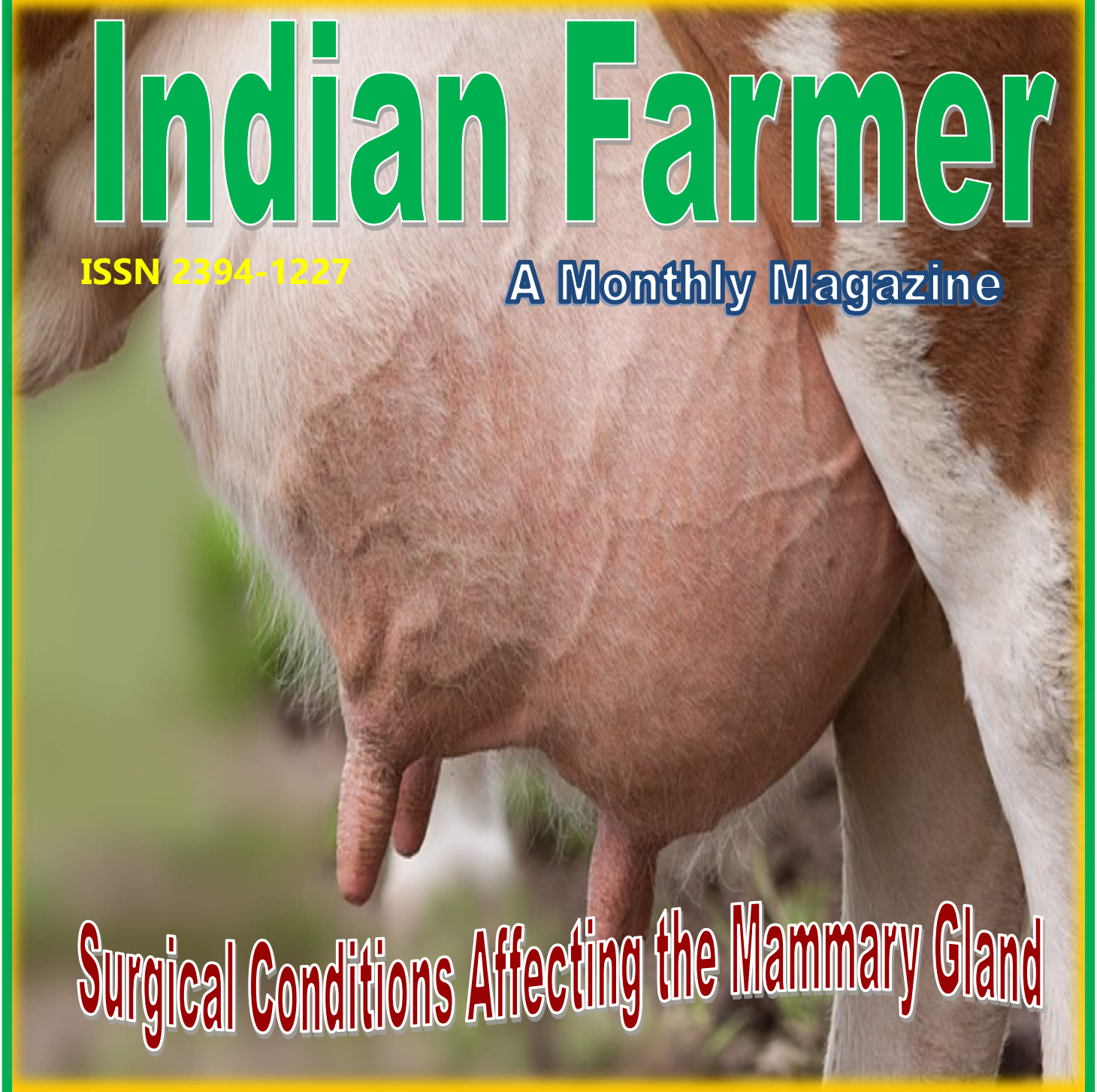

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Effect of Probiotic Feeding on Animal Health and Production

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Probiotics are microbial food supplements which beneficially affect the host animal by improving the intestinal microbial stability. The feeding of probiotics improved the feed conversion efficiency of many species, decreased morbidity or mortality and benefits the consumer through improved product quality. Bacterial probiotics are effective in chickens, pigs and pre-ruminant calves, whereas yeasts and fungal probiotics beneficial in adult ruminants. Probiotics feeding enhanced the growth of many domestic animals, improved the efficacy of forage digestion, quantity and quality of milk, meat and egg. Probiotics protected animals against pathogens, enhanced immune response, reduced antibiotic use and shows high index of safety.

Microorganisms used in probiotics are:

- *Lactobacillus*
- *Streptococcus*
- *Enterococcus*
- *Bacillus*
- *Clostridium*
- *Bifidobacterium*
- *E. coli*

Mechanism of action

Probiotics mainly acts through four ways viz. antagonistic to production of antimicrobial substances, competition with pathogen for adhesion sites or nutritional sources, immunomodulation of host and inhibition of bacterial toxin production.

EFFECT OF PROBIOTIC FEEDING ON ANIMAL PRODUCTION

Growth rate:

Administration of probiotics in chicken, pig, equine, sheep, goat and cattle significantly improved the feed intake, feed conversion efficiency, daily weight gain and total body weight (Chiofalo *et al.*, 2004; Li *et al*., 2006Torres-Rodriguez *et al*., 2007; Samli *et al*., 2007; Casey *et al*., 2007). Probiotics reduced leg weakness in broiler, starvation sterility in sows (Plavnik and Scott, 1980; Bohmer *et al*., 2006). It has the beneficial effect on various digestive processes, like cellulolytic, synthesis of microbial protein, stabilization of ruminal P^H, and increased absorption of nutrients.

Milk production:

Probiotic supplementation in animal feeds having beneficial effect in subsequent milk yield, fat and protein content. The species like *Aspergillus oryzae* and *Saccharomyces cerevisiae* have direct effect on milk production, milk Solids-Not-Fat (SNF) and milk protein percentage in dairy cows. This is due to the numbers of cellulolytic bacteria, fiber degradation and changes in Volatile Fatty Acid (VFA) in the rumen (Martin and Nisbet, 1990).

Meat production:

Due to growing interest of customer for quality and safe animal products, the

probiotic supplements in animal feeds provide beneficial effect on animal health, productivity and quality products. Probiotics improved the carcass quality through water holding capacity, decreased cooking loss and hardness**.** Probiotics reduces the morbidity and mortality in various species and reducing the use of antibiotics for disease control. For preservation of fermented products mainly lactobacillus, Pediococcus and Streptococcus species were used which produce continuous and controlled acidification that inhibit the growth of undesirable microorganism. In various meat industries lactobacillus species were used for prevention of staphylococcus aureus in fermented meat products.

Egg production:

Probiotics supplementation in poultry feed having increased effect on egg production, egg quality, egg shell weight, egg shell thickness and decreased egg contamination. In addition probiotics also reduced the plasma cholesterol level and triglyceride, confirming the role of gastro-intestinal tract organism in recycling of lipid.

EFFECT OF PROBIOTIC FEEDING ON ANIMAL HEALTH

***Protection against pathogens*:**

The probiotics feeding safeguards the host animal by preventing the pathogen proliferation through competition to colonization sites, nutritional source, toxic production or stimulation of immune system. Probiotics can significantly protect mice against infection with the invasive food borne pathogen *Listeria, monocytogenes* and *Salmonella typhimurium* and protect pigs against diarrhea (Corr *et al*., 2007). The protection included a ten-fold increase in survival rate, significantly higher post-challenge food intake and weight gain and reduced pathogen translocation to visceral tissues. Probiotics have been shown to be involved in protection against a variety of pathogens in chicken including *Escherichia coli* (Chateau *et al*., 1993) Salmonella and Campylobacter ((Stern *et al*., 2001) Clostridium and Eimeria (Dalloul and Lillehoj, 2005). Probiotic activity was largely inhibitory since the probiotics bacteria can reduce the level of *E. coli* O157 carriage and faecal shedding in cattle and calves (Brashears *et al*., 2003) and decreased the severity and duration of diarrhea in *Escherichia coli* O157:H7-infected infant rabbits (Ogawa *et al*., 2001; Casey *et al*., 2007.The effect of probiotics supplement in piglet feeding was studied by Simon *et al* (2003) and compared with control group as shown in table 1.

***Improve immune system*:**

Probiotic in a healthy animal stimulate non-specific immune response and enhance the system of the immune protection (Ceslovas *et al*., 2005). Probiotic increased intestinal IgA secretion both in sows and piglets and elevated IgG and IgM levels in turkey (Cetin *et al*., 2005). The effect of intestinal IgA secretion could be related to a more successful mucosal defense which in turn led to a lower level in systemic IgG production in piglets after weaning (Scharek *et al*., 2007). A probiotic influence transport properties of small intestine epithelium and increased absorption of glucose could be interpreted

as a positive effect for the animal. The probiotic that enhance immunoglobulin levels have more positive effect on growth performance, production and ability to disease resistance (Cetin *et al*., 2005).

Table 1. Effect of probiotic supplemented feeds on incidence of diarrhea in piglet

Probiotics	Age	Incidence of diarrhea	Reference
B. cereus	8 weeks	Reduced	Kyriakis *et al.* (2009)
B. cereus	1-85 Days	Reduced	Iben and Leibesteder (1989)
B. cereus	7-21 Days	Reduced	Zani *et al.* (1998)
B. cereus	2 week post weaning	Reduced	Jadamus (2001)
E. faecium	1-70 days	Reduced	Manner and Spieler (1997)
E. faecium	8 day before and after weaning	Reduced	Schumm *et al.* (1990)
P. acidilactici	5-28 days	Reduced	Durst *et al*. (1998)
S. cerevisiae	5-28 days	Reduced	Durst *et al.* (1998)

We conclude that probiotics have a positive effect on animal production by improving growth rate and increasing milk, meat and eggs production. In addition, probiotics can inhibit pathogens by competition for a colonization sites or nutritional sources and production of toxic compounds, or stimulation of the immune system. In order to enhance the efficacy of probiotics, it is necessary to obtain additional knowledge on their mode of action.

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Dehorning Methods of Animals

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This is a process by which the horns of an animal are removed after birth by treating the tender horn roots with a chemical, mechanical or electrical dehorner. Dehorning of yearling and older animals is painfull and results in considerable bleeding. The practice is, therefore, to dehorn the calf before it is 10 days old. Up to this age the horn button does not become attached to the skull.

ADVANTAGES:

- Safe handling and proper feeding of animals
- Protection of animals against injury due to fight.
- It is essential for any animals kept in loose housing.
- Uniform appearance.
- Less floor space required.
- Prevention against horn cancer.
- Cows and heifers can be fed in the same shed.

DISADVANTAGES

- Animal with a nice horn have a style. This sometime is an advantage in exhibition and cattle shows.
- Some breeds have got an important identification marks for horn e.g., Kankrej, Kangayam etc.
- Animals with horn can defend themselves.

MATERIALS REQUIRED

Chemical Method:

1. Caustic stick (KOH) and holder
2. Scissors
3. Vaseline
4. Cotton wool
5. Dusting powder (ZnO)
6. Suitable bedding
7. Spirit

Mechanical Method:

1. Mechanical dehorning clippers (horn pincer and saw)
2. Bandages
3. Cotton wool
4. Spirit
5. Pine tar
6. Sulphanelamide powder and iodoform

Electrical Method:

1. Electrical dehorner
2. Scissors

Rubber Band Method:

1. Tight rubber rings
2. Scalpel
3. Elastrator

Substitute Chemical for Caustic Potash:

- Dehorning paste used for destroying the horns matrix in calf hood. These

often consist of sodium hydroxide to prevent horn growth. A widely used paste formula contains 52% sodium Hydroxide, 14% calcium hydroxide and 44% water.

- Other chemicals:- New patent formula contains Antimony tri-chloride, Salicylic acid.

(A) Chemical method:

- Cast the animal down and secure its feet together with a rope.
- Turn the head slightly towards the operator.
- Locate the horn bud.
- Clip the hair 2 cm around the horn bud.
- Rub the horn bud with a piece of cotton wool soaked in surgical spirit.
- Apply Vaseline in a ring shape around the horn bud.
- Hold the caustic in the holder or with a piece of paper cotton and wet the tip.
- Rub it in a circular motion on the horn bud.
- Stop it as soon as the entire bud surface becomes reddish in appearance.
- Wipe the surface with cotton.
- Put some dusting powder.
- Repeat the same procedure with other bud.

