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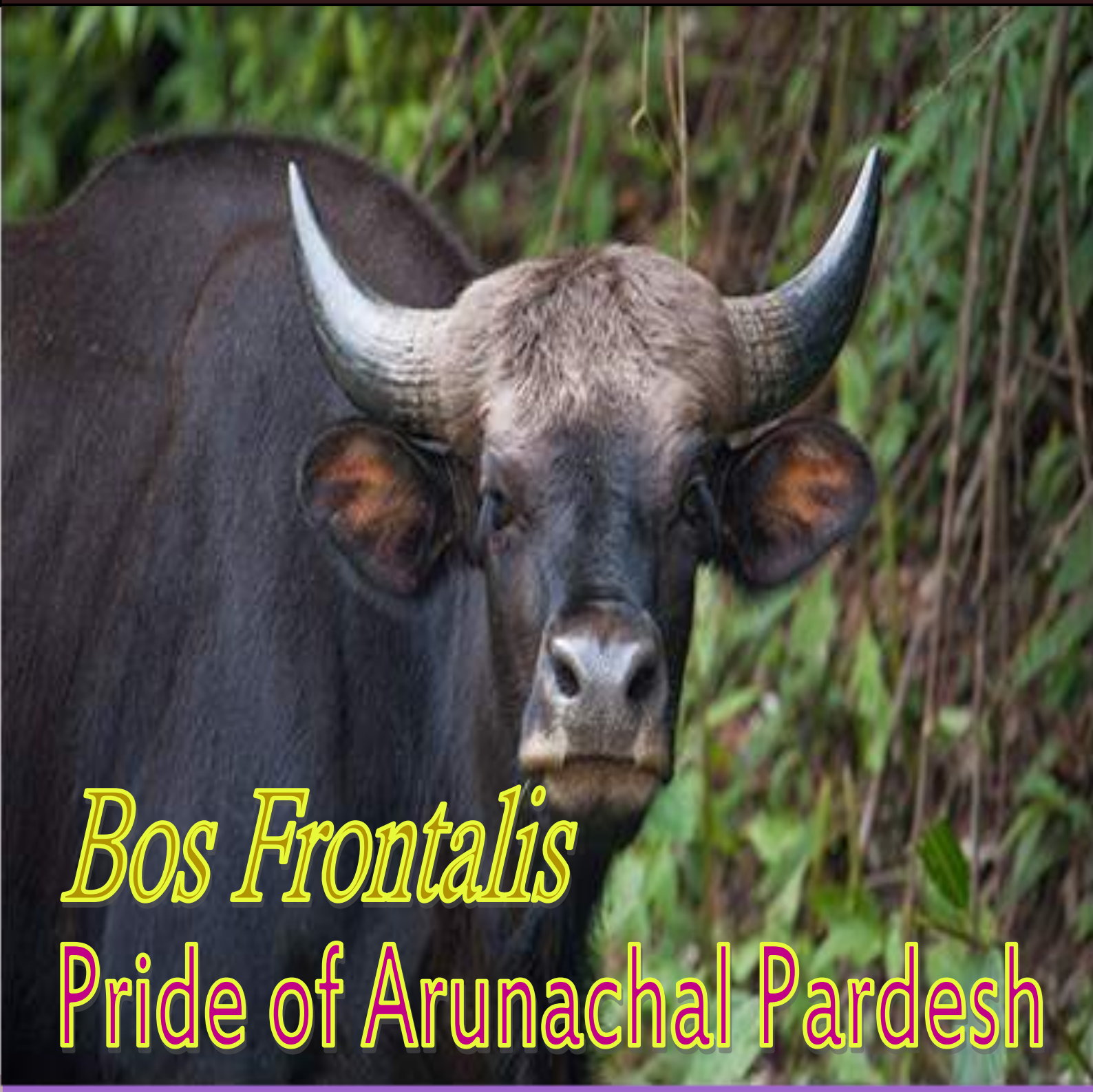

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# INDIAN FARMER

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# Straw Enrichment: A Boon to Dairy Industry

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India, with only 2.29 % of land area of the world, is maintaining nearly 17.4% of human and 10.7% of Livestock population of the world. Growing demand for livestock products by the increasing population and urbanization is one of the major factors responsible for the steady growth of the livestock sector. In view of the current shortage there is an emergent need to enhance the nutritive value of the limited feeds and fodder. Resource wise dry fodder represents the largest amount followed by the green fodder, and the concentrates. Dry fodder mostly comprises of crop residues and is obtained as a by-product after harvesting the food grains. Crop residues have low palatability, nutritionally poor and have to be supplemented with green fodder or concentrates. Therefore, to improve the productive and reproductive capacity of ruminant animals on small-holder farms, there is a need to develop feeding strategies that will enhance the quality and availability of feed resources. Straw treatment increases the accessibility of low quality forages to the digestive enzymes of the rumen's microorganisms so as to improve both their digestibility and intake. These treatments are, in fact, very efficient and some of them emphasized below are extremely easy to put into practice.

## CHEMICAL TREATMENTS:

- Oxidizing agents (peroxyacetic acid, acidified sodium chloride, ozone, etc.) which decompose fairly efficiently the

lignin but are limited in use because they are costlier and some are harmful and corrosive.
- Strong acids
- Alkali based agents (lime, potassium, **caustic soda** either alone or in association and, more recently, **ammonia**), which are able to hydrolyze the chemical bonds formed between the indigestible lignin and the parietal polysaccharides (cellulose, hemicellulose).

The combined effect of these treatments is to cause a reduction in the rigidity of the

cellstructure and a swelling of the cell wall. Thus microbes can colonize more rapidly on the vegetal matter, decomposing it more quickly and intensively increasing its dry matter degradability. Due to the potential dangers involved with caustic soda treatment, these techniques havealmost entirely abandoned in favour of treatment with ammonia. Ammonia ($NH_3$) is a byproduct from industrial "cracking" of hydrocarbons. It is used as a raw material in the fertilizer industry and also applied directly as a fertilizer. It is a gas at the normal atmospheric pressure. It is easy to liquefy and readily dissolves in water. Due to the volatility of ammonia at normal room temperature and pressure, treatment with anhydrous ammonia presupposes that the forages will be treated within hermetically sealed enclosures. Ammonia gas can be added to both dry and ensiled forages. This technique offers no advantage for treatment of legume hays, and often may result in a toxic feed for livestock when high quality, immature forage grasses, sudangrass or small grain hays are ammoniated because of the increased absorption of ammonia from rumen wall. Lower quality crop residues are treated with urea as it is a cost-effective way of improving their feeding value in terms of their voluntary feed intake, dry matter and crude protein degradability. Ammonization increases crude protein (CP) and improves forage digestibility.

**The Principle and Effects of Straw Ammoniation**

The main component of straw is fibre, including cellulose and hemicellulose that can be digested by ruminants. Some cellulose and hemicellulose are bound to lignin and resistant to microbial attack. Ammonia treatment substantially reduces the concentration of neutral detergent fiber in forages. Most of the loss of NDF is due to destruction of hemicellulose. Ammoniation also reduces the amount of lignin in some forage. Ammonia treatment disrupts chemical linkages between lignin and hemicellulose. Lignin inhibits fiber digestion; therefore, disruption of those linkages makes the hemicellulose more digestible. Cellulose digestibility also increases since lignified hemicellulose encases cellulose. Ammonia treatment also changes the physical characteristics of forages making them more pliable and increases their uptake of water (hydration). Hydration rate has an important role in digestion rate; the faster a forage particle is hydrated, the faster it is digested. Thus Ammoniation usually increases digestibility by 20 percent and CP content up to 1-2 times. It can also improve palatability and consumption rate. The total nutritional value can be doubled. In addition, ammoniation reduces mould development, destroys weed seeds (e.g. wild oat, false sorghum, etc.), parasite eggs and bacteria.

**Ammonia sources for Straw Ammoniation**

The sources of ammonia to treat straw include anhydrous ammonia, urea, ammonium bicarbonate and aqueous ammonia.

**Anhydrous ammonia**

Anhydrous ammonia means "ammonia without water." Its formula is $NH_3$, and its N content is 28.3 percent. The normal dosage is 3 percent by weight of the straw DM.The boiling point of anhydrous ammonia is -33.3°C, its vapour density is 0.59 (that of air is 1) and its liquid density 0.62 (that of water is 1). Gas pressure is 1.1 kg/cm$^2$ at -17.8°C and 13.9 kg/cm$^2$ 38°C. At normal temperature and pressure, anhydrous ammonia is a gas. Expensive pressure containers are required not only to keep it as a liquid, but also to transport and store it. Anhydrous ammonia is a potentially dangerous and toxic material, and stringent safety precautions need to be observed when using it. Its natural ignition temperature is 651°C. If the ammonia content in the air reaches 20 percent, an explosion from self-ignition could occur. Attention should be paid to possible ammonia explosions, even though it seldom happens.

**Urea**

The N content of urea is 46.7 percent. Its formula is CO $(NH_2)_2$. It is decomposed into ammonia and $CO_2$ by ureases at ambient temperature. The chemical reaction is:

$$CO(NH_2)_2 + H_2O \longrightarrow 2NH_3 + CO_2$$

The recommended dosage is 4-5 percent urea on DM basis, taking into consideration the effect of ammoniation and costs. Urea can be transported conveniently at normal temperature and pressure. It is harmless to humans. Treating straw with urea does not need complex equipment and the sealing conditions are not as strict as with anhydrous ammonia. Urea is not as effective as anhydrous ammonia for straw treatment, but it is better than ammonium bicarbonate. Thus Urea treatment is the most economic and easily done treatment method to enhance the nutritive value of poor quality fodders.

Key Points regarding Urea:

- Easy availability.
- Urea spray makes the Wheat Straw soft and easy to digest.
- Cheap way of increasing proteins.
- It has a number of beneficial effects on the quality of fodder and growth of the animals, with no side effects.

**AMMONIUM BICARBONATE**

The nitrogen content of ammonium bicarbonate is 15-17 percent; its formula is $NH_4HCO_3$. It can be decomposed into $NH_3$, $CO_2$ and $H_2O$ at a suitable temperature (above 60°C). The chemical reaction is:

$$NH_4HCO_3 \longrightarrow NH_3 + CO_2 + H_2O$$

The dosage of ammonium bicarbonate, estimated by its N content, is 14-19 percent of straw DM. Ammonium bicarbonate is a major product of the fertilizer industry and it is readily available at low price and it is easy to use. Since ammonium bicarbonate is an intermediate product of urea breakdown, theoretically, in the right concentration, its effect should be similar to urea It does not decompose completely at low temperature, thus in cold climates the effectiveness of treatment with

ammonium bicarbonate is not good. When treating with ammonium bicarbonate in an oven, one day is enough, since the temperature reaches 90 °C and it decomposes completely.

**Aqueous ammonia**

Aqueous ammonia is a solution of ammonia in water. The concentration is quite variable, but the usual value is 20 percent. At this concentration, the normal dosage is 12 percent by weight of straw DM. It is only adapted to areas near to fertilizer factories because its low N content makes transport expensive.