PRECAUTIONS:

- In case of bleeding seal it with tincture benzoin or Tincture Ferriperchloride.
- Calves should not be turned out into rain after the treatment with caustic potash to prevent spreading and burning too large and area.
- Caustic potash stick should be previously wrapped in paper to avoid burning of fingers.
- Optimum age of calf for dehorning is two weeks.

(B) Mechanical Method:

Animal should be casted and thrown on the soft ground properly. When animals have partly or fully grown horns, the horn pincers or clippers or dehorning saw is used to cut the horn. The operation should take place when animal is around 2 years of age or older. The wound should be covered with sulphanelamide powder mixed with iodoform or it treated with pine tar or cotton soaked in pine tar than apply bandages.

PRECAUTIONS:

- Whichever the instrument is used, horn should be removed as near the head as possible.
- If dehorning is done in hot and rainy weather, care must be taken to protect the wound from flies. Iodoform may be used as fly repellent.
- As far as possible, dehorning should be done in cold weather.
- Dehorning should not be done at an early age, as the scars are likely to develop.
- To minimize the bleeding, the horn artery may be tied with a silk thread.
- Sanitary precautions must be observed.

(C) Electrical Method:

- Secure the calf of 3 weeks age and thrown on the proper bedding gently.
- Locate the horn buds property.

- Clip the hairs 2 cm around the buds-properly.
- Switch on the current to make end of the electric dehorner red hot.
- The horn is cauterized by applying electric dehorner just for 8 to 10 seconds.
- The calf is let loose when golden colour appears at the site of cauterized horn buds.
- If electric dehorner is used properly the calf never bleeds and the method is quite safe and quick.

(D) Rubber Band Method:

- Secure the calf in which horns are very small and not hard.
- Turn the calf head slightly towards the operator.
- Make a shallow groove around the base o horn forming ring.
- Slip a tight rubber ring over the horn with the help of elastrator and fix it into the grove.
- After few days the horn will gradually get out and fall on the ground because the tight rubber ring will shut off the blood supply to the horn. It is not a dependable and satisfactory method.

Surgical Conditions Affecting the Mammary Gland - Field Application

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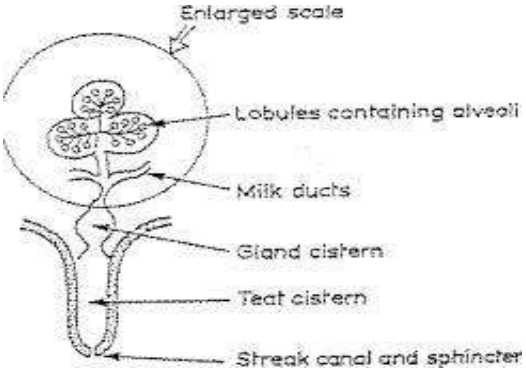
Surgical conditions of mammary glands are getting much attention now a day as these affects the economy of the farmer. Milk alone contributes around 63% to the total output from livestock. The udder and teats are vulnerable to external trauma because of their anatomical location, increase in size of udder during lactation, faulty methods of milking, repeated trauma to the teat mucosa, injury by teeth of calf, paralysis resulting from metabolic disturbances at parturition. Any disease condition of mammary gland not only causes painful milking but also makes the gland prone to mastitis. So this article deals with the field application of surgical conditions affecting the mammary gland.

ANATOMY OF MAMMARY GLAND

Mammary glands are modified skin glands. The shape of the udder may vary from bowl to trough type, round or pendulous. Teats may be cylindrical to conical in shape. In cows and buffaloes, the mammary glands are highly developed and consist of 4 quarters; divided into right and left halves by a complete septum. The suspensary apparatus and blood and nerve supplies the two halves are independent of each other. So one half of the udder can be easily removed without affecting the other. Such half consists of cranial and a caudal quarter has independent glandular tissues but a common blood and nerve supply and lymph drainage. Artery supply from branches of external pudic and perineal arteries, venous drainage is through external pudic, perineal and mammary veins. Nerves supply is primarily through inguinal nerves and caudal mesentric plexus of the symphathetic system.



Anatomy of Teat

- Membranous tubes consists of skin, muscular layer, fibrous layer and mucosa. Skin of teat is free from sebaceous or sweat gland.
- Muscular layer made of smooth muscle in two layers. Superficial in longitudinal fashion and deep circular fashion which forms sphincter to the teat canal.
- Duct system of teat has two main parts. Teat cistern and streak canal.
- The closing mechanism of teat by sphincter prevents the leakage of milk and milking is done by overcoming the closing mechanism by pressure.

Restraint and Anaesthesia

- For simple procedure local anaesthesia is enough (2% lignocaine hydrochloride).
- Small lesion or wound – Local anaesthestic or local block edges of lesion or wound.
- Small fistula or laceration – Ring block around the base of the teat.
- Polyps or granulation tissue growths – Intra luminal local anaesthesia. For this purpose, bandage or intestinal clamp around the base of the teat to prevent milk from entering the teat cistern. The milk present in the teat is expressed out. The teat cistern is then filled with about 10ml of 2% lignocaine after 15 to 20 min, teat cistern desensitized.
- If major or delicate surgery is indicated, control of the animal in lateral recumbency is recommended.

Preparation for surgery

- With holding feed and water for 12 to 24 hours to reduce ruminal distension if the animal is to be controlled in lateral recumbency.
- Strict asepsis even for minor surgical operation.
- Teat should be washed and dried.
- If skin is oily – defatted by ether and alcohol.
- For teat surgery solutions should not applied above the teat since it run down and thus bring infection.
- Clean and aseptic surgery reduces the chances of post operative development of mastitis.

Surgical diseases/affection

It can be divided into three main groups.

Condition that affect epithelial surface of udder/teat	Supernumerary teat Fused teats Teat fistula Papilloma and warts
Surgical diseases of teat cistern	Lactoliths, polyps, teat spider and local and diffused obstructions
Surgical affection of streak canal	Contracted sphincter, enlarged teat orifice, rupture and laceration of streak canal mucosa and occulusion of teat orifice.

Supernumerary teats

Common in bovines. It interferes with milking procedure. Their functional capacity can only be determined after parturition of the animal. Removed for cosmetic reasons.

Procedure

- Under local anaesthetic supernumerary teats are removed by making tw elliptical incisions at the junction of teat and skin of udder.
- Closed with interrupted suture using non-absorbable suture material.
- Remove suture after 7 to 10 days.

Fused teats

- Rarely seen.
- In such case, skin of two teats fused together form the base without any involvement of teat canal or muscles.
- Surgery in such case is by division of the skin in between fused teats and suturing the cutaneous.

- Procedure done under local anaesthesia.

Teat laceration

- Common in goat due to their pendulous udder.
- Barbed wire fences, thorny bushed causes deep injury.
- Superficial wounds are treated by non-irritants, antiseptics.
- Large wound involving the skin and mucularis but not mucosa may require placement of few simple interrupted or vertical mattress sutures using non-absorbable suture material.

Place the animal in lateral decumbency after deep sedation

↓

Tourniquet is applied at the base of teat

↓

Teat siphon is inserted and debridement is done to remove the dead tissue

↓

Mucosa is closed by simple interrupted or simple continuous using absorbable suture material.

↓

Submucosa and mucularis closed together using simple continuous suture.

↓

Final skin is closed with absorbable or non-absorbable suture material using simple interrupted or vertical mattress.

↓

Tourniquets and teat siphon is withdrawn.

↓

Teat is gently squeezed to check any leakage. Use antibiotic if leakage leads to fistula.

↓

Insert polyethylene catheter to prevent or avoid stenosis.

↓

Post operative antibiotics are infused into the affected teat for 4 to 5 days.

↓

Remove cutaneous suture after 10 days.

↓

Since hand milking interfere healing process, use teat siphon for milking for 7days after surgery.

Teat fistula

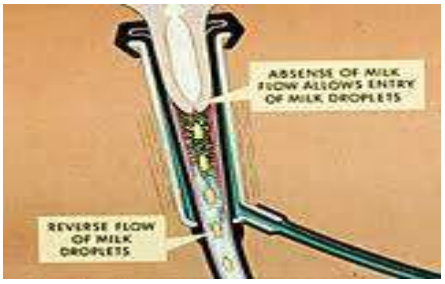
- It is an abnormal opening or passage between teat cistern and teat surface.
- mostly traumatic in origin, rarely congenital

Treatment

- Teat fistula is best treated during dry period.
- If fistula is very small mild chemical cauterisation or electric cautery is enough.
- If fistula is large – reconstructive surgery is necessary.
- Two elliptical incisions are given on the skin edges for debridement. close mucosa layer by simple interrupted. Muscularis and submucosa by simple continuous. Skin is closed by simple interrupted or vertical mattress.

Lactoliths (Milk stone)

- Lactoliths in teat cistern due to mineral deposits.
- Diagnosed by palpation and probing.
- Small lactoliths are removed by milking them out via the teat orifice.
- If large lactoliths, using a mosquito forceps it can be crushed and the small pieces can be removed.
- It too large, sphincter may be slit with a teat knife or a teat bistoury to remove the lactolith.



Polyps

- Generally a pea sized growth attached to the wall of the teat cistern interfere with milk flow.
- Intraluminal local anaesthesia is necessary.
- Insert teat tumour extractor to remove polyp or detached the polyp from the wall.
- Then milked out or retrieved with an alligator forceps.

Teat spider (Membranous obstruction)

- May be congenital or acquired in nature.
- If congenital it is associated with improper development of teat cistern, may not be possible to feel the milk pocket in such case treatment not rewarding and the quarter is allowed to atrophy and become non functional.
- If acquired in nature (Injury, tumor, or infection) the resulting membrane obstruct the milk flow. Palpations shows fluctuating milk above the obstruction (Milk pocket) but milking is not possible.

Treatment

- Prepare teat for surgery.
- Infiltrate local anaesthesia over the affected teat.
- Introduced Hudson's teat spiral upto the membrane for deep penetration with 3 or 4 revolution.
- Alternatively using teat bistoury, membrane can be slit in three or four directions.
- Affected quarter should not be milked completely to avoid a stricture.

Teat cistern obstructions

- Most teat cistern obstruction is initiated as focal fibrotic nodules either from base of teat cistern or tip of the teat.
- Causes – repeated trauma caused by suckling, chroming mastitis leads to formation of fibrotic cords.
- If fibrotic nodule at the tip of teat using teat tumor extractor it is removed.
- If growth is larger than nodules occupies less than 30% of teat cistern, thelotomy is done to remove growth. After removal suture the mucosa by simle interrupted, muscularis - simple continuos and skin by simple interrupted.
- If occupies more than 30% - Silicone prosthesis technique can be done.

Contracted sphincter (Hard milker)

- It is difficult to express the milk which comes out in small streams and milking time is prolonged due to stenosis of streak canal.

Causes

- Overdeveloped sphincter muscle, small diameter of streak canal and acute inflammation as a result of trauma.
- Chronic inflammation due to machine milking with too high vacuum.
- Trauma during dry period may result in scar tissue formation which may stenose the streak canal.

Treatment

- If acute inflammation, local treatment with anti inflammatory.
- If small enlargement of streak canal is required, a conical teat dilator can be used to stretch or tear the fibers around the duct.
- In more advances case, after local anaesthesia a litch teat knife or teat bistoury can be used. While enlarging the duct it is better to make several cuts than to make a large one.
- Larson's teat tube or polyethylene catheter is then placed through the teat orifice and retained for five to seven days.
- Intramammary infusion of antibiotics during the retention of catheter.
- In acute inflammation, temporary discontinuation of milking of the affected quarter and passive withdrawal of milk with a teat siphon at interval of 3 to 4 days.

Enlarged teat orifice (Free milker or leaker)

- Let down of milk spontaneously from teat orifice due to relaxed sphincter or

excessive surgical enlargement or any trauma.

- Inject small amount of mineral oil or lugol's solution around the orifice using 22 to 24 gauge needle.
- If over contraction follow treatment for contractor sphincter.

Rupture and innervation of the streak canal mucosa

- The mucosa of the streak canal is ruptured circularly and gets inverted into the teat cistern.
- 35% of teat stenosis cases in cows are caused by rupture of the teat membrane.
- Removal of tissue by curette or teat bistoury does not provide long tern satisfactory.
- Thelotomy is considered more effective to detached mucous membrane.

Procedure

Sedate the animal and infiltrate local anaesthesia over the affected teat

↓

Place the bandage at the base of the teat

↓

Introduce teat siphon into teat canal

↓

Incision is made just above the blunt end of teat siphon

↓

Stenosis forming tissue is removed with fine pointed scissors or forceps

↓

Close the mucosa, muscularis and skin

↓

Retain the catheter to prevent stricture

↓

Post operative antibiotics are infused into the affected teat for 4 to 5 days

↓

Suture removed after 10 days

Occlusion of teat orifice (Imperforate teat)

- May be congenital or acquired
- In this the milk present in the teat cistern down to teat sphincter but cannot be forced from teat.
- For treatment an 18 gauge hypodermic needle is forced through into the teat cistern under local anaesthesia.
- Once milk let down treatment is like same as contracted orifice.

Amputation of mammary gland

Indication – gangrenous mastitis

Anaesthesia – Epidural block or general anaesthesia

Procedure

- For unilateral gland amputation, the incision is placed at the superiolateral aspect of the gland about 2 to 3 cm away from intermammary groove.'
- For bilateral amputation incision should star at the midline caudally near the base of the udder to extend cranially along the base.

- Skin is resected from both edge
- Once the gland is dissected away from the line of cutaneous incision to expose the external pudic artery and vein located near external inquinal ring.
- Similarly reflection of the cranial part of the gland will expose the perineal artery and large subcuataneous vein.
- All vessels doubly ligated
- Remove the affected gland/both glands.
- Skin flaps are sutured together taking care to close the dead space by taking skin deep to abdominal wall at several places
- Remove suture after 10 days.
- Post operative care like fluid therapy, antibiotic etc. wound dressing.

Success of dairy farming depends on the hygienic and healthy management of barn, byre and cow especially udder hygiene. Simple managemental practices can avoid the severe complicated udder infection and disorders. Selection of cow based on pedigree of healthy udder without any anomalies is highly essential to ensure the success in dairy farming.

Nutritional Management of Sheep and Goat in Arid and Semi-Arid Regions

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Livestock, mainly sheep and goats, rearing is the mainstay of the arid and semiarid regions. Most of the rural population in these areas depends on livestock and their by-products. Agricultural farming in semiarid and arid regions is practiced on a limited scale due to scanty and uncertain rains and shortage of irrigation water leaving most of these regions to be used as rangeland grazing. Climate change leading to frequent and extended drought periods, is complicating the situation. Nutrient contents of these feed resources are so low and unbalanced that the provision of complements is necessary for livestock maintenance and production. Concentrate feeds (e.g. barley, maize, soybean meal, etc.) are commonly used to tackle this objective. However, the impact of such supplementation strategy on livestock performances is often unsatisfactory and too expensive for smallholders. A wide range of alternative feed sources (e.g. fodder shrubs, some agro-industrial byproducts, etc.) and some natural compounds (e.g. tannins and saponins) proved efficient in improving sheep and goat performances and or reducing feeding cost.

MAIN CONSTRAINTS

The rangelands present in these regions do not produce year-long forage requirements and almost all vegetation goes dormant during winter season. The low current contribution of rangelands to livestock feeding is due to the tremendous increase in sheep and goat numbers, but also due to the loss of traditional management tools and the modification of land tenure occupation. The overgrazing of the rangelands has been historic but what amounts to destruction in many parts is recent is following mechanised transport and feed subsidy to pastoralists. The livestock in these areas is heavily dependent on hand-fed concentrates, agro-industrial by-products, cereals and straws. Diets containing these feed resources are often unbalanced for main nutrients, thus cannot overcome microflora and host animal requirements. While chemical based promoters (e.g. antibiotics, probiotics, etc.) proved efficient in stimulating rumen digestion and consequently in increasing sheep and goat performances, the recent concern of consumers about the risk on consuming meat and milk of animals receiving these additives encouraged scientists to look

for simple, cost-effective and healthy alternatives.

Promising solutions to ameliorate small ruminant sector

Lack of adequate year-round feed resources is probably the most important factor contributing to low animal production in arid and semiarid regions in the world. The recent leap in prices of concentrate feeds and the continuous increase of the price of petroleum at the international level is making machinery-based agriculture in serious difficulty and threatening livestock sector. Therefore, there is an urgent need to develop appropriate strategies for better use of local feed resources and to identify technologies optimizing the potential use of these unconventional feedstuffs in livestock feeding.

1. Adapted forages

Forage production in the arid and semiarid regions is low. Often forage species and cultivars adapted to humid conditions are cultivated in these regions, thus they are exposed to heat and water stresses. Extension of appropriate species and cultivars of various forages and legumes for specific agro-climatic and field situations is required to enhance livestock sector.

Because fertile land and water are limiting factors in these regions, the strategy of inclusion of selected forages and legumes into prevailing cropping pattern for increasing fodder production should explored. Although some improved cultivars adapted to dry conditions have been developed by breeders, most of them are not widely cultivated. Additionally, rotation between annual species and the rotation between perennial forage species, e.g. Lucerne - Medics - graminae is overpowered by farmers.

2. Better use of agro-industrial by products

Agro-industrial by-products (AGIBPs) are, in comparison to crop residues, less fibrous and more concentrated, and often have a high nutrient content. Recycling, reprocessing and utilization of any AGIBPs offer the possibility of alleviating the current limited feed resources and to reduce feeding cost. Although, high quantities of some AGIBPs are produced in many countries the utilisation of these feed resources in livestock feeding is still limited. AGIBPs ensiling can be done such as ensiled citrus pulp, tomato pulp and olive cake are incorporated in the diet of sheep and dairy cattle in some Mediterranean farms.

3. **Feed blocks (FBs)**

Feed blocks manufactured by the cold process are made from a mixture of one or more AGIBP (e.g. olive cake, tomato pulp, etc.), binder (e.g. quicklime, cement and clay), water and common salt, as well as urea with or without molasses. Some variations in the blocks have been the incorporation of polyethylene glycol as a tannin-inactivating agent, which has increased the utilization of tanniniferous browse foliage in ruminant feeding. Medicated blocks containing anthelmintic agents and tannins to control internal parasites have been used in Australia and Ethiopia. Mineral enriched FBs (e.g. phosphorus, copper, etc.) can be fed to animals to mitigate their deficiency and improve

reproduction in ruminants. It is clear that depending on the composition, FBs can replace partially or totally concentrate feeds, thus alleviates feeding costs without detrimental effects on livestock performances.

4. AGIBPs-based pellets

Some AGIBPs have been developed e,g pellets composed of olive cake, wheat bran, rapeseed meal, wheat flour residue, salt and minerals. Urea was removed to avoid any risk of intoxication with excessive ammonia in the rumen. Pellets due to their smaller size will be consumed in higher amounts. The ad libitum intake of these pellets by sheep averaged 2.5 kg/day. The cost of these pellets was less as compared to lucerne pellets. In contrast to FBs, mechanisation is necessary to make pellets. In any case, AGIBPs-based pellets seem an interesting technology to reduce the use of conventional feed resources and to satisfy feed demands by farmers.

5. Fodder shrubs and trees (FST) in the smallholders farming systems

The use of shrubs and trees as animal feeds probably goes back as far as when animals were domesticated. Some species are high in essential nutrients but low in anti-nutritive factors (e.g. *Morus alba*), some others are low in nutrients but high in secondary compounds (e.g. *Pistacia lentiscus*) while some shrubs are high in both nutrients and secondary compounds (e.g. *Acacia cyanophylla*, *Atriplex* spp.). In arid and semi-arid rangelands where forage species available are of poor quality, FST could be used as feed supplements to increase animal intake of native resources. They can be used also to defer grazing after the autumn/winter opening rains, so that more production could be obtained. With proper treatment and management, FST could constitute a greater proportion of livestock diets. Good knowledge of their nutritive value, responses of sheep and goats to nutrients and anti-nutrients factors present these FST is required to ensure their better use in livestock feeding.

***(*a) Advantageous use of fodder shrubs and trees**

There are many advantages of promoting fodder shrubs and trees, because of their wider adaptability to harsh agro-climatic conditions and ability to produce for a longer period. As trees require little care after the establishment, the cost of production will be low.

(i) Cactus, a promising shrub species – The popularity of cactus as a feed in numerous dry in various countries is increasing. Characterised by a remarkable tolerance to drought conditions, high water use efficiency, a rapid dissemination and growth, a high biomass yield and a multipurpose use, cactus is a promising range species that can promote livestock sector in dry areas and improve farmers' income. Cactus cladodes are high in soluble carbohydrates, calcium and â-carotene, but they are low in fibre and CP. Therefore, the association of fibre and protein sources to cactus is recommended. The fermentation of cactus with *Aspergillus niger* resulted in an increase of the crude protein content by 12.8% (Oliveira, 2001). Araújo et al. (2005) reported a remarkable increase (up to 400%) of the proportion of protein (260 g/kg DM) in cactus

cladodes fermented with yeast (*Saccharomyces cervisiae*). This procedure of protein enrichment of cactus is technically interesting, but its economical benefit should be evaluated before diffusion at the farm level. Replacing concentrate feeds (i.e. barley) with cactus cladodes had no effect on digestion, lamb growth (Ben Salem & Abidi, 2009) and performances of late pregnant-early suckling ewes. Total replacement of corn and barley with cactus could be achieved without any negative effects. However, with forages such as hay, straw and silage the replacement level should not exceed 50%; otherwise digestion, daily gain and milk production is impaired (Ben Salem & Abidi, 2009). Cactus could be used in sheep and goat feeding as fresh, dried or ensiled material: - Cactus cladodes are fed mostly as fresh to cows, sheep, goats and dromedaries. Cactus cladodes could be dried then ground, and the meal obtained used as a supplement feed for animals.

(ii) Benefits from secondary compounds containing shrubs - Plant secondary compounds include those in categories such as phenolics, saponins, alkaloids, nonprotein amino-acids, essential oils and glycosides.

Tannins –These secondary compounds are classified into two categories: Hydrolysable tannins (HT) are potentially toxic and decrease the nutritive value of feedstuffs wherease Condensed tannins (CT), are widespread in dicotyledonous species and occur infrequently in graminacae. They are present mainly in the foliage of a wide range of shrubs and trees. CT bind to proteins in the rumen, reduce protein degradation and when dietary crude protein (CP) concentrations exceed animal requirements for CP, these effects can improve performance. However, when dietary CP concentrations are low and fibre concentrations are high, CT are nearly always detrimental.

According to Hoste (2005), tannins might interfere directly with the biology of various nematode stages and they could indirectly improve the host nutrition by protecting the diet proteins from ruminal degradations and this could modulate worm biology. Recent studies have showed that repeated distribution of sainfoin hay , *Acacia cyanophylla* foliage reduced faecal egg counts in kids and lambs, respectively. The biological effects of saponins include defaunation and increased nutrient absorption rates. This property is associated with a decrease of lower level of ammonia in the rumen fermentation system and an improvement of the efficiency of microbial synthesis. Saponins are also known to increase permeability of the intestinal mucosal cells. However, their use in practice is still limited.

(iii) Alley-cropping technique – It consists of cultivating herbaceous vegetation (graminae and or legumes) between rows of tree or shrub species. Usually leguminous plants are selected so that the soil benefits from both mulch and nitrogen fixation. After harvest the woody species are allowed to grow freely to produce foliage for sheep and goat feeding. This system (i) improves soil; (ii) increases crop yield (iii) reduces weeds and (iv) improves animal

performance. Properly managed, alley-cropping allows diversification to benefit from several markets. It also promotes sustainability in both crop and livestock production. The economic and agronomic assessment of alley-cropping shows that this technology is economically profitable.

(iv) Shrub mixing technique – Most fodder shrubs and trees are either low in essential nutrients (energy and/ or digestible nitrogen) or high in some secondary compounds (e.g. saponins, tannins, oxalates). These characteristics explain the low nutritive value of these fodder resources and the low performances of animals. For example, *Atriplex* spp. foliage is low in energy and true protein although they contain high levels of crude protein, fibre and oxalates (Ben Salem et al., 2010). The association cactus-atriplex is a typical example of the benefits from shrub mixing. The high salinity and the low energy content of atriplex foliage could be overcome by cactus. In summary, diversification of shrub plantations should be encouraged to promote livestock production in the dry areas.

6. Rangeland management

Many semiarid and arid regions are characterised by an erratic nature of rainfall. The strong rainfall seasonality is among the main reasons of the high production variability of rangelands. The scope of range management is to ensure equilibrium between seasonal dietary requirements of animals and range production. Animal reproduction could be manipulated to line up maximum feed requirements with the annual peak of range production. The low fodder potential of arid and semiarid areas coupled with degradation of natural rangelands resulted in excessive use of supplementary feeding. The generalised utilisation of subsidised feed supplements resulted to an increase of stocking rates which were far beyond the carrying capacity, thus aggravating range degradation. Adjustment of the stocking rate, rotational and/or differed grazing could be emphasised to reach this objective. Manipulating vegetation consists in introducing other animal species whose positive or negative impact may influence its evolution over time. Options for better management of private rangelands could be easily adopted by corresponding herders. However, the application of these options on collective rangelands is difficult.