**Other sources**

Besides the above sources of ammonia, human and animal urine also can be used to treat straw. Urine can be used as a source of urea. In effect, although it consists of 90 to 95 % water, urea is the most important of the solid constituents and makes up more than 70 % of the nitrogen content in the urine. For domestic mammals, the urea content of urine ranges from 2 to 25 g/litre. One of the reasons why this treatment method has not really been used extensively from the purely practical difficulties involved in collection and storage of the urine.

**Reason for low nutritive value of Straw**

The degradation of the cell walls requires the microbes to attach themselves to the feed particles so that the enzymes can penetrate inside the fibrous structures. But wheat straw shows a high proportion of lignified walls, incrusted with lignin in a very complex manner ,the lignified walls resist for a long time the microbial degradation and the peristatic mastication (of rumination) and they are thus only digested slowly. Thus in order to have good digestive utilisation, the cellulolytic fermentation process should be correctly carried out, the microorganisms in the rumen must be able to find the nutritive elements which they need for self development and to enable them to degrade the polysaccharides of the cell walls of the wheat straw

**Nutritional Value Enhancement of Straw with Urea:**

As straw especially Wheat Straw is not easily digested that's why it cannot be eaten in a large quantity, and also it does not fulfill the nutritional requirements of animals. For this reason it is treated/ enriched to improve its nutritional value. The quantity of the proteins in the Wheat Straw increases when only urea is used in the preparation but when molasses is mixed with Wheat Straw, then in addition to increase in protein value, its energy content is also increased and animals get more energy. Ammonia treatment (3%) of dry forages generally increases the CP content by about 8 percentage units. Ammoniated straw will contain 12-14% CP as compared to 4-6% for untreated straw. Inclusion of urea is associated with increase in digestibility of OM and increase in the voluntary intake of OM. The volatile fatty acid (VFA) pool in the rumen is also higher in treated straw. The increase in digestibility coupled with the increase in feed intake results in a substantial increase in consumption of digestible energy by animals fed ammoniated forages as compared to those fed untreated forage. In other words, ammoniated straw can provide adequate energy and protein to

maintain cattle and sheep under most conditions. Ammoniated fodder is generally adequate in energy and protein but mineral and vitamin supplementation especially Vitamin A and sulfur adequacy should be examined closely.

**Wheat Straw Enrichment Process:**

Step 1: Chaffing of Wheat Straw

Wheat Straw is procured and chaffed.

Step 2: Adding of Urea

Dissolve 4 kg Urea in 50 litres of water. Since urea is not easily dissolved in water, so add it in water in small quantities, stirring it continuously, this mixture would be enough for 100 kilograms of Wheat Straw.

Step 3: Spraying of Urea Solution

Now spread about 9-10 inches of Wheat Straw on the ground and spray the Urea solution on it and mix up the Wheat Straw. Spread the second layer on it and repeat

this process. In this way, spray the whole of the solution on the Wheat Straw and press it to remove the trapped air.

Step 4: Covering

After that, cover it with a plastic sheet to protect it from air and moisture. If a plastic sheet is not available, cover it with anything like a thatch mat and mud. Mud alone can also yield the required results. Ensure that the moisture in it is not more than 50%. The ideal temperature for all

this process is 30-35°C. In the other process, molasses is also used with urea.

For 100 kilograms of Wheat Straw, 4 kilograms urea is mixed with 50 litres of water and then 10-15 kilogram molasses is

added to this mixture. The remaining process is the same. This mixture mixes easily and completely if it is sprayed during threshing at the point where Wheat Straw emerges from the thresher.

Cover the Wheat Straw with a plastic sheet after the spray. Keep the Wheat Straw under the plastic cover for 3 weeks to protect it from moisture

**Changes in the Wheat Straw after Urea Treatment:**

When Wheat Straw is kept covered in this process, urea is converted into ammonia gas which darkens the colour of the Wheat Straw, thus increasing the proteins in it and making it easily digestible for the animals. Urea also acts as fungicidal to the final product. Urea treatment dissolves the carbohydrates (mainly the hemicelluloses) partially thus swelling the vegetal matter in an aqueous environment, so easing access by the rumens cellulolytic microorganisms and reducing the physical strength of the cells, so easing mastication by the animal and digestion by the microbes and enriching the forage in nitrogen. During summer place the Wheat Straw in an open environment for some time after a 20-day treatment so that the extra ammonia and its smell disappear, before feeding it to the animals. Feed 4-5 kilogram fodder daily to pregnant and lactating animals, and even to those which are non lactating animals. Use the straw by mixing it with green fodder, so that nutritional requirements of the animals are fulfilled. Precautionary measures during Treated Straw Feeding:

- The calf six month should not be fed with treated straw.
- The pregnant cattle should not be fed with treated straw.
- The quantity of the urea should be appropriate during the preparation.
- It is also important to ensure that urea is dissolved well in water.
- Provide a lot of water to the animal.

The cost of the Straw Enrichment process is 60 paisa per kilogram as the cost of urea is 10-15Rs/kg but the use of enriched straw increases milk production by 20%. It means the rate of profit is much higher as compared to the cost.

**Beneficial modification to Urea Treatment of Straw:**

Urea along with calcium sulphate:

However, inclusion of high amount of urea in the poor quality roughage is still limited because of the rapid hydrolysis of urea to NH3–N and absorption from the rumen. This could result in a potentially large part of the N excreted in the urine and faeces as a loss of potential nutrient for production; thus can contribute to environmental pollution .Slow release urea has been achieved by binding urea to calcium sulphate and could improve N utilization in the rumen in increasing microbial protein synthesis as well as milk production in ruminants found that the inclusion of Urea-calcium sulphate at 180 g/kg DM in the feed block could improve in vitro rumen fermentation, microbial mass and digestibility.

*Urea along with Calcium hydroxide*:

Although, urea-treated (5%) rice straw has been used as roughage during the dry season but the cost was relatively high due to increasing price of urea. Elseed et al. (2003) suggested that when amount of

urea was reduced and combined with calcium hydroxide Ca $(OH)_2$, it could improve rumen degradability. The concentrated alkaline agents can chemically break the ester bonds between lignin and hemicellulose and cellulose, and physically make structural fibers swollen. These effects enable rumen microbes to attack the structural carbohydrates more easily, increasing digestibility and at the same time increasing palatability of the treated straw. Moreover, calcium residue which remained in the treated straw causes no serious problems to the animal or environment and can be a calcium supplement to the animals. Based on this study, implications could be made that using 2.2% urea+2.2% calcium hydroxide treated rice straw for straw treatment could be an alternative treatment with regards to its effectiveness and treatment cost.

## CONCLUSION

It is clear that urea treatment constitutes a simple and efficient technique which can be used practically in the farms. Essentially, one should consider all the factors, which might influence success and any constraints, which have to be overcome. Urea treatment does not pose difficulties as long as it is carefully done. It constitutes a practical technique which may be used with equal success for small farmer communities, as well as by cooperatives or large farms to improve the nutritive value of the straw and thus to increase animal productivity and overall profitability of the dairy venture.

# Reclamation/Amelioration of Acid Soils

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In aqueous systems, an acid is a substance that donates $H^+$ ions to some other substance. Conversely, a base is any substance that accepts $H^+$ or donates $OH^-$. Pure water undergoes slight self ionization $H_2O \ to \ H^+ + OH^-$. The $H^+$ ion actually attaches to another $H_2O$ molecule to give $H_3O$. Since $H^+$ and $OH^-$ are both produced by dissociation of a water molecule, $H_2O$ is both a weak acid and a weak base. The product of $H^+$ and $OH^-$ concentrations, is the dissociation constant of water $K_W: K_W = [H^+] \times [OH^-] = [10^{-7}] \times [10^{-7}] = 10^{-14}$ (at $25^0$ C). Adding an acid to water will increase $[H^+]$, but $[OH^-]$ will decrease since $K_w$ is constant. The $[H^+]$ in solution can be conveniently expressed using pH which is defined as $pH = \frac{log\,1}{H^+} = -\log[H^+]$. Soil pH measures $H^+$ activity (Activity = concentration x Activity coefficient) and is expressed in logarithmic terms. Each unit change in pH means a tenfold change in the amount of acidity and basicity. Acid soil is a base unsaturated soil which has got enough of adsorbed exchangeable $H^+$ ions so as to give a pH of lower than 7.0.

**Acid Soils**

Acid soils occupy approximately 60 percent of the land area of the Earth. They arise under humid climate conditions from carbonaceous less soil-forming rocks in all thermal belts of the Earth. Soil acidification is partly a consequence of the depletion of calcium and magnesium. This occurs through the leaching of cations of calcium and magnesium by infiltrating water and through their uptake by crops. Acidification of soils is intensified by the application of mineral fertilizers, primarily nitrates as well as by acid rains and climate change. Acidic soil reaction and the associated negative characteristics reduce the productivity of the soil and the quality of crops as well as adversely affecting ecological balance in farmland. Broadly the acid soils of India can be classified into seven group's viz. Lateritic, laterite and lateritic red, mixed red, black and yellow, ferruginous red, podsolic brown forest and forest soils, foot hill soils and peat soils. In India about 90 million hectares of land i.e. $1/4^{th}$ area of India comes under acid soils. Out of the total cultivated area of 157 million hectares about 49 million hectares is acidic. Out of this about 26 million hectares has a pH of < 5.5 and 23 million hectares has a pH between 5.5 to 6.5. In

base unsaturated soils the pH ranges from 5-6 and base saturation varies from 16 to 67%. In Himachal soils iron contributes towards acidity whereas in the North East $Al^{3+}$ contributes significantly to soil acidity. The acid sulphate soils of Kerala are influenced by dissolved $H_2SO_4$, $Fe_2(SO_4)_3$ and $Al_2(SO_4)_3$.

**Reclamation of Acid Soils**

In general the fertility status of acid soils is very poor. Under strongly to moderately acidic soils the plant growth and development is affected to a great extent. The management of acid soils should aim at realization of the production potential either by addition of amendments to counteract the abnormalities of such soils or to manipulate the agricultural practices to obtain optimum crop yields under acidic conditions. One of the most important and practically feasible management practices is the use of lime and liming materials. The lime requirement of acid soil may be defined as the amount of liming material that must be added to raise the pH to some prescribed value. This value is usually in the range of 6.0 to 7.0, since this is an easily attainable value within the optimum range of most crop plants.

**Liming**

There are two main chemical approaches to determine lime requirement of acid soils:

1) To apply lime to bring soil to a desired soil pH, preferably between 6.5 to 6.8.
2) To add lime to neutralize the exchangeable Al.

It has been observed that raising the pH to neutrality is useful for temperate soils and addition of lime to neutralize exchangeable Al is useful for tropical soils.

**Liming Materials**

A substance whose Ca and Mg compounds are capable of neutralizing soil acidity is called a liming material. It provides hydroxyl ions and mostly ground limestone is used. Liming materials are necessary for the neutralization of soil solution hydrogen ions. The commonly used liming materials are oxides, hydroxides, carbonates and silicates of Ca or Ca+ Mg. The presence of only these elements does not consider a material as a liming material. In addition to these compounds the accompanying anion must be one that will reduce the activity of $H^+$ ions and hence Al in the soil solution. These are called "Agricultural Liming Materials".