7. Better control of livestock watering

Unlike feed nutrients, oftentimes water does not receive adequate consideration to ensure optimal nutrition and performance of ruminant animals, mainly those raised under drought conditions. Water is essential for the adjustment of body temperature and for growth, reproduction and lactation mechanisms, for digestion pattern and for nutrients exchanges. Livestock requirements for water in dry areas are high due to high temperature and the radiation load from the sun. Another factor, at times more important than climatic conditions, is the type of vegetation being grazed. Much higher water intakes and water turnovers have been recorded for sheep grazing on halophytes than on grasslands (Ben Salem et al., 2010). Water deprivation for

short periods is rather beneficial to range lambs and kids; it improves diet digestibility and N retention. Water Deprivation for 3 days or more would have detrimental effects on feed intake by lambs and ewes which exhibited reduced milk production (Aganga et al., 1990). Five days water deprivation of desert goats had no effect on DM intake, but increased DM digestibility of the diet.

CONCLUSION

Small ruminants are critical to the development of sustainable and environmentally sound production systems. Efforts should be intensified to improve productive and reproductive performances of sheep and goat using simple and cost-effective options. Desertification, drought and global warming justify the needs for a serious reflection on the readjustment/establishment of new feeding strategies for the improvement of animal production without detrimental effects on the environment. Therefore, the development objectives should move towards resource conservation and natural resource management while striving for greater agricultural production. A wide range of local and alternative feed resources and secondary compound-containing plants and their extracts could, if adequately used, improve sheep and goat health, performances and the quality of their products. However, the wide transfer and adoption of these technical options at the farm level should be associated with the organisation of local institutions (farmers associations, NGOs, etc.), market organization and the support of policy makers to boost livestock production in arid and semiarid regions.

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Forecasting – A System of Pest Forewarning

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Weather forecasting

"Weather forecast describes the expected meteorological conditions for a specified place (or area) and period of time"; an alternative and more probabilistic definition states that "weather forecast is an expression of probability of a particular future state of the atmospheric system in a given point or territory".

- The multiplication and growth of insect is mainly governed by weather parameters.
- The knowledge of crop-weather-insect relationship can guide operational and tactical measures to avoid insect-pests.
- The meteorological–based forecast for development of population of insect-pest can be useful for practicing environmentally safe and need based pesticides.
- Forecasting/forewarning refers to foreknow the future scenario on the basis of past and present situation of pest data.
- Forewarning system for pests is a cornerstone & important tool for Integrated Pest Management.

TYPES OF FORECASTING:

In weather forecasting we now have a very wide range of operational products that traditionally are classified in the following groups:

1. Now-casting (NC)
2. Very Short Range Forecast (VSRF)
3. Short Range Forecast (SRF)
4. Medium Range Forecast (MRF)
5. Long Range Forecast (LRF)

1. Now-casting (NC) and very short range forcasting (VSRF):

NC is the extrapolation of current weather to some future time (up to 2 hours), mainly based on the behavior of existing phenomena as described by intensive observations; VSRF is the anticipation of events beyond the period during which extrapolation usually works (up to 12 h) 71.NC and VSRF focus on meso and micro scale weather events, with spatial scales below 1000 km and time scales of some hours.

Objective:

- Manage works without produce soil compaction.
- Manage field activities during the growing period of crops.
- Minimize the waste of biocides applied against weeds, pests and diseases.
- Manage mitigation activities against frost.
- Manage harvest activities for different crops.

- Prevent and mitigate the effects of flash floods or debris flow.

2. Short and Medium Range Forecasts:

Short and Medium Range Forecasts describe the behavior of weather variables (precipitation, air temperature, sky coverage and solar radiation, wind velocity and direction, etc.) and weather phenomena (frontal systems, anticyclones, tropical cyclones, squall lines, etc.). The typical range is beyond 12 hours and up to 72 hours for Short Range Forecasts (SRF) and beyond 3 days and up to 10 days for Medium Range Forecasts (MRF).

SRF and MRF are important for farmers in order to plan the day's work on activities like:

- Preparatory activities, such as land preparation and preparation of plant material.
- Planting or seeding/sowing.
- Crops, fruit trees and vine management; application of fertilizer, irrigation; thinning, topping, weeding; pest and disease control.
- Management of grazing systems.
- Harvesting, on-farm post-harvest processing and transporting of produce.
- Livestock production.

Long Range Forecasts (LRF) are forecasts for periods greater than 1 month in advance.

Usefulness of forecasting for control of insects:

Within broad limits weather is one of the principal factors controlling insect occurrence and governing their general distribution and numbers. Weather factors, acting in combination, can either foster or suppress insect life, e.g. temperature and humidity control the time interval between successive generations of insects as well as the number produced in each generation. Feeding habits are also controlled by weather and climate. Large-scale, low-level wind patterns are an important factor in the migration of insect pests. As regards insecticides used to control pests, weather controls not only the insect's susceptibility but also the effectiveness of the pesticides.

Example:

"The low temperature prevailing since past 15 days and incessant rains may encourage the attack and development of Rice hoppers. Farmers are advised to take suitable prophylactic spray measures".

GEOGRAPHIC INFORMATION SYSTEM (GIS) - A POTENTIAL TOOL FOR PEST FORECASTING

Geographic Information System (GIS) is a powerful, computer-based tool which can store information on spatial, temporal and other attributes together. Like any other database management system, GIS also have all the inherited functionality to query, analyze, display and manipulate data. The specialty about GIS is that the data can be displayed in the form of maps. Pest simulation models can be linked to get visual status of pests at different locations over a geographical area. A decision support system on integrated pest management can also be linked with the GIS generated information for timely and effective management of pests over a large area.

Internet based forecasting systems:

The advantage of Internet based interactive system is that spatial variability in soil and management practices can be addressed. Farmers are advised for their farm-specific problems. Local weather conditions, type of soil, type of crop and phonological stage, as well as level and type of insect-pest infestation is considered for advising for decision making on sowing, harvesting, irrigation, nutrient management and chemical application. In this system, users have choice to provide the observed field conditions or to manipulate the input levels to analyze the different possible scenarios. An example from Denmark will elucidate this system. It should, however, also be realized that there is a serious risk that in many areas of the world we can't reach farmers through internet or other new technologies and we create auto referential services. Such that CIPRA is one of the forecasting systems in Canada which was mainly implemented to forecast the pests, diseases, crops and post harvest disorders. CIPRA is user-friendly software that can predict the development of pests (insects and diseases), crops (phenology) and some postharvest disorders based on hourly weather data. Thus, in real time, the software allows to target the best time for pest control approaches to protect crops. The software is based not only on weather observations from several automatic stations across Quebec, but also on weather forecasts. The establishment of a central computer network provides access to real-time weather data. The likelihood of pest development is then calculated using bioclimatic models that have been scientifically developed.

The CIPRA approach contributes significantly to pesticide reductions in the environment and the promotion of sustainable crop production systems for Canadian farmers.

Limitations of forecasting:

- It is time consuming and labour intensive method.
- It requires continuous evaluation for validity.
- It is location specific.
- Faulty forecasting may lead to disastrous consequences.

Seed Treatment- A Potential Tool in Integrated Pest Management

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In the successful cultivation of various crops, insect-pests is one of the major limiting factor. Among the various methods of insect control, the uses of chemicals are more popular in the farming community, because it gives quick results. But farmers are using insecticides indiscriminately, which results in additional cost and many undesirable effects like insect resistance, resurgence, environmental pollution, residues in food and fodder crops and adverse effects on natural enemies of insects. In recent era, the eco-friendly approaches to manage the crop pests are advisable. To reduce the adverse effects on natural enemies and cost of application as well as to increase the effectiveness of synthetic insecticides, the approach of seed treatment has been adopted in various field crops.

Seed treatments should be considered as tools in an integrated pest management (IPM) plan. IPM is the use of a combination of cultural practices, host resistance, biological control, and chemical control methods to simultaneously minimize economic losses due to pests, avoid development of new pest biotypes that overcome pesticides or host resistance, minimize negative effects on the environment, and avoid pesticide residues in the food supply.

PURPOSES OF SEED TREATMENT:

- **Control of Seed borne Pathogens:**

Seed borne, disease-causing pathogens may occur on the surface of seed, hidden in cracks or crevices of seed, or as infections deep inside the intact seed. These pathogens may be important for three reasons. First, some pathogens do not survive in soil or crop residue and are dependent on the seed borne phase for survival between crops. Second, even if a pathogen can survive in soil or residue, being seed borne may allow it to get a head start and, thus, result in more severe disease. Third, seed borne pathogens may hitch a ride to new localities in seed shipments.

- **Protection of Seeds and Seedlings**

Seed treatments can protect the seed and seedling from attack by certain insects and pathogens. Non systemic fungicides or insecticides form a chemical barrier over the surface of the germinating seed. This barrier protects the germinating seed from chewing insects, such as wireworms, or soil borne pathogens, such as pythium. Certain

systemic seed treatments can protect aboveground parts from sucking insects, such as aphids, or foliage diseases, such as rust. Systemic fungicides and biological seed treatments can also protect young plants from root rot.

Advantages of Seed Treatment:

- Seed borne pathogens are vulnerable. The seed borne phase is often the weak link in the life cycle for many plant pathogens.
- Using seed treatments to control seed borne pathogens is often very effective for disease control.
- Seed treatments are not subject to spray drift because chemicals are applied directly to seeds, little is wasted on no target sites, such as bare soil.
- Seeds and seedlings are generally more vulnerable to diseases and insects than mature plants.
- Relatively small amounts of pesticides are used in seed treatments compared to broadcast sprays. This reduces the cost and the potential environmental impact.
- Seed treatments are relatively easy and cheap to apply compared to broadcast sprays.

METHODS OF SEED TREATMENT

Seed treatment pesticides are applied as dusts, slurries, or liquids. The principal objective is to thoroughly coat the seed with an appropriate rate of pesticide. The proper selection and operation of seed treatment equipment can help assure uniformity of coverage, adequate control of the target pest, and enhanced seed germination. Dusts are dry powder formulations that are mechanically mixed with the seed. Dust applications add no moisture to the seed. However, they are difficult to distribute uniformly over the seed and tend to sift off seed readily. Slurries are prepared by mixing insoluble formulations (wettable powders, dry flowables, etc.) in water. Slurry treatments provide accurate and thorough seed coverage. Liquids (for example, solutions and emulsifiable concentrates) can be mixed with water in a manner similar to that for slurries. Liquid treatments also provide uniform coverage of seed.

SEED TREATMENT EQUIPMENTS:

Insecticides mostly used for Seed Treatment:

Diazinon is a nonsystemic, organophosphate insecticide useful against soil borne insects, such as seed corn maggot and seed corn beetle. Diazinon has been commonly used as a planter-box treatment but is no longer labeled for soybean.

Imidacloprid (trade names Gaucho) is a systemic insecticide effective against aphids, chinch bug, flea beetle, hessian fly, leafhopper, seed corn maggot, thrips, whitefly, white grubs, and wireworms. It reduces incidence of some diseases by controlling the insect vectors.

Permethrin (trade names Barracuda, Kernel Guard Supreme, and Profound) is a non systemic, pyrethroid insecticide useful against soil borne insects, such as wireworm and seed corn maggots.

Tefluthrin is the active ingredient found in Force soil insecticide. As a seed treatment (marketed as Proshield), tefluthrin is currently only available on certain field corn hybrids. It is a non systemic, pyrethroid insecticide useful against soil

borne insects such as wireworm and seed corn maggots.

Thiamethoxam (trade name Cruiser) is a systemic, neo nicotinoid insecticide effective against various sucking and chewing pests, such as thrips, aphids, Colorado potato beetles, seed corn maggot, Hessian fly, leafhoppers, chinch bugs, and wireworms. Currently, the product is labeled for use only on wheat and barley seed.

A. Seed dresser

B. Slurry seed treater

Bacteriophages and its uses in biomedicine

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Bacteriophages or phages are bacterial viruses that invade bacterial cells and, in the case of lytic phages, disrupt bacterial metabolism and cause the bacterium to lyse. Thousands of varieties of phage exist, each of which may infect only one type or a few types of bacteria. Like all viruses, phages are simple organisms that consist of a core of genetic material (nucleic acid) surrounded by a protein capsid. The nucleic acid may be either DNA or RNA and may be double-stranded or single-stranded. There are three basic structural forms of phage: an icosahedral (twenty-sided) head with a tail, an icosahedral head without a tail, and a filamentous form. Over the past three decades, phage research has revealed the abundance of phages in nature, the diversity of their genomes, their impact on evolution of microbial diversity, their control of infectious diseases and their influence in regulating the microbial balance in every ecosystem where this has been explored. These findings have led to a resurgence of interest in phage research.

DISCOVERY OF BACTERIOPHAGES

Ernest Hankin, a British bacteriologist, reported in 1896 on the presence of marked antibacterial activity (against Vibrio cholerae) which he observed in the waters of the Ganges and Jumna rivers in India, and he suggested that an unidentified substance (which passed through fine porcelain filters and was heat labile) was responsible for this phenomenon and for limiting the spread of cholera epidemics. Frederick Twort, a medically trained bacteriologist from England in 1915 and Félix d'Hérelle from France in 1917 independently discovered bacteriophages. D'Hérelle coined the term bacteriophage, meaning "bacteria eater," to describe the agent's bacteriocidal ability. D'Hérelle also recorded a dramatic account of a man suffering from dysentery who was restored to good health by the bacteriophages. It was D'Herelle who conducted much research into bacteriophages and introduced the concept of phage therapy.

DISTRIBUTION

Phages are widely distributed in locations populated by bacterial hosts, such as soil or the intestines of animals. One of the densest natural sources for phages and other viruses is sea water, where up to 9×10^8 virions/ml have been found in microbial mats at the surface, and up to 70% of marine bacteria may be infected by phages.

CLASSIFICATION

Phages are classified by the International Committee on Taxonomy of Viruses (ICTV) according to morphology and nucleic acid. Nineteen families are currently recognised that infect bacteria and archaea. Of these, only two families have RNA genomes and only five families are enveloped. Of the viral

families with DNA genomes, only two have single-stranded genomes. Eight of the viral families with DNA genomes have circular genomes, while nine have linear genomes. Nine families infect bacteria only, nine infect archaea only, and one (Tectiviridae) infects both bacteria and archaea.

ICTV classification of prokaryotic (bacterial and archaeal) viruses				
Order	**Family**	**Morphology**	**Nucleic acid**	**Examples**
Caudovirales	*Myoviridae*	Nonenveloped, contractile tail	Linear dsDNA	T4 phage, Mu, PBSX, P1Puna-like, P2, I3, Bcep 1, Bcep 43, Bcep 78
	Siphoviridae	Nonenveloped, noncontractile tail	Linear dsDNA	λ phage, T5 phage, phi, C2, L5, HK97, N15
	Podoviridae	Nonenveloped, noncontractile tail (short)	Linear dsDNA	T7 phage, T3 phage, P22, P37
Ligamenvirales	*Lipothrixviridae*	Enveloped, rod-shaped	Linear dsDNA	Acidianus filamentous virus 1
	Rudiviridae	Nonenveloped, rod-shaped	Linear dsDNA	Sulfolobus islandicus rod-shaped virus 1
Unassigned	*Ampullaviridae*	Enveloped, bottle-shaped	Linear dsDNA	
	Bicaudaviridae	Nonenveloped, lemon-shaped	Circular dsDNA	
	Clavaviridae	Nonenveloped, rod-shaped	Circular dsDNA	
	Corticoviridae	Nonenveloped, isometric	Circular dsDNA	
	Cystoviridae	Enveloped, spherical	Segmented dsRNA	
	Fuselloviridae	Nonenveloped, lemon-shaped	Circular dsDNA	
	Globuloviridae	Enveloped, isometric	Linear dsDNA	
	Guttavirus	Nonenveloped, ovoid	Circular dsDNA	
	Inoviridae	Nonenveloped, filamentous	Circular ssDNA	
	Leviviridae	Nonenveloped, isometric	Linear ssRNA	MS2, Qβ
	Microviridae	Nonenveloped, isometric	Circular ssDNA	ΦX174
	Plasmaviridae	Enveloped, pleomorphic	Circular dsDNA	
	Tectiviridae	Nonenveloped, isometric	Linear dsDNA	

REPLICATION

Bacteriophages may have a lytic cycle or a lysogenic cycle, and a few viruses are capable of carrying out both. With *lytic phages* such as the T4 phage, bacterial cells are broken open (lysed) and destroyed after immediate replication of the virion. As soon as the cell is destroyed, the phage progeny can find new hosts to infect. Lytic phages are more suitable forphage therapy. Some lytic phages undergo a phenomenon known as lysis inhibition, where completed phage progeny will not immediately lyse out of the cell if extracellular phage concentrations are high. This mechanism is not identical to that of temperate phage going dormant and is usually temporary.

In contrast, the lysogenic cycle does not result in immediate lysing of the host cell. Those phages able to undergo lysogeny are known as temperate phages. Their viral genome will integrate with host DNA and replicate along with it fairly harmlessly, or may even become established as a plasmid. The virus remains dormant until host conditions deteriorate, perhaps due to depletion of nutrients; then, the endogenous phages (known as prophages) become active. At this point they initiate the reproductive cycle, resulting in lysis of the host cell. As the lysogenic cycle allows the host cell to continue to survive and reproduce, the virus is reproduced in all of the cell's offspring. An example of a bacteriophage known to follow the lysogenic cycle and the lytic cycle is the phage lambda of E. coli. Sometimes prophages may provide benefits to the host bacterium while they are dormant by adding new functions to the bacterial genome in a phenomenon called lysogenic conversion. Examples are the conversion of harmless strains of Corynebacterium diphtheriae or Vibrio cholerae by bacteriophages to a highly virulent ones, which cause Diphtheria or cholera, respectively. Strategies to combat certain bacterial infections by targeting these toxin encoding prophages have been proposed.

ATTACHMENT AND PENETRATION

To enter a host cell, bacteriophages attach to specific receptors on the surface of bacteria, including lipopolysaccharides,teichoic acids, proteins, or even flagella. This specificity means a bacteriophage can infect only certain bacteria bearing receptors to which they can bind, which in turn determines the phage's host range. Host growth conditions also influence the ability of the phage to attach and invade them. As phage virions do not move independently, they must rely on random encounters with the right receptors when in solution (blood, lymphatic circulation, irrigation, soil water, etc.).

Myovirus bacteriophages use a hypodermic syringe-like motion to inject their genetic material into the cell. After making contact with the appropriate receptor, the tail fibers flex to bring the base plate closer to the surface of the cell; this is known as reversible binding. Once attached completely, irreversible binding is initiated and the tail contracts, possibly with the help of ATP present in the tail,[3] injecting genetic material through the bacterial membrane. Podoviruses lack an elongated tail sheath similar to that of a myovirus, so they instead use their small, tooth-like tail fibers to enzymatically degrade a portion of the cell membrane before inserting their genetic material.

Synthesis of proteins and nucleic acid

Within minutes, bacterial ribosomes start translating viral mRNA into protein. For RNA-based phages, RNA replicase is synthesized early in the process. Proteins modify the bacterial RNA polymerase so it preferentially transcribes viral mRNA. The host's normal synthesis of proteins and nucleic acids is disrupted, and it is forced to manufacture viral products, instead. These products go on to become part of new virions within the cell, helper proteins that help assemble the new virions, or proteins involved in cell lysis. Walter Fiers(University of Ghent, Belgium) was the first to establish the complete nucleotide sequence of a gene (1972) and of the viral genome of bacteriophage MS2(1976).

Virion assembly

In the case of the T4 phage, the construction of new virus particles involves the assistance of helper proteins. The base plates are assembled first, with the tails being built upon them afterwards. The head capsids, constructed separately, will spontaneously assemble with the tails. The DNA is packed efficiently within the heads. The whole process takes about 15 minutes.

RELEASE OF VIRIONS

Phages may be released via cell lysis, by extrusion, or, in a few cases, by budding. Lysis, by tailed phages, is achieved by an enzyme called endolysin, which attacks and breaks down the cell wall peptidoglycan. An altogether different phage type, the filamentous phages, make the host cell continually secrete new virus particles. Released virions are described as free, and, unless defective, are capable of infecting a new bacterium. Budding is associated with certain Mycoplasma phages. In contrast to virion release, phages displaying a lysogenic cycle do not kill the host but, rather, become long-term residents as prophage.

Phages in medicine and therapeutics

a) Phage therapy

With the recent development of antibiotic resistance within the microbial population, the need for new antibacterials and alternative strategies to control microbial infections is of increasing urgency. One possible option is the use of bacteriophage as antimicrobial

agents. Lytic phage kill bacteria via mechanisms that differ from those of antibiotics, and therefore, can be considered as antibacterials with a 'novel mode of action', a concept desired for all new antibacterial agents. The use of phages to treat bacterial infections in animals and humans is an old idea. In Eastern Europe and the former Soviet Union, phage therapy has been used successfully to treat bacterial dysentery, staphylococcal lung infections, surgical wound infections, among others. Phage therapy was exploited for both diarrheal disease and the treatment of traumatic infections during and after World War II. During the 1920s and 1930s, therapeutic phage applications spread rapidly in response to a desperate need for treatment of bacterial infections in Western Europe and the USA. Orally administered phage preparations were reported to effectively treat patients infected with dysentery. Patients suffering from staphylococcal septicemia were also successfully treated by intravenous administration of anti-staphylococcal phages. Phages were reported to reduce the severity of staphylococcal meningitis and eliminate S. aureus from the cerebrospinal fluid. However, with the development of antibiotics for the treatment of infections in the early 1940s and their concomitant widespread use, early clinical trials were abandoned in the West. There is a current renewed interest in bacteriophage therapy in Western Europe and the USA in light of the emergence of drug-resistant pathogenic bacteria and there are strong indications that phages may yet have an important role to play in the treatment of bacterial infection in western countries.

b) Phage lysins as antimicrobials

A number of recent studies have shown the enormous potential of the use of phage endolysins, rather than the intact phage, as potential therapeutics. Phage endolysins, or lysins, are enzymes that damage the cell walls' integrity by hydrolyzing the four major bonds in its peptidoglycan component. The majority of phage lysins studied to date are modular in structure, composed of at least two distinctly separate functional domains: a C-terminal cell-wall binding domain, which directs the enzyme to its target, and an N-terminal catalytic domain. The catalytic domain can comprise one or more of the following types of peptidoglycan hydrolases: endopeptidases, muramidases (lysozyme), N-acetylmuramoyl- L-alanine amidases and glucosamidases. Most of the lysins studied to date are amidases.

c) Phage display

Phage display technology is a particularly powerful molecular tool that has had a major impact on drug discovery, pharmacology, immunology and plant science. It is a technique by which foreign peptides, proteins or antibody fragments are expressed at the surface of phage particles. The heterologous peptide or protein is cloned into a phage or phagemid genome as a transcriptional fusion with one of the coat protein genes.

These phages then become vehicles for expression that not only carry within them the nucleotide sequence encoding the expressed proteins, allowing the gene sequence to be retrieved, but also have the capacity to replicate.

d) Vaccines

A novel and exciting use of phages is the use of whole phage particles to deliver vaccines in the form of immunogenic peptides attached to modified phage coat proteins, or as delivery vehicles for DNA vaccines. Phage display is useful for the identification of immunogenic epitopes or mimotopes on displayed peptides which could, in turn, become the basis of peptide vaccines. A study carried out comparing the humoral immune response of animals immunized with a recombinant hepatitis B vaccine or with mimotopes generated by phage display demonstrated that the mimotopes could induce a response similar to that induced by the original antigen; in fact, the mimotopes induced the most reproducible and potent response. Bastien et al. investigated whether a recombinant phage displaying a known protective epitope to the human syncytial virus could protect against infectious challenge in mice. The authors reported that complete protection against the corresponding pathogen could be elicited through mucosal delivery of a filamentous phage displaying the vaccine peptide. This study supports the usefulness of phage display of defined epitopes in prophylactic vaccination. Vaccination with phagedisplaying immunogenic peptides has a number of advantages over the use of recombinant peptides, such as the stimulation of both the cellular and humoral arms of the immune system.

e) **Detection of pathogens**

The specific interaction of a bacteriophage and its host lends itself to using phages for the detection of bacteria, in particular, pathogenic bacteria. Unlike other detection systems such as ELISA and PCR, detection with phage is a natural system whereby the phages specifically recognize and bind to their host cells.

CONCLUSIONS

In summary, bacteriophages have several characteristics that make them potentially attractive therapeutic agents. They are highly specific and very effective in lysing targeted pathogenic bacteria, rapidly modifiable to combat the emergence of newly arising bacterial threats. Phages may be alternative treatment modalities against rapidly emerging, antibiotic-resistant bacteria to warrant further studies in the field of phage therapy. Bacteriophages offer complementary approaches to conventional antibiotics and other antimicrobial agents, and they can be used in various applications ranging from food safety to human therapeutics.