$CaSO_4$ is not considered as a Liming material because:

$$CaSO_4 \leftrightarrow Ca^{2+} + SO_4^{2-} \rightarrow SO_4^{2-} + H_2O \rightarrow H_2SO_4$$

Also, after dissociation Ca results in replacement of adsorbed $Al^{3+}$ in a localized zone with a significant lowering of soil pH. Therefore, gypsum does not qualify as a liming material.

**Kinds of Liming Materials**

1) **Oxides of Lime (Burned or quick lime):** It is more caustic and is produced as:

$$CaCO_3 + Heat\ \Delta\uparrow \rightarrow CaO + CO_2 \text{ or } CaMg(CO_3)_2 + Heat\ \Delta\uparrow \rightarrow CaO + MgO + 2CO_2\uparrow$$

2) **Hydroxides of Lime (Slaked Lime):** It is more caustic than burned lime. If it is kept in moist air then:

$$CaO + H_2O \rightarrow Ca(OH)_2$$

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

**3) Carbonates of Lime:**

Calcite ($CaCO_3$) and Dolomite [Ca Mg $(CO_3)_2$].

**4) Slag**

**a)** Blast Furnace Slag: It is a by product of the manufacture of pig iron. It behaves as Calcium silicate and its neutralizing value is 75 to 90%.

**b)** Basic Slag: It is a by product of open heath method of making steel from pig iron which in turn is produced from high P iron ore. The impurities in the iron including Si and P are fluxed with lime and basic slag is produced. It has a neutralizing value of 60-70%.

**c)** Electric Furnace Slag: It is produced from electric furnace reduction of phosphate rock during preparation of elemental P. It is also calcium silicate

**5) Others**

Coral shells, chalk, wood ash, pressmud (paper mill by product), sugar factory waste, fly ash and sludge are also used for ameliorating soil acidity depending upon their abundance and availability in a region.

**Influence of Lime on Soil Properties**

**A) Direct Effects:**

1) The toxicity of Al, Fe and Mn is reduced since they are rendered insoluble
2) The uptake of Ca and Mg is increased, and
3) The $H^+$ ion toxicity is removed.

**B) Indirect Effects:**

1) It increases the N and P availability and decomposition of organic matter is increased. P is increased due to reduced fixation by Fe and Al. The uptake of K is more efficient in limed soils. When there is excess K there is luxury consumption of K leading to its wastage. But in the presence of lime there is competition between K, Ca and S and thus K consumption decreases. This is desirable to increase the Ca concentration in plants.
2) It increases the availability of micronutrients.
3) It encourages microbial population and thereby increases nitrogen mineralization and nutrient availability. Most of the organisms responsible for the conversion of ammonium and nitrates require large amounts of active Ca. Thus by liming the nitrification increases.
4) Liming enhances nitrogen fixation.
5) Liming improves soil physical conditions by reducing bulk density and increasing the percolation and infiltration.
6) It controls certain plant pathogens especially fungi.
7) Liming increase the efficiency of the applied fertilizers.

**Liming Reaction**

Lime reaction in soil depends upon the nature and fineness of liming material. Lime is usually applied to soils in the form of ground lime stone. Limestone can be calcitic ($CaCO_3$), dolomitic [Ca Mg $(CO_3)_2$] or a mixture of both. Both are sparingly soluble in pure water but become soluble in water containing $CO_2$. The greater the partial pressure of $CO_2$ in the system, the more soluble the limestone becomes:

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$$

$$\rightarrow Ca^{2+} (Take\ part\ in\ cation\ exchange\ reaction) + 2HCO_{3-}$$

$$H^+ + HCO_{3-} \rightarrow H_2CO_3 \leftrightarrow H_2O + CO_2$$

Thus $H^+$ in the soil solution reacts to form weakly dissociated water and the $Ca^{2+}$ ion from the limestone is left to undergo cation exchange reactions. The acidity of the soil is, therefore, neutralized and the per cent base saturation of the colloidal material is increased. The process of changing pH by addition of $Ca(OH)_2$ is:


## CONCLUSION

Liming of acid soils plays a key role in increasing their fertility. Now days specialized machinery and liming technologies have been developed. For this purpose industrial wastes containing calcium are of considerable current use, including ash. To promote sustainable land use, a set of models descriptive of the dynamics of environmental reaction as well as of the attendant processes in the agricultural systems should be made; the liming dose should be determined very carefully; GPS should be used for its application and new varieties of plants suitable for acid soils should be developed.

Figure 1 Acid Soils

Figure 2 Addition of lime for reclamation

## REFERENCES

1. Von Uexküll, H. R., and E. Mutert. Global extent, development and economic impact of acid soils. *Plant and soil* 171(1995): 1-15.
2. Beaton, James D., and Werner L. Nelson. Soil fertility and fertilizers: An introduction to nutrient management. Vol. 515. Upper Saddle River, New Jersey, USA: Pearson Prentice Hall, 2005.

# Cytokine: As adjuvant in poultry vaccines

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Adjutants are molecules,compounds or macromolecular complexes cause minimal toxicity but long lasting immune effects on their own.The addition of adjuvants to vaccines enhances, sustains and directs the immunogenicity of antigens, effectively modulating appropriate immune responses, reducing the amount of antigen or number of immunizations required and improving the efficacy of vaccines in chicks or immuno-compromised birds.Since, the poultry industry has made restrictions over the use of antibiotics as growth promoter because it causes the antibiotic resistance to humans due to the residual effects of antibiotic in the poultry products. So, the poultry producers require effective adjuvants that promote protection and that do not cause any pain or distress to birds when administered with a vaccine. To fill the gap cytokines have been tried as adjuvant to poultry vaccines. Cytokines are naturally derived proteins that are produced by the immune system immediately following infection or vaccination to regulate the immune responses by mediating a multitude of effects ranging from activation and differentiation of immune cells to enhancing the immune function. Generally cytokines characterized as Th1 cytokines (IL-2. IFN-γ, TNF and Lymphotoxin (LT) which are involved in CMI and Th2 cytokines (IL-4, IL-5, IL-6, IL-10 and IL-13) involved in regulation of humoral immunity. Except IL-6, all cytokines cloned in chicken are being categorized as Th1 like. Similarly based on the function, chicken cytokines classified as pro-inflammatory (IL-1ß, IL-6, IL-8), Th1 (IFN-γ, IL-2, IL-8), Th2 (not described), Th3/Tr1 (TGF-ß) and others (IFN-α, IFN-ß, IL-15, IL-16, chemokines).

**Reasons to go for alternative approach**

There are concerns over the use of live vaccines in the poultry industry in terms of emerging of hepervirulent strains. However, killed and recombinant subunit vaccines do not offer an adequate level of protection and often require the use of adjuvants.Aluminium hydroxide (alum) and oil emulsion adjuvants have been commonly used in many veterinary and human vaccines because of their safety. However, comparative studies in humans and animals show that alum is a weak adjuvant for the induction of antibody

responses to recombinant protein vaccines. It has been shown in mice to bias towards Th2 rather than Th1 responses. Alum poorly induces cell-mediated immunity, particularly cytotoxic T-cell responses, which is a significant drawback for its use in vaccines against intracellular parasites and some viruses. Additionally, alum adjuvants have a tendency to induce IgE-mediated immune responses and may promote IgE-mediated allergic reactions. The use of oil-based adjuvants, in contrast, is limited by induction of side-effects and adverse site reactions. CFA is a typical example, having been shown to induce inflammation and ulceration at the site of injection as well as fever and sensitivity reactions.

In spite of these problems, the major restrictions have been made over the use of antibiotics as growth promoter due its residual in the product cause deleterious effect to consumer. So, the alternative to in-feed antibiotic was in-feed enzymes such as Avizyme, which acts by increasing the rate of diet digestibility and sugar provision, ultimately changing the substrate quality and quantity available to intestinal flora.Next alternative was betaine which acts as an osmolytee to minimize intestinal damage caused by species of gut parasiteve such as Eimeria. This in turn inhibits secondary infections by opportunistic C. perfringens and reduces the incidence of necrotic enteritis.Another alternative was the use of bacteriocins, small proteins produced by certain bacteria for the purpose of eliminating the other competing bacteria. However, the recent findings confirm that many chicken cytokines reveals its adjuvant potential with poultry vaccines.

**Chicken cytokines as adjuvant**

The immunoadjuvant activity of ChIL-1ßhas been assessed using tetanus toxoid as an antigen. ChIL-1ßincreased antibody responses when administered in vivoas a recombinant protein compared to antigen alone. Combined administration of ChIFN-α, ChIFN-γ and ChIL-1ßincreased antibody responses to tetanus toxoid in an additive manner. The birds administered with Fowlpox vector (FPV) fused with NDV genes gave protection to birds after challenge with NDV; however, the chickens had lost weight due to the fowlpox virus. When ChIFN-α was co-administered with the NDV gene in FPV, the birds did not lose bodyweight and also it protected the birds from challenge with NDV compared to non-vaccinated birds.

Birds treated with ChIFN-γ resulted in protection from infection with *Eimeria* and reduced weight loss associated with this disease. ChIFN-γ was also found to act as a natural growth promoter, with treatment resulting in an increase in body weight of 3-8%. The anti-viral effects of co-delivering ChIFN-α and ChIFN-γ as these cytokines have been reported to act synergistically in vitro.

The ChIL-1β has been examined for its immunoadjuvant activities using tetanus toxoid as an antigen. When administered as recombinant protein, ChIL-1β was found to increase antibody responses compared to administering the antigen alone. Co-administration of ChIL-1β, ChIFN-α andChIFN-γ showed an additive effect on the antibody responses

to the tetanus toxoid. Similarly, in vivoadministration of ChIL-2 and measurement of the changes in T-cell populations showed that rChIL-2 induced the expression of cell surface IL-2 receptor (CD25) on peripheral blood lymphocytes as well as increased the proportion of CD4+ and CD8 + T cells. The ChIL-15 also plays a main role in activating NK cells and CD8+ memory T cells and the primary function of ChIL-18 is upregulation of IFN-γ production by Th1, NK cells and NKT cells.

**Effective delivery system for chicken cytokines**

Most recently, the chicken cytokines genes are fused in virus vector and then injected to birds, so that it can express continuously and gives long time protection to birds against infectious diseases. The poultry industry relies on cost-effective methods of vaccine and adjuvant delivery. The use of in-ovovaccination has increased in recent years, and may eventually be a preferred means of immunization in poultry, due to reduced labour costs and less animal handling.The development of automated systems for vaccine and adjuvant administration on a commercial scale introduces a new method of delivery of cytokines as vaccine adjuvants. Automated machines can safely inject large numbers of eggs, ensuring accurate and consistent dosage.