Biostimulation –a novel approach towards farm animal reproduction

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Reproduction is an essential prerequisite for livestock production and successful management of farm animals so, is one of the prime components of animal husbandry practices. The livestock production in the tropical areas faces lot of challenges largely due to the effects of nutrition and other environmental stresses compared to the temperate areas. In a tropical country like India, which has been endowed with a vast livestock resource, animal reproduction is always being challenged. Various attempts have been made on the regulation and control of animal reproduction through the use of hormones and application of biological agents. Some of these applications have so far failed to be consistently effective and besides, some of these biological are not easily available or too expensive for farmers in a developed country like India. Therefore, harnessing the reproductive potential of livestock species in developing countries may require development of management strategies such as biostimulation to effectively improve reproduction. Males play important roles in reproductive function in addition to mating. In many species, males seem to trigger neuro-endocrine reflexes which alter reproduction (positively or negatively) in females. A "negative" example is the "Bruce Effect" where pregnant mice will abort if exposed to a male mouse of a different strain (or even if placed in a cage recently vacated by a male). A "positive" example is induced ovulation in cats where male copulation is an absolute prerequisite for ovulation to occur. Biostimulation (male or bull effect) can be defined as the stimulus provoked by the presence of males, which induce estrous and ovulation through genital stimulation, pheromones, or other external cues (Chenoweth, 1983). In 1901, Heape proposed that the presence of males stimulates the onset of puberty in several mammals. In cattle, Neresjan in 1959 reported that postpartum anestrus interval is reduced if cows are exposed to vasectomised bulls. Biostimulation plays important roles in reproduction such as:

- ✓ Hastening sexual maturity
- ✓ Induction of ovulation
- ✓ Reduction of postpartum anoestrus
- ✓ Coitus or mating in many mammalian species including insects, rodents, wild animals, feral population, swine, sheep, goats and cattle.


Fig: Flehmens reaction in farm animals

MECHANISM OF BIOSTIMULATION

The stimulus provoked by the introduction of the males can act through different pathways, including olfactory, visual and auditory signals (Ungerfeld, 2007). The pheromones or allelomimetic cues act on the hypothalamus which releases the pulses of GnRH through anterior pituitary to secrete LH and FSH. The male pheromones are perceived by the vomeronasal organ (VNO) of the nasal cavity of females in all the terrestrial vertebrate species. The VNO contains specific neuron receptors which stimulate a cascade of neuroendocrine responses in the female body. The pheromones are known to have a potential role communication between the con specifics during reproduction and management in animals (Rekwot *et al.,* 2001). The word pheromone comes from the Greek word *pherein*, to carry or transfer, and *hormon,* to excite or stimulate Strictly speaking, pheromones are a subclass of semiochemicals (chemicals involved in animal communication).The term pheromone refers to air-borne chemical substances, that are secreted externally by an animal in urine, faeces or secreted by cutaneous glands and cause a specific reaction in a receiving individual of the same species; the reaction involves either the release of a specific behaviour or physiological change in the recipients endocrine or reproductive system (Izard, 1983; Rekwot *et al.,* 2000). Pheromones are classified based on their function as Signaling pheromones and Priming pheromones.

Signalling (releasing) pheromones are substances that evoke an immediate behavioural response. Usually, this involves an olfactory cue that transfers specific information and consequently elicits a specific behaviour. Olfactory cues that transmit specific information and result in specific and immediate behavioural responses in the male appear to be produced in the urine or vaginal secretions of females of many species. These odours are present at oestrus and proestrus but not at any other time. Male shows flehmens reaction due to pheromone in the urine or vaginal secretions of females.

Flehmens reaction: Male stands rigidly and holds his head in horizontal position (which it moves slowly from side to side)

with his neck extended and upper lips raised. It lasts for about 10-30 seconds. Flehmens reaction occurs in almost all the domestic animals except in swine. When the male investigates the anogenital region of females, there is transport of non-volatile olfactory signals from the oral cavity to the sensory epithelium of the Vomeronasal organ (VNO). VNO a bilateral blind sac which opens into the incisive duct or nasopalatine canal, which contains receptors for low-volatile pheromones in urine and vaginal secretions. The specialised chemoreceptor (VNO) helps in oestrus detection in females by the males and co-ordination of sexual activity. Flehmens reaction is believed to be the best method of estrous detection.

Priming pheromones are the substances that cause physiological events in endocrine and reproductive systems (Izard, 1983). Usually, it involves an olfactory cue that elicits a measurable physiological response. It plays role in influence on the induction of puberty, the termination of seasonal anoestrus and shortening of postpartum anoestrus in animals.

ROLE OF BIOSTIMULATION IN REPRODUCTION

Effects on puberty and sexual maturity

In domestic animals, priming pheromones from the male have an influence on the induction of puberty.Alteration in age of puberty in heifers occurs with bull exposure. The social interaction between bulls and prepubertal heifers decreases the age at attainment of puberty in heifers. Moreover the priming pheromones mediated by the accessory olfactory system influences the ovarian function, including reproductive maturation. Heifers exposed to vasectomised bulls attained puberty at 23.1 months significantly lower than the age of 26.4 months at onset of puberty for the non-exposed heifers (Rekwot *et al*., 2000). Some studies suggested that bull urine acted as the source of priming pheromone, where 67% of heifers exposed to urine and 32% of heifers exposed to only water attained puberty (Izard and Vandenbergh, 1982). A positive effect of biostimulation in onset of puberty is seen in winter-born heifers (pubertal females) but negative effects in spring-born heifers (prepubertal females) (Small *et al.,* 2000). So the response to male effect is sometimes related to the time close to spontaneous puberty achievement that heifers are at the beginning of the exposure. The presence of a boar accelerates puberty in gilts by about 30 days and also introduction of boars to gilts at about 190 days of age (i.e. mean age at puberty) leads to a marked synchrony in attainment of the pubertal oestrus. Daily introduction of a mature boar to prepubertal gilts from an age of approximately 160 days onwards also advances attainment of puberty. Age of the boar also induces the onset of puberty. Gilts exposed to either 2 year-old or 11 month-old boars attained puberty 24 days earlier than gilts exposed to boars that were 6.5 months of age (Kirkwood *et al*., 1981). The inability of young boars to advance puberty in gilts has been attributed to a lack of production of the priming pheromone or to a decreased ability to produce the pheromone as compared to the older boars.

Intensity of estrus and reduction of postpartum anoestrus

Positive effect of biostimulation is seen in cyclic activity in cows, when exposed either to bulls or androgenised steers. Weekly exposure of bull with the postpartum cows decreases the anoestrus interval and increases early pregnancy rate (Miller and Ungerfeld, 2008).The mean interval from parturition to resumption of ovarian activity for the bull-exposed cows was 68.6 days, shorter than the duration of 75.6 days for the non-exposed cows and in other study it was 43 versus 63 days postpartum (Rekwot *et al*., 2000). In a study by Alberio *et al*., 1987 (cited by Rekwot *et al*., 2001) the ovarian and behavioural activity of suckling beef cows indicated that in the group with the teaser bull, the proportion of cows in heat and ovulation was higher than in the control group (heat: 67.9 versus 32.7%; ovulation: 73.6 versus 40.4%.). The intensity of the stimulus is also related to the percentage of female that respond to biostimulation. The fenceline contact of primiparous cows with bulls increases the proportion of cyclic females after 14 day of contact, but the proportion is greater, with direct physical contact compared to fenceline contact with males (Berardinelli and Tauck, 2007). Biostimulation is also effective to reduce anoestrus periods in buffaloes (Gokuldas *et al.,* 2010).

Enhance male sexual performance

Presence of female generally improves the level of sexual activity in males. When young bulls are reared in isolation many fail to respond or show less interest in mounting compared to bulls raised with females. Sudden introduction of estrous ewes in group of rams induces sudden changes in the behavioural and endocrine system of males. This is called as "**Female effect"** (opposite of male effect). Presence of females in a group of males is associated with increases in plasma testosterone level and elevated concentrations of luteinizing hormone (LH) in many species. Female effect is also seen in cattle, goat and pigs. It has been reported that the sexual preference in pigs increases when boars are housed in close proximity with the gilts or sows or when social contact of female. Simply viewing the process of copulation in case of pigs and sight of mounting in case of bulls is very important for sexual arousal.

Effect of biostimulation on semen biology:

There is increase in semen volume when the bull is stimulated. In rams, the physical contact with female increases the semen volume. Similarly in boar, the physical contact with female for a period of 92 hours increased the quality and quantity of semen

CONCLUSION

Modern animal husbandry practices give emphasis on improvement of reproduction of both male and female. The phenomena of biostimulation no doubt, can act as a "**management tool"** for improving the reproductive efficiency in farm animals. Practical use of biostimulation in animal husbandry can be obtained by housing the young males and females in the nearby paddocks or males can be paraded in herd of growing females which are close to age at puberty or females can be paraded in a herd of growing males if they are not living in close proximity with each other. Biostimulation is an inexpensive, suitable

and a novel approach towards enhancing the early onset of puberty and significant reduction of postpartum anoestrus in domestic animals.

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Embryo Transfer in Cattle- Advantages and Disadvantages

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Embryo transfer in cattle has recently gained considerable popularity with seedstock dairy and beef producers. It is one step in the process of removing one or more embryos from the reproductive tract of a donor female and transferring them to one or more recipient females. But the actual transfer of an embryo is only one step in a series of processes that may include some or all of the following: superovulation and insemination of donors, collection of embryos, isolation, evaluation and short-term storage of embryos, micromanipulation and genetic testing of embryos, freezing of embryos and embryo transfer. In dairy cattle, genetic improvement for milk production is limited. Many dairy producers are finding markets for animals with strong pedigrees, superior type and increased production potential. Thus more and more cows are being flushed. Embryo transfer allows dairy producers to increase the number of offspring from cows believed to be genetically superior. Each cow can be selectively bred to three or four superior bulls in a given year. The identification of a qualified donor is critical, since the marketability of her offspring is the important factor.

Most of the applicable embryo transfer technology was developed in the 1970s and 1980s; however, the history of the concept goes back much farther. Embryo transfer was first performed and recorded in rabbit by Walter Heape in 1890. In 1949 first successful embryo transfer in sheep and goat was recorded by Warwick and Berry and in cattle and pig in 1951 by Willett *et al.* and Kvansnickii respectively. ETT is one of the most important reproductive biotechnologies where male and female genetic material could be utilized for the faster improvement of livestock. In view of acute shortage of breeding bulls and elite animals, especially of Indian breeds, this technology has more relevance to our country. There is need to set up regional stations for faster multiplication of these elite animals to produce bulls required for that region aid their genetic evaluation through sibling testing (ONBS), before they can be used for wider dissemination of germ plasm using AI.

STEPS IN EMBRYO TRANSFER

1) Donor Selection

The first step in the embryo transfer technology is the selection of the donor cow. Dairy cattle are selected on the basis of milk production trait. The potential donor cow should be reproductively sound to produce maximal results and she should have a normal reproductive

tract on rectal palpation and have a normal postpartum history, especially with regard to cycle lengths of 18 to 24 days. The cattle should be at least 60 days postpartum before the transfer procedure begins. The donor cows in embryo transfer programs should be selected on the following criteria:

Regularity of the heat cycles of the donor.

- ✓ Usually history of no more than two NI/AI per conception.
- ✓ Previous calving interval of 365-days.
- ✓ There are no any parturition difficulties or reproductive irregularities.
- ✓ No any conformational or detectable genetic defects.

She should be maintained at the level of nutrition appropriate for her size and level of milk production. Both the very obese cow and the thin cow will have reduced fertility, so it is important that the donor cow be in an appropriate body condition score at the time of embryo transfer.

2) Superovulation of the donor cow

The next step in the embryo transfer process is Superovulation". It is the release of multiple eggs/ova at a single estrus. Cows or heifers properly treated can release as many as 10 or more viable egg/ova cells at one estrus. Approximately 85% of all normal fertile donors will respond to superovulation treatment with an average of five transferable embryos. Some cows are repeatedly treated at 60-day intervals with a slight decrease in embryo numbers over time. The basic principle of superovulation is to stimulate extensive follicular development through the use of a hormone preparation, which is given intramuscularly or subcutaneously, with follicle stimulating hormone (FSH) activity. The injections of FSH are given twice daily for four days at the middle or near the end of a normal estrous cycle, while a functional corpus luteum (CL) is on the ovary. A prostaglandin injection is given on the third day of the treatment schedule which will cause CL regression and a heat or estrus to occur approximately 48 to 60 hours later.

3) Insemination of the cow

Since there are multiple ovulations by the protocol of superovulation in the donor, hence there is more need of viable sperms to fertilize most of them. Therefore, many embryo transfer technicians will choose to inseminate the cow several times during and after estrus. One scheme that has been used successfully is to inseminate the superovulated cow at 12, 24, and 36 hours after the onset of standing heat. Using high quality semen with a high percentage of normal, motile cells is a very critical step in any embryo transfer program. The correct site for semen placement is in the body of the uterus.

4) Collection of embryos

Now a day non-surgical method of embryos collection is preffered over surgical methods. For nonsurgical embryo collection, a small synthetic rubber catheter is inserted through the cervix of the donor cow, and a special medium (PBS) is flushed into and out of the uterus to harvest the embryos seven or eight days after estrus. This collection procedure is relatively simple and can be completed in 30 minutes or less without harm to the cow. A presterilized stylet is placed in the lumen of the catheter to offer rigidity for passage through the cervix into the body of the uterus. When

the tip of the catheter is in the body of the uterus, the cuff is slowly filled with approximately 2 ml of normal saline. The catheter is then gently pulled so that the cuff is seated into the internal os of the cervix. Additional saline is then added to the cuff to completely seal the internal os of the cervix. A Y-connector with inflow and outflow tubes is attached to the catheter. A pair of forceps is attached to each tube to regulate the flow of flushing fluid. The fluid is sequentially added and removed by gravity. The fluid in the uterus is agitated rectally, especially in the upper one-third of the uterine horn. The uterus is finally filled with medium to about the size of a 40 day pregnancy. One liter of fluid is used per donor. Each uterine horn is filled and emptied 5 to 10 times with 30 to 200 ml of fluid each time, according to size of the uterus. The embryos are flushed out with this fluid into a large graduated cylinder. After about 30 minutes, embryos settle and can be located under a stereomicroscope by searching through an aliquot from the bottom of the cylinder.

5) Evaluation of the embryos

Before the transfer of embryos into the recipient cows embryos are selected or evaluated for effectiveness of the embryo transfer program. For this the individual embryos are located using the microscope, they are evaluated for their quality and classified numerically for the success if transferred to a recipient female. The major criteria for evaluation include:

- ✓ Regularity of shape of the embryo
- ✓ Compactness of the blastomeres
- ✓ Variation in cell size
- ✓ Color and texture of the cytoplasm
- ✓ Overall diameter of the embryo
- ✓ Presence of extruded cells
- ✓ Regularity of the zona pellucida
- ✓ Presence of vesicles

Embryos are classified according to these subjective criteria as:

Grade 1: Excellent or Good, Grade 2: Fair, Grade 3: Poor, Grade 4: Dead or degenerating

Embryos also are evaluated for their stage of development without regard to quality. These stages are also numbered:

Stage 1: Unfertilized, Stage 2: 2 to 12 cell, Stage 3: Early morula, Stage 4: Morula, Stage 5: Early Blastocyst, Stage 6: Blastocyst, Stage 7: Expanded Blastocyst, Stage 8: Hatched Blastocyst, Stage 9: Expanding Hatched Blastocyst

There is apparently no difference in pregnancy rates of fertilized cells in different stages of development assuming that they are transferred to the recipient female in the appropriate stage of the estrous cycle. Stage 4, 5, and 6 embryos endure the freezing and thawing procedures with the greatest viability. Embryo quality is also of utmost importance in the survival of the freezing and thawing stress. Grade 1 embryos generally are considered the only ones to freeze. Grade 2 embryos can be frozen and thawed, yet pregnancy rates typically are reduced.

6) Selection and preparation of recipient females

Proper recipient herd management is critical to embryo transfer success. Cows that are reproductively sound, that exhibit calving ease, and that have good milking and mothering ability are selected as recipient. They must be on a proper plane of nutrition with sound health. If a cow is flushed every 90 days over a 12 month period and five

pregnancies are obtained per collection, an average of 20 pregnancies per year could result. Some cows have produced more than 50 pregnancies per year by embryo transfer. To maximize embryo survival in the recipient female following transfer, conditions in the recipient reproductive tract should closely resemble those in the donor. This requires synchronization of the estrus cycles between the donor and the recipients, optimally within one day of each other. Synchronization of the recipients can be done in a similar manner and at the same working time as the donor cows. Injectable prostaglandin products are available and should be injected into the recipient at the same time they are injected into the donor cow. This optimizes the probability that the recipient will be in the same stage of the estrus cycle as the donor when transfer takes place. This timing again must match the time of insemination of the donor cow so that the donor and the recipients have a similar uterine environment seven days later when the transfer takes place. Synchronizing drugs only are effective on recipient females that are already cycling. "Anestrus," or non-cycling, cows that are too thin or too short in postpartum days will not make useful recipients.

7) Transfer of the embryos

The transfer of the embryo into the recipient cow first requires "loading" of the embryo into a 0.25ml insemination straw. This is done under microscopic viewing, with the aid of a 1ml syringe and requires considerable practice, patience, and dexterity. Degenerated or embryos of very low grade need not be loaded and can be discarded. Just prior to embryo transfer, the ovaries of the recipient are palpated rectally to determine which ovary has ovulated. With the aid of an assistant to hold open the vulva of the recipient cow, the transfer gun or insemination rod is carefully passed through the cervix. The tip of the rod is then allowed to slide into the horn on the same side of the ovary with an active corpus luteum (CL). The embryo is gently expelled in the forward tip of that uterine horn. Great care is taken to not cause damage to the lining of the uterus. Such inflammation and scarring would greatly reduce the probability of the pregnancy being established. Embryo flushing and embryo transfer are both done after an epidural anaesthetic (2% Lignocain) has been given to block contractions of the digestive tract and aid in the ease of manipulation of the cervix and the uterine horns. Recovered embryos can be transferred immediately or may be stored frozen in liquid nitrogen after evaluation/grading. The freezing and thawing process usually results in an approximately 10 - 20% reduction in pregnancy rates from those observed with fresh embryos.

ADVANTAGES OF AN ET PROGRAM IN CATTLE

- ✓ Increase the number of offspring sired from superior females.
- ✓ Results in faster genetic progress.
- ✓ Increase the frequency of desired mating, capitalizing on excellence of a mating.
- ✓ Obtain offspring from old or injured animals incapable of breeding or calving naturally.
- ✓ Increased farm income through embryo sales.

- ✓ Exportation and/or importation of embryos are easier than with live animals.

DISADVANTAGES OF AN ET PROGRAM IN CATTLE

- ✓ Can be cost prohibitive and success rates are less than AI.
- ✓ Cost and maintenance of recipient females.
- ✓ Requires a technician with the skills to flush embryos from the reproductive tract.
- ✓ Possible spread of disease through recipients.

A Highlight on Disposal Pattern in Dairy Cattle

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In the present era, where the milk production traits have received major emphasis, the fitness traits related to health and reproduction are often overlooked. It had led to increase incidence of disposal in dairy animals. Undesirable disposal of dairy animals at farms is one of the major problem as it results in huge economic loss, affects the sustainability of enterprises and hinders in genetic improvement of a breed or animals. Genetic improvement of a breed means, improvement of animals of that breed for a particular desirable trait or traits of economic importance. These desirable traits are often milk production and fertility in case of dairy animals. For genetic improvement of animals, selection of animals for a particular trait/traits is practiced at the farm. Selection is the alternative form of culling, means if we select or allow some animals to remain and to reproduce in a herd, then we automatically reject or cull other animals from the herd. Selected animals are only allowed for breeding or to reproduce to give rise to future generation. An intense selection (as much as less animals of high genetic merit are selected to reproduce) of animals for desirable trait results in a rapid genetic improvement of animals. An intense selection is only possible with a large herd size, as large herd size gives freedom for more intense selection. Undesirable disposal of animals in a herd is major constraint in achieving large herd size and ultimately hinder in genetic improvement of a breed.

DISPOSAL PATTERN AND ITS CLASSIFICATION

Disposal means removal of animals from the herd due to any reason either voluntary or involuntary. Primary means of disposal are mortality (commonly termed as death) and culling (Waldner *et al*. 2009 and Pinedo *et al*. 2010). A broad classification of disposal pattern is shown in the following figure.

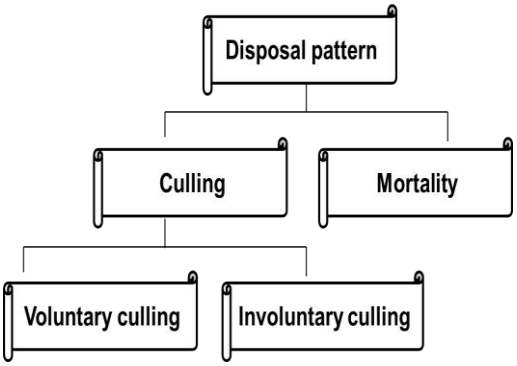

Fig. A broad classification of disposal pattern

Culling is the removal of animals from the herd due to various reasons, other than death. Culling is of two types: voluntary and involuntary culling. Voluntary culling is a type of culling where a cow is removed from the herd because of low production, irrespective of her health. Whereas, involuntary culling is the removal of a cow from the herd due to various diseases,

deformity or health problems, regardless of her production relative to her herd mates (Hadley *et al*. 2006). In simple words, voluntary culling is a type of culling where a low producing cow is removed from the herd, even if she was very good in health. Involuntary culling means that an unhealthy cow is removed from the herd, even if she was a very good milk producer. **Selection for milk yield is alternative form of voluntary culling.** Excessive incidence of mortality and involuntary culling are not beneficial, as they are indicative of poor herd health and also affect profitability of dairy farming.

Disposal pattern in dairy female animals

Disposal of cows/buffaloes can be classified into four categories according to the stages of life i.e. abnormal calving, in female calves and heifers up to first calving and in adult lactating cows.

- ***Abnormal calving***

Disposal of an animal may start even before its birth due to negligence or lack of knowledge of farm manager. Abortion, dystocia, premature birth and still birth come under the category of abnormal calving. Abortion in dairy cattle is commonly defined as the loss of the foetus between the ages of approximately 42 to 260 days. Pregnancies lost before 42 days are usually referred to as early embryonic deaths, whereas a calf that is born dead between 260 days and full term is defined a stillbirth. A low rate of abortions is usually observed on farms and a rate of 3 to 5 per cent abortions per year is often considered "normal." Incidence of abortions above 10% should be taken seriously. Dystocia is a condition of difficult parturition. Dystocia causes calf death at or shortly after birth and leads to uterine infections, more retained placentas, and longer calving intervals. In cattle the most common cause of dystocia is foeto-maternal disproportion, but faulty disposition also often causes dystocia. First calvers are more susceptible to dystocia, due to not fully grown reproductive organs, therefore require especial care before and during calving. Premature birth is the birth of a calf before completion of full term. Premature born calves are physically weak and do not have fully grown organs, therefore it is very challenging for them to survive further. Therefore, pre-mature born calves require especial care and attention by farm manager.

- ***Disposal pattern in female calves and heifers***

Female calves are future replacement (use to replace old and unproductive cows) of herd. Therefore, dairy farm manager often wants to include more number of young female animals into the milch herd regularly to maintain economic sustainability of enterprise. At most of the farms female calves are rarely used to cull to maintain proper herd size. But calves leave herd because of mortality. During the whole life of an animal, calf hood is the stage, where maximum mortality has been reported. Especially, first month of age is most critical age group of calves and most vulnerable to die (Upadhyay 2013), therefore, require especial attention by farm manager. On an average mortality rate of 24% has been observed upto age at first calving (AFC) in indigenous female calves. And out of total female calf mortality upto AFC, around 60% was reported during first month of age. Major reasons of calves' mortality are pneumonia, diarrhoea and weakness.

Calves born during winter season are more prone to die because of pneumonia and other respiratory problems, therefore, require especial attention. Calves born during rainy season, also need to save from calf diarrhoea. Calves should be provided with warmth (in winter season) and should be fed colostrum immediately after birth. After two weeks of age calf should be offered with warm gruel and calf replacer in the winter season, as they are rich source of energy and provide warmth to calves. Thereafter proper deworming and vaccination should be followed for keeping calves disease free. Some female calved are also culled after one year of age due to late maturity and poor growth. So these issues can also be taken in to consideration, while formulating feeding and management strategies.