## CONCLUSION

Cytokines such as IFN-α, IFN-γ, ChIL-1ßand cMGF have been shown to possess adjuvant activities, and have the potential to be used in vaccine formulations to provide improved protection against disease.The choice of particular vectors will enable antigen and cytokine targeting to specific sites such as the gut or respiratory tract, thereby allowing the most appropriate type of immune response to be generated at the correct site. Moreover, the cytokines offer a natural approach to therapeutics particularly in relation to the enhancement of protective immune response produced by vaccines.

## REFERENCES

Hilton, L. S., Bean, A. G. and Lowenthal, J. W. 2002. The emerging of avian cytokines as immunotherapeutics and vaccine adjuvants. Veterinary Immunology and Immunopathology, 85:119-28.

Asif, M., Jenkins, K. A., Hilton, L. S., Kimpton, W. G., Bean, A. G. and Lowenthal, J. W. 2004. Cytokines as adjuvants for avian vaccines. Immunology and Cell Biology, 82:638-43.

Kalaiyarasu, S., Senthilkumar, D., Manojkumar, Sankar, P., Elamurugan, A. and Karikalan, M. 2013. Cytokines as potent therapeutic agent and vaccine adjuvant in poultry. Research News For U. 10:110-116.

# Understanding the Social Behavior Protocol In Animals

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**Abstract**

*Understanding social behavior of animals is desirable for efficient scientific management so that animal should be kept with comfort for sustainable production. Environment, people and companion cow can all affect how a cow behaves, eats and milks. As farm get larger and have more labour, dairy farmers need to be even more conscious of cow behavior and the factors that cause cow stress and affect productivity of animals. While handling animals it is important to remember factors which can affect behavior such as temperament (reflected in flight distance), breed and species and type of environment in which animal are kept. Temparament, fitness and production of animals are highly correlated which is controlled by different components of animal behaviors especially social behavior. Social behavior of animal include care giving to young ones, dominance-subordinate relationship, sexual relationship with adult animals, leader-follower relationship and other temporary or permanent relationship between two different species. Careful study of different behavior may solve the problems relate to feeding, breeding and production. As we know that disturbed production leads to altered behavior response in animals. Basic social behavior data guides towards comfort of cow and ultimately production. Stable hierarchy in herd related to high production. High producer animals are generally dominant animals. Kick and steps during milking also suggest discomfort. Naturally livestock like to live in group. Cattle and buffaloes live in group to form herd, sheep and goat form flock and band respectively.*

Animals express all the behavior and instinct when kept in group (Albright, 1997). Behavior of animals is good indicator of animal welfare and comfort (Cook et al., 2005). Animals in poor state of welfare may suffer from discomfort, distress or pain which may compromise with growth, survival, production and reproduction (Fraser and Broom, 1990). Five freedoms (Webster, 2001) are required to ensure that animals are in comfortable environment. Five freedom include freedom from thirst & hunger,

discomfort, pain-injury-disease, abnormal behavior and fear and distress. Animal behavior is expressed in form of cognition. Cognition means power of thinking or learning through experience. Gregarious animal forms group, whenever they are in group develop relationship with members. Habit of response to each other slowly becomes regular and predictable. Such behavior between individual is called social relationship. For sake of convenience social behavior may be divided into following type:

1. Care dependency relationship
2. Dominance-subordinate relationship
3. Sexual relationship
4. Leader-follower relationship
5. Relationship between two different species.

**CARE DEPENDENCY RELATIONSHIP**

Dam offspring relationship is very strong and unique relationship related to rearing and maintaining species. This behavior is important in farm animals related to survival of young once. The survival of offspring depends solely on care and attention provided by dam. In some of the birds, the parental care is provided specifically by both the parents. In farm animals as nursing and caring is restricted solely to dam, therefore known as maternal behavior. Under intensive system of management with zero days weaning system it is responsibility of attendant to take care of calf. Mothering ability is very important criteria for selection of dam especially in pig. New born calf starts suckling 2-5 hors after birth. The calf grasps the teat and wraps teats with the help of tongue and suck vigorously. It generates negative pressure essential for milk flow. Suckling attempt well supported by cow with milking ease and cow fill relax after evacuation of udder.

**Dominance-subordinate relationship:**

Animals if kept in group, a social hierarchy are established automatically within cluster. Dominant animals are generally males (patriarch); most of breeding was performed by aged dominant male in available females if kept naturally. In some species aged dominant female lead the group i.e., matriarch like elephant.

**SEXUAL RELATIONSHIP**

Sexual relation restricted to adult male and females of animals that too for a restricted period. In farm animals sexual behavior is expressed during period of estrus of 6-16 hrs (*Noakes et al., 2001*) therefore called as estrus behavior. Estrus behavior in farm animal is characterized by attractiveness, proceptivity and receptivity. Estrus is states during which the female seeks and accept the male. Alterations during period include physiological and behavioral changes. Physiological changes comprised of hyperaemia, inflammation and rise in temperature. Behavior changes commonly observed is reduction in ingestive and resting behavior, increase in locomotion i.e., hyperactivity and vocal behavior. Animals during estrus are hyper active it respond to environmental stimuli which ordinarily would have been ignored. Realtive social hierarchy positions are temporarily ignored as animal approach those with higher or lower rank. Agonistic interaction increases. Grooming activity inform of licking other animals are increased. Rise in mounting activity if

animals are kept free. Female in estrus can form temporary sexually active group (SAG) of 6 or less animals. Some cow stands to be mounted is known as "mountee". Mounting is shown by females to catch the attention of males. Average 25 mount was observed during a estrus period in cow. Most of the estrus is shown during night by animals.

Sexual behavior in male related to quality semen production. Sexual behavior in male animals is measured by libido or sex drive i.e., willingness and eagerness of male animals to mount and attempt service to female. Libido score card (0-9 score card) developed by *Chenoweth et al. (1979)* to evaluate potency of males. Male sexual behavior comprised of threating & displaying, challenging & contesting, sign posting & marking, searching & driving and nudging & tending. Male libido measured by reaction time. Shorter reaction times have more libido and vice-versa.

Male sexual behavior protocol:

Pattern of male sexual behavior in case of male encompasses several sequence of behavior elements like:

1. Courtship
2. Erection
3. Protrusion
4. Mounting
5. Intromission
6. Ejaculatory thrust
7. Ejaculation
8. Dismounting

The manifestation of all activity may or may not express all the time. Some time it may be fully expressed. Flehman's response: Curling of upper lips in male so as to expose gum region and thereby activating vomero-nasal organ in their oral cavity to detect pheromones especially related to female in estrus.

**LEADERSHIPFOLLOWER RELATIONSHIP**

Dominance within the animals is decided by fighting within the group. In cattle, sheep and goat generally older and aged animals are leader others are follower. In sheep farm this type of relation is prominent and pertinent. As dominant animals, use to drive the flock to the other place. Sheep voluntarily follow leaders. Therefore goats (Judas) are trained to lead the flock of sheep especially during slaughter and ecto-parasite control by dipping.

**Relationship between two different species:**

When two different species resides in same locality/ shelter some relationship may develop which help in their survival and maintenance.

**Locality and behavior of animals:**

All animal species remains attached to place where they are born and brought up i.e., niche (Fig-1.). They have special affinity to place where they spent their life as young animals. They form home range to live and wander. When animals are removed forcibly from home range they

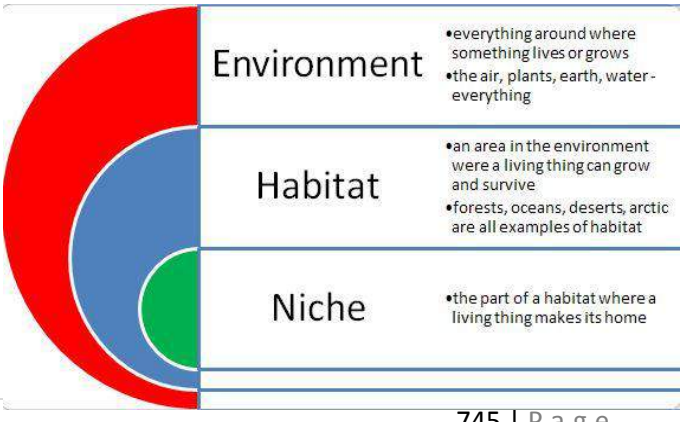


Figure 1

were emotional disturbed. Therefore for weaning, mother should be separated from young one to minimize stress. If young one is removed from mother they fill double stress i.e., from separation of a particular site and their dam both. It is commonly observed that if milking cow is purchased and taken to new place problem of letdown was common.

**Homing:**

An animal if taken from its home range makes every effort to return to its home range. This habit is pertinently seen in dog due to greater sense of smell. Ability of animals to find direction to return to their home range is known as orientation or direction of travel. Animals have limited orientation sense as compared to birds.

**Migration:**

Some birds' species have two home ranges, they move regularly to visit both place according to favorability of climate. Each year some birds encircle the globe in their travels from their winter quarters to summer breeding areas and back again by migration. Humming birds which weighs about 3 gm almost doubles its weight with fat before migrating the 800 km stretch across the Gulf of Mexico.

**Territoriality/ Niche marking:**

It is area fixed by boundary one side of which animal attack stranger animals and other side it live in alone. Territory is smaller than home range. In cattle and buffalo bulls we cannot find two breeding bull in one village.

**Space (personal) requirement for animals for proper expression of behaviors** (Albright and Arave, 1997)**:** When personal space of animals violated overcrowding begins particularly at manger and resting place. Dominant animals use to displace the subordinates and both the animals fill social stress. At highest density animals are so stressed that productivity is lower down. Additional space and comfort in animal associated with 1 kg/ day more milk as compared to animals under stress. Kicks and steps at the time of milking especially for more than 20% of animals suggest discomfort.

**Personal spaces for animals include:**

1. Physical space,
2. Social space
3. Flight distance.

**Physical space:** Space which animal require for occupying lying and living i.e., for rising standing and stretching body parts.

**Social space:** It is minimum distance that an animal keeps between itself and other member of same herd.

**Flight distance:** It is minimum distance an animal will allow an unknown animal to approach before taking a flight. Flight zone (Fig-1) is animals' personal space. When a person enters in flight zone of the animals, they will move away. Understanding of flight zone can reduce stress and help to prevent accidents in handlers. Size of flight zone depends on tameness and wildness of animals. Very high producing cows are very tame and have no flight zone. The size of flight zone will slowly diminish when animals receive frequent, gentle handling. Extremely tame livestock are often difficult to drive because they no longer have a flight zone. These animals should be led with bucket or halter or routine training.

Temperament, fitness and production of animals are closely related (Fig-3).

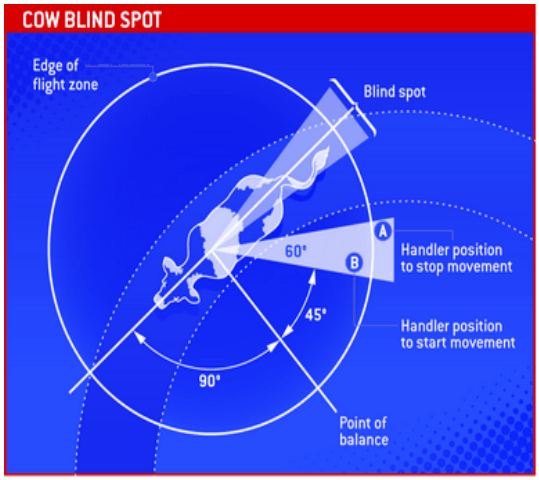


Figure 3

size is more than 100 (high stocking density). In case of inadequate feeding or

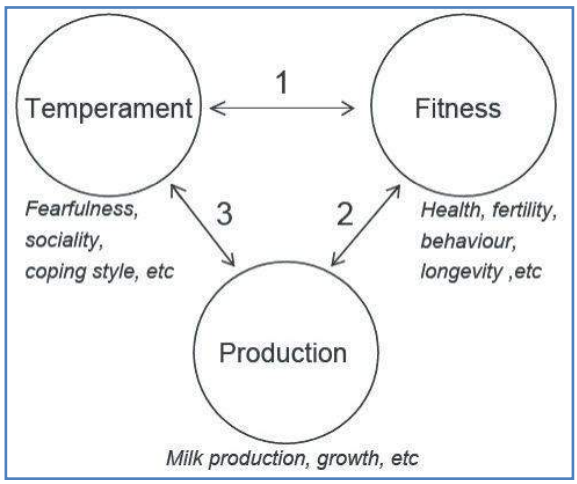


Figure 2

When animals are kept in group show hierarchy and more conflict, however number of encounters reduces to a minimum as social stability is achieved in group. When social status is well established in a group by initial encounters, there is no need of further encounter. As the dominant animals establishes their position by using sight and minor reactions. If environment is changed reestablishment of peck-order/ hierarchy is desired. Social stability in a herd depend on

1. Recognition between individuals
2. Established social position
3. Memory of social encounters which established the social status.

Social stability in herd is required for better production and good performance. It has been estimated that in cattle if they are kept in a group of 50-70 in cattle (20-30 in pig), were able to recognize each other hence stable. If size of herd is larger than 70 the group is not stable. Performance is adversely affected if group watering space due to large group dominant animal commands on subordinates, which suffers more.

**Social organization of the group:**

Organization based on dominance level. Dominance level is determined by age, body weight and height of the animals in group. Diagram show inverted U shaped graph. This graph indicates that up to 9 years (Fig-4) dominance level increases followed by decrease.

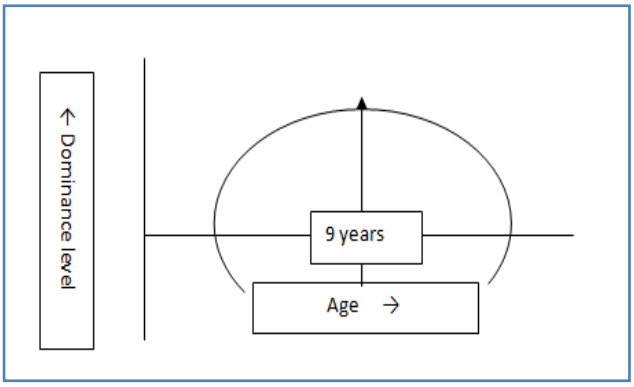


Figure 4

Under free range condition there may be several overlapping peck order

(hierarchy). Adult females have there own social position different from adult and juvenile male. As young male grow may fight with adult female and eventually dominate them. If the herd is very large then hierarchy may breakdown into series of smaller hierarchy.

**SOCIAL ORDER**

Social position in herd is not visible when animals are grazing or resting. It is clear cut exhibited when limited feed and space is available for unlimited number of animals.

**Production performance Vs Social behavior in herd:**

Dominant animals generally produce more as compared to subordinates due to their ability to eat more both in quality and quantity. Docile temperament and animal in comfort are more producing in dairy herd as compared to aggressive dam (Drissler et al., 2005). Animals culled on productivity basis are generally sub-ordinates in a group.

**Dominance Vs Aggressiveness:**

| Dominance | Aggressiveness |
|---|---|
| **Inhibition of behavior of other animals** | Include fighting and threatening |
| **If established fighting is not required** | Fighting and threatening shown frequently. |

**Interaction of animal (Donor Vs Recipient) in a particular species**: If donor and recipient in a system is synergistic production performance is best and said to be in **co-operation (Table- 1)**.

| | **Recipient** | |
|---|---|---|
| *Donor* | - + (Altruism) | - - (Spite/bad feeling) |
| | + + (Cooperation) | + - (Selfishness) |

Table-1

**Types of conditioning in animals:** Rein forcer is essential for increasing desired behavior (Table -2).

| | | | |
|---|---|---|---|
| Operant conditioning | Reinforcement (Increase behavior) → | Positive stimulus received & Negative stimulus removed by escape or active avoidance → | Increase (↑) behavior |
| | Punishment (Decreased behavior) → | Negative consequence & No rein forcer → | Decrease (↓) in behavior |

**Table -2**

**Repetition of pattern of behavior at regular interval:** Also known as circadian rhytham in animals i.e., walking, moving, eating, social interaction, ruminating drinking etc. 7.00 A.M. to 11.00 PM and sleeping between 11.00 PM to 7.00 AM (Fig-5). Animals should not be disturbed during 11.00 PM to 7.00 A.M. other wise production may be affected.

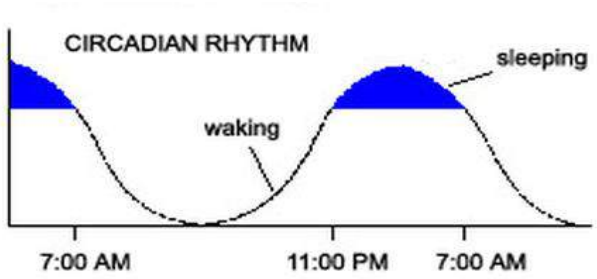


Figure 5

## CONCLUSION

Knowledge of behavior in general and social behavior in particular is used pertinently for handling animals. Altered behavior can be used as sign for diagnosis of disease. Normal and basic social behavior study can be useful for animal husbandry package of practices. Behavior problems can be easily controlled using intervention at the level of animal and environment. Animal can be easily controlled, move along races, up ramp, into vehicle and strange room etc. Similar natured animals i.e., socially related, if kept together will aid in management to reach desired production standard of farm. Dominant animals produce more as compared to subordinates. Docile temperament and animal in comfort are more producing in dairy herd as compared to aggressive dam. Animals culled on productivity basis are generally sub-ordinates not dominant.

## REFERENCES

Albright, J. L. and Arave, C. W. (1997) The behavior of cattle, CAB International , Wallingford, Oxon, U.K.; New York, USA.

Chenoweth, P.J., Brinks, J.S. and Nett, T.M. (1979) A comparison of three methods of assessing sex-drive in yearling beef bulls and relationships with testosterone and LH levels. Theriogenology 12:223.

Cook, N. B., Bennett, T. B. and Nordlund, K. V. (2005) Monitoring indices of cow comfort in free stall housed dairy herds. J. Dairy Sci., 88: 3876-3885.

Drissler, M., Gaworski, M., Tucker, C. B. and Weary, D. M. (2005) Freestall maintenance effect on lying behavior on dairy cattle. J. Dairy Sci., 88: 2381-2387.

Fraser, A. F. and Broom, D. M. (1990) Farm animal behavior and welfare (3rd Edition.) Baillere Tindall London, U. K. pp 162.

Noakes, D. E., Parkinson, T. J., England, G. C. W. and Arthur, G. H. (2001) Infertility in cow: In Arthur's Veterinary reproduction and Obstetrics. Eightth edition. pp. 425. W. B.. Saunders company, The Curtis center, Pennsylvania.

Webster, A. F. J. (2001) Farm animal welfare: the five freedom and free market. Vet. J. 161, 229-237.

# Heat Detection In Cattle And Buffalo: An Overview

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Proper heat detection to achieve appropriate timing of insemination is the biggest restriction in attaining high conception rate in dairy herd. Heat detection is the key in the success of an effective breeding program. This was achieved by close observation, timed AI and sound record keeping. There is no substitute for good management. Accurate estrus detection is a key to efficient reproduction and to high milk production (Roelofs *et al.,* 2010). The term estrus was used for the first time by Heape. It comes from the Greek word "Oistros" meaning a gadfly, member of the Family Oestridae, who's buzzing during summer, caused cows to become hyperactive, usually showing frenzied behavior similarly to that exhibited by females at estrus (Sanders and Bancroft, 1982). In female cow the estrus behaviour comprised of attractiveness, proceptivity and receptivity. Three distinct patterns are observed during estrus includes male like mounting, rise in spontaneous activity and mating responses. The female stands immobile for mounting on her, indicates that she is definitely in heat (Negussie *et al.,* 2002). Buffaloes are seasonally polyestrous with an average cycle length of 21 day (range 18-24), and an average duration of estrus of 18 hours (5- 36) (Drost, 2007). Buffaloes are shy or poor breeder. The estrus behaviour is shown during September to January with peak during October to November (Suthar and Dhami, 2010).

The nutrition was one of the most important factors for conception in animals. Cattle in poor condition or negative energy balance generally have poor reproductive performance. Deficiency of vitamin and minerals (Vitamin A, E & Selenium) could be the cause of deterioration in sign and symptoms of estrus (Zobel *et al.,* 2012). Ruminal temperature has daily variation; therefore, RuT were compared for time periods before, during, and after estrus that included the same daily hours the day before and the day after estrus. Ruminal temperature was greater ($P < 0.001$) during the first 8 h after cows were first observed in estrus (38.98) compared with RuT on the same daily hours the 2 previous days (38.45) (Cooper-Prado *et al.,* 2011). Acidity, pH, density, dry matter, fat and lactose levels, were determined from the obtained milk samples in evening milking. In this study, milk yield of cows in estrus was determined as 4.8 kg while post estrus production elevated to 5.8 kg ($P<0.01$) (Akdag *et al.,* 2010). The cervical mucus is

collected from cow suspected of heat; it is smeared on slide and dried naturally in air. If fern pattern appears in slide in microscope indicates animal in estrus. This pattern appears 84 hours before estrus and starts declining before ovulation (Mangal, 2009).

Heat detection aids are very important tools for efficient reproductive management if used in combination with expert eye. Cows with detector (KaMaR) plus CHALK marking on tail were more efficient than detector alone. Visual observation with tail paint is 98 % efficient as compared to heat watch alone i.e. 91 %. Electronic heat mount detector also known as heat watch system is a radio-telemetric system that senses the mounting activity. The data recoded is transmitted to a receiver then recorded by computer for subsequent retrieval (Taras and Spahr, 2001).