- ***Disposal pattern in adult cows***

Culling in lactating cows is a common practice. Around 23% of cows were culled during each lactation in case of indigenous dairy cows (Abbas 2005 and Upadhyay 2013). Culling rate in case of exotic (taurine) and crossbred (cross of taurine and indigenous cattle) cows was found to be slightly higher than that of indigenous cows. Involuntary culling is the major reason of culling in adult cows. Whereas, voluntary culling for low milk yield is generally found to be only around 12% in dairy farms. Major reasons of involuntary culling are teat and udder problems (viz. teat block, teat fibrosis, udder fibrosis, abscess in teat and udder) and reproductive problems (viz. repeat breeder, cystic ovary, post-partum anestrous, pyometra, hydrometra, irregular estrous cycle, endometritis, prolapse, abnormal reproductive organ, chronic cervicitis and metritis). Incidence of mortality in lactating cows are comparatively lower than the calfhood stage, but few cows may die in herd because of infectious diseases. Reducing incidence of involuntary culling at a dairy farm is of major concern. It is crucial for ensuring animal welfare and also for ensuring profitability of dairy farming. Proper feeding, health care and management can help in reducing incidence of disposal of animals. Animal should be provided with nutritionally balanced died according to their nutritional demand. Proper feed formulation should be done at each farm for different categories of animals. Animal should be dewormed and vaccinated time to time. Diseased animals should be isolated from the herd, and should be given proper treatment by qualified veterinarian.

CONCLUSION

For ensuring animal welfare and profitability of dairy farming incidence of involuntary culling and mortality should be minimized. Calves especially during their early months of age need especial attention to protect them from pneumonia and diarrhoea, as these are major reasons of calf mortality. Adult cows need to save from teat & udder problems and reproductive problems as these are major reasons of involuntary culling. If a farm manager could be able to do these things then he can further increase the intensity of selection of animals for low milk yield, thereby improving his animals in a rapid way.

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Animal Genetic Resources of India: A SWOT Analysis

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India has traditionally been a mega biodiversity center and rearing of domesticated animals of different species viz. cattle, buffalo, sheep, goat, pig, camel, horse, donkey, yak and mithun by livestock keepers has been practiced since time immemorial. Animal husbandry is an integral component of Indian agriculture supporting livelihood of more than two-thirds of the rural population. Livestock provides milk, egg, meat as nutritious food, draught power for agriculture, wool, fibre, manure and domestic fuel, hides & skin. In 2010-11, this sector contributed 121.84 million tonnes of milk, 63.02 billion eggs, 42.99 million kg wool, and 4.83 million tonnes of meat. Milk is the main output of livestock sector accounting around two third (67%) of the total output by livestock sector. Meat and egg share 17.5% and 3.6% of the value of livestock output. Our indigenous animal genetic stock is rich in variability and is endowed with many desirable attributes like disease resistance, tolerance to hot and humid stresses, adaptability to different environment and production management systems and ability to utilize coarse roughages and crop residues. However, their productivity levels are generally low as far as milk yield and egg production are concerned. This however need not have prevailed as a drawback, for it is possible to improve yields and other performance parameters through selective breeding. Moreover, the consumers have a favourable preference for products of indigenous animals especially milk and eggs which also fetch premium price in the market. Also, milk from Indian zebu cattle and buffaloes contain only A2 allele of beta-casein protein which is considered to be safe for human consumption whereas A1 allele of beta casein is found to have higher frequency in most of B. taurus breeds which has been implicated in certain diseases, namely type 1 diabetes mellitus (DM1), ischaemic heart disease (IHD), arteriosclerosis and neurological disorders, such as autism and schizophrenia. The sustainable use and conservation of animal genetic resources has been, and generally continues to be, a low priority in developing agricultural, environmental, trade, human and animal health policies. The effect has been a failure to invest adequately in promoting native livestock and poultry genetic resources in financial, development and capacity-building institutions.

STRENGTHS

1. Mega livestock biodiversity with existence of almost all major domesticated farm animal species.
2. Large number of breeds in each farm animal species adapted to the specific agro climatic conditions.
3. Diversified draft, milch and dual purpose cattle breeds. The draft breeds can significantly contribute in agricultural operations to save fossil fuels.

4. Adaptability of germplasm to diverse changing climatic conditions of hot arid, humid tropical and temperate climates and better resistance to parasites and diseases.
5. Capability to survive and produce on coarse and poor quality feed and fodder resources (low input).
6. Availability of best breeds of buffaloes, a multipurpose farm animal species.
7. Large network of Research Institutes, State Agricultural/Animal Science Universities,State Animal Husbandry Departments, Livestock Development Boards and NGOs engaged in conservation and development of AnGR.
8. Large amount of ITK available with the livestock keepers for management of AnGR.
9. Seasonal migration of nomadic pastoralists help overcome adverse conditions especially during winter and rainy seasons which enable them to sustain the breed population maintained by them.

WEAKNESSES

1. Lack of reliable breed wise livestock census data.
2. Low productivity of indigenous livestock.
3. Poor implementation of breeding policies.
4. High population density vis-à-vis inadequate feed and fodder resources, and pasture land availability.
5. Lack of performance and pedigree recording at farmer's level.
6. Inadequate number of superior/proven bulls/bucks/rams/semen for AI and natural mating.
7. Inadequate funding for conservation of AnGR.
8. Insufficient patronage to native breeds.
9. Lack of local institutions like breed societies or herders groups/association.
10. Poor marketing system for animals, animal products and by products.
11. Inadequate insurance coverage of livestock and poultry.
12. Lack of legal support for registration of livestock breeds and protection of farmers/ livestock keepers' rights.
13. Poor orientation for characterization and conservation of AnGR.
14. IPR issues not clearly defined in case of AnGR.
15. Lack of harmony and coordination among different agencies

OPPORTUNITIES

1. Integral part of agriculture with synergistic relationship.
2. Substantial contribution to GDP.
3. Gainful employment, particularly to rural women and youth.
4. Excellent potential of indigenous AnGR for low cost conversion of poor quality roughages into animal protein to cater the fast growing dietary demand of human
1. population.
5. Large export potential for animal germplasm including semen/embryos adapted under

tropics, animal products and by products.

6. Presence of large genetic variability within breeds for bringing genetic improvement in traits of economic and environment importance.
7. Availability of technologies like genomics, phenomics, nano-biotechnology, cloning, etc for faster genetic improvement in AnGR.
8. Exploitation of animal draught power for better efficiency in farm operations.
9. Scope for allele mining for biotic and abiotic stresses in indigenous AnGR. 5
10. Increasing scope and market for organic agriculture.
11. ITK provides researchable issues for animal production and health care.

THREATS

1. Loss of superior germplasm due to uncontrolled breeding and migration.
2. Genetic dilution due to indiscriminate breeding.
3. Trans-border illegal export of AnGR.
4. Over mechanization replacing draft animal power.
5. Changes in production system leading to intensive monoculture.
6. Continued decreasing land under fodder production.
7. Increased human population pressure.
8. Increased pollution and degradation of environment.
9. Continuous decline in population of some breeds due to change in land use pattern.
10. Traditional grazing areas in forests or revenue lands are planted or occupied with exotic species viz, Lantana, Prospis juliflora, Eucalyptus, etc. which has significantly reduced the grazing area and affected population of breeds.

Therapeutic Management of Organophosphate Poisoning in Bovines

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The use of Organophosphate compounds (OPCs) have become extensive in past few decades in homes, gardens and in the productive fields related with Agriculture and Veterinary practices. They produce acute and sub-acute toxicity by a cholinesterase inhibition. Some organophosphates such as diazinon and methyl parathion have significant lipid solubility, allowing fat storage with delayed toxicity due to late release. Exposure of organophosphates by multiple routes can lead to serious additive toxicity, efficiently absorbed by inhalation, ingestion, and skin penetration. The anticholinesterase OPCs are the organic derivatives of phosphorous containing acids. OPCs, the anticholinesterases, produce significant morbidity and mortality in India. Following accidental or malicious exposure, these anticholinesterases lead to three well defined neurological syndromes i.e. initial life threatening acute cholinergic crisis which often requires management in intensive care unit, intermediate syndrome in which cranial nerve palsies, proximal muscle weakness and respiratory muscle weakness are common and animal often require respiratory support and delayed organophosphate induced polyneuropathy. Only few organophosphates pesticides have been implicated as causes of delayed neuropathy. OPCs produce significant illness in developing countries. There is a wide range of toxicity in these agents and wide variation in cutaneous absorption, making specific identification and management quite important. However, it is important to understand and develop appropriate strategies to manage these cases with available resources in these countries. Common organophosphate pesticides include malathion, dichlorvos, chlorpyrifos, trichlorfon, fenitrothion and malathion. Organophosphates inhibit the enzyme acetylcholinesterase in the cholinergic synapse and red cells and butyrylcholinesterase in the plasma. The inhibition of cholinesterase leads to acetylcholine accumulation at the nerve synapses and neuromuscular junctions, resulting in an over-stimulation of muscarinic and nicotinic acetylcholine receptors. The continued stimulation of the acetylcholine receptors leads to the clinical signs and symptoms of organophosphate poisoning.

SIGNS AND SYMPTOMS OF POISONING

Some of the most commonly reported early symptoms include headache, nausea, dizziness, and hypersecretion, the latter of which is manifested by sweating, salivation, lacrimation, and rhinorrhoea. Muscle twitching, weakness, tremor, incoordination, abdominal cramps, and diarrhoea all signal worsening of the poisoned state. Miosis is often a helpful diagnostic sign and the patient may report blurred and/or dark vision. Anxiety and restlessness are prominent.

At sufficient dosage, loss of enzyme function allows accumulation of ACh peripherally at cholinergic neuroeffector junctions (muscarinic effects), skeletal nerve-muscle junctions (excess ACh may be excitatory cause muscle twitching, but may also weaken or paralyze the cell by depolarizing the end-plate), and autonomic ganglia (nicotinic effects), as well as centrally. Signs and symptoms are broadly divided into muscarinic, nicotinic and central nervous system effects.

- ***Muscarinic effects***- Bronchospasm, bronchorrhoea, salivation, urinatation, diarrhoea, miosis, hypotension, bradycardia and vomiting.
- ***Nicotinic effects***- Hypertension, mydriais, tachycardia and sweating. Nicotinic effects at neuromuscular junction are confusion, agitation, coma and respiratory failure.
- ***Central nervous system effects***- Muscle weakness, fasciculations and paralysis.

Increased pulmonary secretions coupled with respiratory failure are the usual causes of death from organophosphate poisoning. Recovery depends ultimately on generation of new enzyme in all critical tissues.

DIAGNOSIS

In our country diagnosis of Organophosphate Poisoning is generally based on:

History of intoxication (ingredients of organophosphate, time and route of exposure, amount ingested, malicious poisoning)

- Clinical manifestations
- Initial vital signs (respiratory rate, heart rate, systolic blood pressure)
- Initial blood tests (white blood cell count, haematocrit, platelet count, serum blood urea nitrogen, creatinine, sodium and potassium concentration, amylase, arterial blood gas analysis)
- SChE activity and electrocardiographic results

TREATMENT

- Intubate the patient and aspirate the secretions with a large-bore suction device if necessary. Administer oxygen by mechanically assisted pulmonary ventilation, if respiration is depressed.
- Improve tissue oxygenation as much as possible before administering atropine, so as to minimize the risk of ventricular fibrillation.

- Activated charcoal was administered after gastric lavage for all patients that decreases absorption by 42% if done at 20 minutes and by 16% if performed at 60 minutes. Atropine and pralidoxime (PAM) administration were administrated in accordance with the protocol of the hospital.
- Atropine is effective against muscarinic manifestations, but it is ineffective against nicotinic actions, specifically muscle weakness and twitching and respiratory depression. Glycopyrolate has been studied as an alternative to atropine and found to have similar outcomes using continuous infusion.

MANAGEMENT

- Remove contaminated clothing (wear gloves) and wash the patient thoroughly with soap and water.
- Monitor patient for secretions, pulse rate, pupil size, blood pressure, oxygen saturation and pulse.
- Ensure adequate airways protection, if the patient has respiratory distress intubate early.
- Ensure adequate oxygenation and circulation.
- Give atropine until patient is fully atropinised.
- Monitor the patient over 15 minutes and in case of high dose of atropine the reduction in the infusion of atropine is done to avoid too high agitation, pyrexia, reduced bowel sounds and urinary retention.
- Perform ECG and administer intravenous magnesium to treat arrhythmias.
- Patients with minor exposure to organophosphates can be discharged if asymptomatic after 12 hours of observation.

CONCLUSION

Many literatures have reported on the various factors include initial blood pressure, serum cholinesterase (SChE) level and electrocardiogram findings (prolongation of QT interval) that predict the outcome in acute organophosphate Poisoning. The absence of an increase in serum cholinesterase (SChE) activity is associated with higher mortality in organophosphate poisoning. The SChE dynamic activity can provide a guide to physicians in the evaluation and management of organophosphate poisoned patients.

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