**PROTOCOL FOR SUCCESSFUL HEAT DETECTION (Du Ponte, 2007):**

1. Tracking of individual animal throughout their life using permanent numbering system.
2. A sound record keeping system should be supplemented with frequent information updates.
3. Standard operating procedure (SOP) should be established. Punctual staff should be selected for the heat detection program and recording information like animal identification, time of onset of heat with respect to different sign and estimating ovulation time.
4. Morning hours are crucial for heat detection as heat detection rate were higher during morning hours (Dransfield *et al.,* 1998). Cow in heat is the first cow to rise in morning in herd.
5. Any interruption to cattle such as feeding or milking should be avoided during monitoring.
6. Special surveillance required for detecting animal grouping activity i.e., SAG. Cattle approaching heat usually congregate together.
7. Duration of heat may change with respect floor surface, as activity rises 3-15 times greater on soil surface than on concrete. There is sudden drop in mounting activity on slippery surface.
8. Heat detection aids should be used wisely and efficiently. Heat detector should be used only as a supplement to visual observation rather replacement.
9. The herd may synchronize with hormones or its combination to increase the probability of detecting estrus at appropriate time.
10. To catch every in heat a balance programme should be formulated keeping in view that animal return to estrus 18-24 days later.
11. Hoof problems and sore feet should be treated immediately as lame cattle will not mount or permit to ride on, which decreases the chances of detecting animal in heat.
12. Standard protocol should be followed and all activities are documented.

**HEAT DETECTION EFFICIENCY AND ACCURACY:**

Efficiency and accuracy of heat detection is increased by noticing animal in heat, before elapse of 50 days of parturition. Factors which affect the expression of estrus should be thoroughly monitored. Herd is critically monitored using heat expectancy chart. Number and percentage of breedable heat should be observed carefully. Efficiency of detection is expressed as percentage of possible estrus period that are observed in a given period of time. The accuracy of detection is the percentage of estrous period observed that is true estrus.

Inadequate heat detection is one of the major factor limiting reproductive performances in factor limiting reproductive performances in herds; therefore it is an area of farm activity where increased effort or investment is likely to be profitable. Cattle come into estrus at all times of the day, moreover she may not be very active in hot weather and remain in heat for only a short period of time (roughly 12-18 hours), making it difficult to observe. Allowing animal to interact in small group (three to five) with two to three visual observations per day will increase the chances of catching cycling animals. The use of synchronization and heat-detection aids can greatly shorten the time spent in heat detection but will not benefit a non-cycling herd. The management interventions are required to maintain the herd cyclic. For this high grade nutrition should be provided, and also need exceptional cow comfort including hoof health, body condition and non slippery surface.

**REFERENCES**

Akdag, F., Cadirci, O. and Siriken, B. (2010). Effect of estrus on milk yield and composition in Jersey cows. *Bulg. J. Agric. Sci.*, **16**: 783-787.

Cooper-Prado, M. J., Long, N. M., Wright E. C., Goad, C. L. and Wettemann, R. P. (2011). Relationship of ruminal temperature with parturition and estrus of beef cows. *J. Anim. Sci*., **89**:1020–1027.

Dorst, M. (2007). Bubaline versus bovine reproduction. *Theriogenolgy,* **68**: 447-449.

Dransfield, M. B., Nebel, R. L., Pearson, R. E. and Warnick, L. D. (1998) Timing of insemination for dairy cows identified in estrus by a radiotelemetric estrus detection system. J. Dairy Sci. 81(7): 1874-1882.

Du Ponte, M. W. (2007). The Basics of Heat (Estrus) Detection in cattle. LM-15 series, Co-operative extension service, University of Hawai'Manoa.

Mangal, V. (2009). Study on Estrous Behaviour, Cervical Mucus Characteristics and Fertility in Sahwal Cattle . M. V.Sc. Thesis. NDRI, Karnal, Haryana, India.

Negussie, F., Kassa, T. and Tibbo, M. (2002). Behavioural and physical sign associated with estrus and some aspect of reproductive performance in Fogera cows and heifers. *Trop. Anim. Health Prod*., **34**: 319-328.

Roelofs, J., Lopez-Gatius, F., Hunter, R. H. F., Van Eerdenburg, F. J. C. M. and

Hanzen, Ch. (2010). When is a cow in estrus? Clinical and practical aspects. *Theriogenology,* **74 (3)**: 327-344.

Sanders, D. and Bancroft, J. (1982). Hormonal and sexuality of women-the menstrual cycle. *Clin. Endocrinol. Metab.*, **11**: 639-659.

Suthar, V. S. and Dhami, A. J. (2010). Estrus detection methods in buffalo. *Vet. World*, **3** (2):94-96.

Taras, E. E. and Spahr, S. L. (2001). Detection and characterization of estrus in dairy cattle with an electronic heat mount detector and electronic activity tag. *J. Dairy Sci*., **84** (4): 792-798.

Zobel, R., Pipal, I. and Buic, V. (2012) Anovulatory estrus in dairy cows: treatment options and season on its incidence. *Veterinarski Archiv*., **82** (3): 239-249.

# Importance Of Vital Signs, Rumen Motility And Mucous Membrane In Domestic Animals

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Examination of animals carry out in various ways includes *direct palpation* (the fingers*) or indirect palpation* (probe), *percussion (*the surface of the body produce vibration and emanate audible sounds) and *Auscultation.* In general, *Vital signs* include temperature, heart or pulse rates, respirations and state of hydration. The important principle is to determine the vital signs before handling and examining other body systems, which may distort the vital signs. The sequence that follows taking the vital signs can vary, based on individual circumstances, the urgency of the case, if any, and the ease of doing the particular examinations. Auscultation of the abdomen is an essential part of the clinical examination of cattle, horses and sheep. It is of limited value in pigs. The intestinal or stomach sounds will indicate the nature of the intraluminal contents and the frequency and amplitude of gastrointestinal movements, which are valuable aids in clinical diagnosis.

**A) Respiration:**

The respiration should be examined from a distance, preferably with the animal in a standing position, as recumbency is likely to modify it considerably.

**Physiological effect that alters the respiration:** The effects of exercise, excitement, high environmental temperatures and fatness of the subject: obese cattle may have respiratory rates two to three times that of normal animals.

| Species | Rectal Temp (°F) | Respiration Rate (/min) | Pulse Rate (beats/min) |
|---|---|---|---|
| Cow | 100-102.5 | 26-35 (Standing-at rest) | 36-60 |
| | | 24-50 (Sternal recumbency) | |
| Horse | 99-100.5 | 8-16 | 28-40 |
| Pig | 100-102 | 10-20 | 70-120 |
| Sheep | 101.5-105.5 | 10-20 | 70-80 |
| Goat | 101.5-103.5 | 25-35 | 70-80 |
| Dog | 99.5-102.5 | 20-34 | 70-120 |
| Cat | 100-102.5 | 16-25 | 120-140 |

Table1: Showed the Rectal Temperatue, Respiration rate and Pulse rate of Different Domestic animals.

**Respiratory rate**

An increased respiratory rate is designated as polypnea, decreased rate as oligopnea and complete cessation as apnea. The rate may be counted by observation of rib or nostril movements, by feeling the nasal air movements or by auscultation of the thorax or trachea.

**Respiratory rhythm**

The normal respiratory cycle consists of three phases of equal length: inspiration, expiration and pause. In the standing neonatal foal, both the inspiratory and expiratory airflow patterns are essentially monophasic, whereas the adult horse typically has a biphasic inspiratory and expiratory airflow pattern. The transition from monophasic to biphasic flow patterns occurs within the first year of life.

**Prolongation of phases**

Prolongation of inspiration is usually due to obstruction of the upper respiratory tract; prolongation of the expiration is often due to failure of normal lung collapse, as in chronic alveolar emphysema in horses, atypical pneumonia, parasitic pneumonia and Anaphylaxis in cattle. *In most diseases of the lungs there is no pause* and the rhythm consists of two beats instead of three.

Cheyne-Stokes respiration-Abnormal type of breath with period of respiratory arrest (apnea) for 15-30 sec followed by gradual increase and then gradual decrease in amplitude of movements. Observed in Renal and Cardiac disease and severe toxemia.

Biot's breathing-Recurring series of relatively shallow, rapid breath characterized by alternating periods of hyperpnea and apnea. Seen in Meningitis.

**Respiratory depth**

The amplitude or depth of respiratory movements may be reduced in painful conditions of the chest or diaphragm and increased in any form of anoxia. Moderate increase in depth is referred to as hyperpnea and labored breathing as dyspnea. In dyspnea, there is extension of the head and neck, dilatation of the nostrils, abduction of the elbows and breathing through the mouth plus increased movement of the thoracic and abdominal walls. Loud respiratory sounds, especially grunting, may also be heard.

**Type of respiration**

In normal respiration there is movement of the thorax and abdomen. In painful conditions of the thorax, e.g. acute pleurisy, and paralysis of the intercostal muscles, there is relative fixation of the thoracic wall and a marked increase in the movements of the abdominal wall. This syndrome is usually referred to as an abdominal-type respiration. The reverse situation is thoracic type respiration, in which the movements are largely confined to the thoracic wall, as in peritonitis, particularly when there is diaphragmatic involvement.

**Thorax symmetry**

This can also be evaluated by inspection. Collapse or consolidation of one lung may lead to restricted movements of the thoracic wall on the affected side. The

'rachitic rosary' of enlarged costo-chondral junctions is typical of rickets.

**Respiratory noises or stridors**

Coughing - due to irritation of the pharynx, trachea and bronchi

Sneezing - due to nasal irritation

Wheezing - due to stenosis of the nasal passages Snoring - when there is pharyngeal obstruction, as in tuberculosis adenitis of the pharyngeal lymph nodes

Roaring - in paralysis of the vocal cords

Grunting - a forced expiration against a closed glottis, which happens in many types of painful and labored breathing.

**B) Rectal Temperature:**

Normally the temperature is taken per rectum and is more convenient site to obtain. When this is impossible the thermometer should be inserted into the vagina. As a general rule the thermometer should be left in place for 2 minutes. Smaller the species higher the normal temperature. Temperatures of healthy animals are lowest in early morning and higher somewhat in mid of the day and peak at evening around 6 p.m (0.8-1.5°C). Tuberculosis in horses have higher temp in morning than evening.

**Physiological Increase in Temperature:** After feeding particularly if excessive and frequent in dairy cattle, after forced exercise, on the day of partition except in bitch, exposure to high atmospheric temperature, excited animals, clinical examination itself especially in sheep, nervous dogs and fur bearing animals. Female, Pregnant, Young animals have higher temperature than male, Non-pregnant and old animals.

**Hyperthermia** is simple elevation of the temperature past the critical point, as in heat stroke. Proctitis, Rectal paralysis cause increase in temperature. Sow and mares prior to parturition shows rapid rise in temperature as a result of bacterial activity.

**Fever or pyrexia** is the state where hyperthermia is combined with toxemia, as in most infectious diseases. The cause may be specific (Virus, bacteria, fungi and protozoa, Abscess, Empyema, Bacteremia, Septicemia) and Non-specific (Foreign proteins, substance cause tissue damage, protein degradation products, necrotic tissue). Temperature of body start rise when the environmental temperature reaches 34°C in sheep, 30°C in pig, 27°C in dog, 32°C in cat.

**Hypothermia**, a subnormal body temperature, occurs in shock, parturient paresis and acute rumen impaction of cattle, Mulberry heart disease hypothyroidism and just before death in most diseases except Tetanus.

**C) <u>Pulse:</u>**

**Site of Pulse in different animals:** Horse – External maxillary artery, facial artery, Transverse facial artery, Median artery (Restless horses preferable), Great Metatarsal artery. Ox-Facial artery, Median artery (Common) but preferable is Middle coccygeal artery. For Dog, Cat, Sheep, Goat, Small pig and young calf Femoral artery is preferred and large pig its middle coccygeal artery.

Pulse should be observed minimum 30 sec. The important characters of Pulse are Rate, Rhythm and Quality.

**Physiological factors that influence Pulse Rate**: Smaller the *species* more frequent the pulse is, but not always. *Size* of the animal, age- young have higher rate than adult, physical condition-athletic animal have less frequent pulse than non athletic animals, Sex-male have lower PR than female, Pregnancy increases PR, Parturition increase in frequency, lactating animals have higher PR than non lactating, Excitement due to mis handling increase PR, exercise increase PR, Posture except horse, PR is less frequent when the animal is lying down, Ingestion of food, rumination, environmental temperature increase PR.

All painful conditions, disease not primarily involving CV system shows increase in PR.

**Pulse rhythm:** Time interval between peak of series of successive pulse waves and temporal sequence may be regular or irregular except Sinus Arrhythmia. Intermittence rhythm occurs with constant periodicity and it indicates mild degree of Heart block. Commonest causes of irregular intermittence of pulse are Secondary Heart block, Ventricular extra systoles and Auricular fibrillation.

**Pulse quality**: Amplitude of pressure waves vary with rate of systolic filling of heart. Change is quality as a result of structural or functional disease of heart or abnormality of blood vessels such as Arterial thrombosis, Embolism, Vasomotor disturbances, certain types of passive venous congestion.

**D) Rumen of cattle and sheep:**

This is a very useful part of the clinical examination. In normal animals there are 1-2 primary contractions per minute, Secondary contractions of the dorsal and ventral sacs of the rumen occur at about 1 per minute and are commonly associated with eructation. The examination is made in the left paralumbar fossa and a normal sequence of sounds consists of a lift of the flank with a fluid gurgling sound, followed by a second more pronounced lift accompanied by a booming, gassy sound. The intestinal sounds that are audible on auscultation of the right flank of cattle and sheep consist of frequent faint gurgling sounds, which are usually difficult to interpret. *Rumen Motility* is absent in Simple indigestion, Acute Impaction, Traumatic Reticulo peritonitis, Vagus indigestion, rumenitis, Actinobacillosis, Neoplasia of rumen and Reticulum and displacement and torsion of abomasum.

**E) <u>Examination of the conjunctiva:</u>**

This examination is important because it is a good indicator of the state of the peripheral vascular system. The pallor of anemia and the yellow coloration of jaundice may be visible, although they are more readily observed on the oral or vaginal mucosa. Engorgement of the sclera vessels, petechial hemorrhages, edema of the conjunctiva as in gut edema of pigs or congestive heart failure, and dryness due to acute pain or high fever are all readily observable abnormalities.

## REFERENCE

Radostits, O. M., Gay, C. C., Hinchcliff, K. W., Constable, P. D. (2007). Veterinary Medicine. 10th Edtn, Elsevier Saunders Publications.

Reece, W. O. (2004). Dukes' Physiology of Domestic Animals, 12th Edtn, Cornell University Press

McCurnin D. M. and Bassert, J. M. (2010). Clinical Textbook for Veterinary Technicians, 6th Edtn, Elsevier Saunders Publications.

Holtgrew-Bohling K. H. (2012). Large Animal Clinical Procedure for vet technicians, 2nd Edtn. Elsevier saunders publications.

Kelly, W. R. (1974). Veterinary Clinical Diagnosis, 2nd Edtn, Edited by C. Gardell. Harcourt Publishers.

# Manipulation Of Rumen Fermentation

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Fermentative activity is of greater importance in the digestive process of ruminants because the feed which is taken by the animal has to undergone fermentation before enzymatic digestion in abomasums and intestine. To avail maximum fermentation and to reduce the loss of energy during this process, we need to manipulate the ruminal fermentation.Manipulating Rumen fermentation through treatment of Roughage, concentrate and strategic supplementation with organic acids could improve rumen efficiency by maintaining higher pH, opt ammonia-nitrogen, thus reducing methane and increasing microbial protein synthesis and essential VFAs, for enhancing ruminant productivity in the tropics. Decreased methane production in favor of propionate to improve the energy balance of animals. Van Nevel and Demeyer (1988) identified five possible sites for improvements in ruminant fermentation.

a) Increasing the digestibility of structural CHO (cellulose, Hemi cellulose, Pectin, Starch) and control lactic acid concentration.
b) Protecting dietary protein against microbial degradation in the rumen and increase bioavailability of amino acids in the small intestine.
c) Altering microbial end-products of fermentation.
d) Improving the net microbial growth and fiber digestion.
e) Reducing the rate of Ammonia release from NPN.

## WAYS TO ALTER FERMENTATION

Altering the *composition of diet and feeding method* are the traditional ways of altering rumen fermentation. Recently, various *chemical compounds* were shown to alter rumen fermentation parameters.

**Defaunation** or removal of protozoa is well known to affect rumen fermentation. Scientist all around the world proposed the *introduction of genetically modified strains of rumen bacteria* for manipulating the rumen fermentation in various ways especially fiber degradation. But still it is in preliminary stage.

**Removal of non ciliated protozoa from the rumen**

Non ciliated protozoa's are non-essential for the survival and growth of ruminants.

In vitro culture of protozoa till date hasn't produced any noticeable success. So, animals are used widely to evaluate the role of protozoa in nutrition and productivity of ruminant. Four ways to obtain cilia-free animals.

1. ***Chemical agents:*** Chemical defaunation agents are lethal to animal health. Toxic level varies from one animal to another animal within the species. Ionophores are used commonly but its use is restricted due to development of antimicrobial resistance. So no chemical agents presently in use for either experimental use or commercial use. E.g. Sodium Sulfosuccinate, Copper Sulfate and Monensin.

2. ***Dam-young separation after 48hr of Parturition:*** This technique is applicable nowadays because here the animals are isolated at birth and reared separately which prevents the contact and inoculation from mother. This technique requires a big animal stock reared with special care from birth to mature age.

3. ***Diet and feeding regime:*** This is the ideal. In vitro addition of Tannin containing plants depress the population. Similarly additions of Colloidal hydrated aluminium silicate (Clay)-2g/day, depress 69% protozoa population by interfering with ciliary motion. Antimicrobial agents (Salinomycin, Lasalocid, and Monensin) decrease protozoa population.

**a) Manipulation of Carbohydrate (CHO) fermentation**

Ad libitum feeding of concentrates (e.g. barely) results complete disappearance of ciliates. Increasing fiber or starch fermentation will result in increased VFA production in the rumen results in high ruminal lactate concentration i.e. low pH, leads to Ruminal Acidosis. Increase Concentrate feeding also results in low pH of the rumen because of highly digestible capacity than forages. Low pH favors the growth of *Streptococcus bovis* and *Lactobacillus spp* which favors lactate (10 times stronger than VFAs) production and its accumulation. Lactate Accumulation can be prevented by 1) inhibiting lactic acid production, 2) enhancing lactic acid fermentation to propionate. Increased production of propionate is beneficial to the animal because it decrease the methane production in the rumen. Supplementation of Organic Acids like Malate, Fumarate and Aspartate with CHO resources is more beneficial to ruminants, because organic acids stimulate specific ruminal micro population rather inhibit by Ionophore compounds. e.g., *Selenomonas ruminantium* (Strictly anaerobic) is the one spp where use reductive or reverse citric acid cycle known as succinate-propionate pathway to synthesize succinate and propionate.

**b) Manipulation of Nitrogen metabolism**

Nitrogen utilization is affected by many factors such as dietary N conc., Degradability, microbial community, and their interaction with other nutrients). Manipulating N metabolism in the rumen is to enhance ruminal escape of dietary protein by minimizing its degradation and optimizing microbial protein production from NPN. Minimization of protein


degradation can be achieved by intervening at the proteolysis, peptidolysis or a.a deamination stages. This will reduce losses incurred in the conversion of dietary protein to microbial cell protein. Ammonia is a prime intermediate in the conversion of dietary N to microbial N. Besides N microbial protein synthesis in the rumen requires other nutrients, such as sulfur and vitamins. The goal in manipulating microbial protein synthesis is to increase efficient production by improving NH3 assimilation and urea recycling, thereby minimizing N excretion. Urea recycling provides a great advantage when ruminants are fed low-protein diets.

**c) Manipulation of Lipid Fermentation**

Compounds such as fatty acids shown some defaunating properties which may be probably due to fatty acids rather than oil itself. Improving of the Fatty acids

| NAME | MOLECULE | ACTION |
|---|---|---|
| **1-CHEMICAL TREATMENTS** | | |
| Manoxol OT<br>Aerosol OT | Dioctyl Sodium Sulfosuccinate (DSS) | surfactant, detergent |
| Synperonic NP9 | surfactant | detergent |
| Rexol 25J | Ethoxylated nonyl phenol | |
| Teric GN9 (nonionic) | nonylphenol + 9 moles ethylene oxide | surfactant detergent |
| Copper | copper sulfate | toxic |
| Rumensin | monensin | ionophore antibiotic |
| Bentonite | Clay | |

profile of ruminant can be achieved by two distinct approaches.

i. Modification of the Fatty acids profile during meat or milk processing such as drying, heating etc.,

ii. Modification through the changes in animal diet ultimately leads to greater bypass of dietary Fatty acids from the rumen, or might be a consequence of altered microbial metabolic activity. Commonly used fat supplements such as oilseeds are more inert i.e. rumen protected fats. Oil rich in Unsat FA are relatively more digestible in the small intestine than sat fats, but when fed oilseeds at high conc. can interfere with ruminal fermentation and metabolic processes such as milk fat synthesis in the mammary gland. The extrusion process of oilseeds likely results in a faster and greater availability of oil in the rumen than when whole oil seeds are fed.

4. ***Physical treatment:*** such as emptying the rumen shown to be effective and reliable. It's a routine procedure in physiological experiments and doesn't appear to harm the animal also, but addition of HCHO increases the danger of digestive disorders.

In general, defaunation decrease the conc. of VFA in rumen, this is due to absence of protozoal stimulation on bacterial metabolism.

***Addition of probiotics in the diet:*** Fungal feed additives or Fungal Probiotics (Yeast or filamentous fungi-*Saccharomyces cerevisiae* and *Aspergillus oryzae)* can be given to animals at any stage unlike ionophores which can be given in less quantity that too in specific period.

**REFERENCES**

Manipulation of Rumen fermentation with organic acids supplementation in ruminants raised in the tropics, Sittisak Khampa and Metha Wanapat, TROFREC, Thailand.

Pierre Paul FRUMHOLTZ, 1991. Manipulation of the rumen fermentation and its effects on digestive physiology.

Use of rumen modifiers to manipulate ruminal fermentation and improve nutrient utilization and lactational performance of dairy cows. Christopher M.Dschaak, Utah State university.

# Strategy To Raise The Calf Crop

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A healthy calf is the starting point for a profitable dairy farm business. The first few months in the calf life are much more important. Proper attention should be paid to the rearing of young calves. The person in charge of calf rearing has one of the most responsible jobs on the farm and. The main purpose of rearing calf is to raise well–developed heifers, which will be able to achieve a desired weight for first insemination to calve at an early age. The advantages of early calving are lower rearing costs, early productivity and a higher life-time milk production, thus making the milking animals more profitable. For the prevention of problems at calving time, it is of most importance that the heifers are well developed. The optimal time of first insemination is more depended on body weight than age. Some heifers may be able to achieve the desired weight in 14 months; others may achieve the same in 16 months of age. Thus the proper age for insemination and calving are governed by the development of the heifer. Though good young stock rearing practices, it is possible to inseminate the heifers at an average age of about 14-15 months.

## EARLY MANAGEMENT

An excellent calf management is begins with care of the dam prior to calving. About 11 to 13% of calves born to first lactation dams are stillborn, Calf mortality is influenced by the health of the dam. Additionally, calves have a better chance of survival if stress during the birth process is minimized, health of dam, crowding and cleanliness of the calving. The feeding of more energy-dense diets to multiparous cows during the last 21 d of gestation tended to linearly increase the birth weight of calves (Gao *et al*., 2012).The factors that influence stress include size of calfpen and quality of assistance provided. Immediately after birth remove any mucous or phlegm from the nose and mouth of the calf. Normally the cow licks the calf immediately after birth. This helps' dry off the calf and helps in stimulating breathing and circulation. When the cow does not lick or in cold climate, rub and dry the calf with a dry cloth or gunny bag. Provide artificial respiration by compression and relaxing

the chest with hands.The naval should be tied about 2-5 cms away from the body and cut 1cm below the ligature and apply tincture iodine or boric acid or any antibiotic. The wet bedding should be from the pen and keep the stall very clean and dry.The weight of the calf should be recorded and wash the cow's udder and teats preferably with chlorine solution and dry. The calf is allow to suckle the first milk of the mother i.e. Colostrum.The calf will be standing and attempts to nurse within one hour if calf is born weak then assistance is required to feed the colostrum.

## FEEDING COLOSTRUM

Colostrum is defined as the secretion from the mammary gland of the mammals during the first few days of parturition. In the dairy industry, secretions from the milking animal's udder for one day after the parturition are commonly referred to as colostrum. Secretions produced second and third day after parturition are called transition milk. Calf management procedures have also been associated with the risk of mortality. Among them, one of the most important risk factors of mortality (and morbidity) is failure of passive transfer of antibodies via the colostrum (Rea *et al*., 1996; Donovan *et al*., 1998; Beam *et al*., 2009). Colostrum differs from the normal milk in many ways. It is markedly higher in solids, fats, protein, vitamins and immunoglobulin (Ig) and is lower in lactose. The amount of solids and protein (especially Ig), decline rapidly after the first day, so that by day four the milk reaches normal composition.It is essential that the calf receives about 1.5 – 2 liters of colostrum within the first half an hour of birth. On the first day fresh Colostrum can be fed 3 – 4 times. From day two, twice daily feeding should sufficient. In each feeding 2 liters of Colostrum should be given.If, the calf is not provided with the Colostrum for the first 6 hours of life, the amount of colostrum will have to be increased to compensate for the reduced absorption of antibodies. However, the delay in colostrum feeding increases the risk of bacterial infection.The intestines do not discriminate among molecules. If colostral molecules do not saturate the intestinal absorptive sites, it is possible that bacteria may reach the sites first and be absorbed in the calf system. The maximum absorption occurs within the first 6-8 hour after birth ( Blom, 1982). The amount of antibodies from individual female shows difference due to breed, nutritional status and parity to influence passive transfer of colostral immunoglobulin in calves (Sangwan et al., 1985). If bacterial reach the absorptive sites before the colostral proteins, the calf will be at great risk of septicemia, which is often fatal. Therefore, it is necessary that colostrum is fed as soon as possible after birth.In addition to colostrum fed at birth, calves need milk for the first 3 to 4 weeks of life. After that, they can digest vegetable starches and sugars. All liquids should be fed at room or body temperature. The clean utensils should be used to feed calves.

## LIQUID FEED FOR CALVES

Consistency in feeding of calves is important to ensure good health and

growth. Time of feeding and the quantity and temperature of liquid feed should be monitored for best results. Sanitation of feeding equipment is also critical.Milk replacer is the most common choice of liquid feed for calves . Milk replacer quality can differ and primarily relates to the protein source (plant-based proteins, animal plasma or egg protein vs. milk-based protein) and fat levels. Younger calves less than 4-weeks-old do not efficiently digest plant-based proteins. The higher-protein milk replacers are available to encourage higher growth rates in pre-weaned calves. Feeding more whole milk or increased amounts of milk replacer in an accelerated growth of the. While the early growth may be more rapid, greater reliance on liquid nutrients may delay starter intake and development of the rumen. However, the calves in cold housing during the winter need increased nutrients in order to maintain growth rates while maintaining body heat.

**Weaning**

Weaning or separation of the calf from the cow is a management practice adopted in intensive dairy farming systems. Weaning helps in uniformity of management and ensures the availability of milk to each calf as per required amount, avoiding wastage or over-feeding. It is depending upon the system of management adopted, weaning can be done at birth, at 3 weeks, at 8-12 weeks or at 24 weeks. In field conditions, weaning is practiced at 12 weeks. In an organised herd, where large numbers of calves are raised, weaning at birth is advantageous. Weaning at birth also helps in adopting milk substitutes and calf meals at early age so that the cow's milk can be saved for human consumption.

**After weaning**

From weaning to 3 months, gradually raise the level of calf starter. High quality hay should be available for calves to eat all day. You can feed up to 3 percent of the calf's body weight of higher moisture feeds like silage, green chop, and pasture. Take care to avoid feeding too much of these forages since they can limit overall nutrient intake.

**Water**

Make clean, fresh water available at all times. To prevent the calf from drinking too much water at one time, put the water in a different container and location than you used for milk feeding. Water promotes consumption of calf starter, indirectly aiding rumen development and increasing growth rates. Water is necessary to promote digestion of calf starter by rumen microbes, resulting in production of volatile fatty acids that stimulate rumen development. Start providing water at 3 to 5 days of age. The clean drinking water provide in a bucket separated from calf starter . Most farmers provide water to calves at the same time they begin feeding calf starter.

**Starter**

Provide a high-quality calf starter by 3 to 5 days of age. Start with a few ounces of calf starter per day, and remove the leftovers each day before adding fresh starter. Calf starter stimulates rumen development more than consumption of hay. If early weaning is a goal for your calf program, then early development of the rumen is important and will help calves thrive during periods of stress prior to weaning.

**Adequate Housing is important**

Keep calves in individual pens until they reach weaning age. Separate pens prevent the calves from suckling one another and reduce the spread of calf disease. Calf pens must be clean, dry, and properly ventilated. The ventilation should provide fresh air at all times without drafts blowing directly on the calves. The calf housing should be bedded to keep the calves comfortable and dry. Sawdust or straw is most commonly used. Outdoor calf pens must be partially covered and walled to prevent excessive heat caused by the sun and to guard against cold winter rains and wind. Pens open to the east gain warmth from the morning sun and provide shade during the warmer parts of the day. Rain seldom falls from the east.

**Keep Calves Healthy**

Preventing disease in the newborn calf gets them off to a good start, reduces death losses, and is cheaper than treating sick animals. The disease of new born calf and neonatal calf mortality are the major cause of economic losses in the livestock production. It is roughly estimated that a calf mortality of 20 % may reduce net profit to 40 % (Blood and Radostits, 1989). Neonatal calf mortality varies from 12.5 to 30 % in India (Verma *et al*., 1980). Observe calves regularly, feed them correctly, and provide clean surroundings. Don't allow the calf to suckle colostrum if the dam is suffering from foot and mouth disease. Vaccinate the new born calf on day one for tetanus. Areomycin give 10-15 mg/kg body weight in milk for first four days.Regular deworming schedule should be followed to control internal parasites. For that piperzine adept has to be given first on 7th day and subsequently every month up to one year age.For first two months, the calves should be kept on the floor spread with paddy straw bedding.In winter and rainy seasons the pens should be protected with gunny bag curtains.If the calves are licking the walls or floor put a bamboo basket around muzzle and secure by tying it around neck.If more calves are there, put them in different pens as per their size/ age group.Sprinkle lime powder around the calf shed and corners after thorough cleaning to avoid coccidiosis. Spray Exctodix per 3-4 mg/lit on calves once in a month to prevent external parasites.Dehorning is advised to avoid body and udder injuries when grown up. It is known as disbudding. It is generally done by cauterizing horn bud with red hot iron rod at the age of two weeks and the cauterized area is treated as open wound till it is completely healed.Feeding regime for calves:

## CONCLUSION

The current high demand for and high value of replacement heifers means that management of calves and heifers should be a high priority. Making time to feed newborn calves adequate amounts of high-quality colostrum is the single most important step managers can take to ensure healthy, well-grown calves that will produce milk to their potential during lactation. Measuring levels of passive immunity in calves permits effective management of a farm's colostrum program.To keep calves healthy and growing well, choose a high-quality milk replacer and avoid milk replacers with plant-based proteins for the first 4 weeks

of life. Early weaning of calves can help reduce costs associated with feeding of milk replacer, but doing so successfully requires early introduction and consumption of sufficient amounts of calf starter and water. The calves are babies and high-quality nutrients will help them thrive in spite of typical stresses associated with the pre-weaning period.

# Therapeutic Management of Livestock Ectoparasites

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Arthropods apart from their obvious and serious role as vectors of major parasitic disease are noxious in their direct effects. India being a tropical country and one of the hot spots shares a large number of globally registered ectoparasites. Livestock free of ectoparasites are hard to find, though proper management and treatment can reduce incidence of ectoparasitic infestation and can also reduce probability of many fatal diseases (Babesiosis, Theileriosis, Trypanosomiosis). Rarely attention drawn over importance of livestock ectoparasites on human health (Tungiasis, Myiasis, Scabies). Various ectoparasitic infestations common in India along with their treatment and prevention strategies are as follows.

**Stomach Bots in Equines**

Numerous tiny white eggs appeared on the hair coats of horses. Measuring roughly one to two millimetres. Bot eggs can be found on any part of the body covered in hair, but are usually located along the forelegs, shoulders, and face. Horses with bots (Fig: 1) may suffer mild gastritis and stomatitis, resulting in pain or discomfort during eating. The owner will come to know about bot infestation only when spiny elongated larvae about 2-2.5 cm appears in the faeces. **Causal agent**: Larvae of ***Gasterophilus*** spp. Flies.

*Fig: 1. Bot larvae in Horse stomach*

**Treatment**:

1. Macrocyclic lactones available for use in horses are ivermectin injectable or per oral @ 0.2mg/kg b.wt and moxidectin injection @ 0.4mg/kg b.wt .Moxidectin has proved to be less potent against stomach bots.
2. Closantel can be given orally as bolus or suspension @ 10 mg/ kg b.wt.
3. If macrocyclic lactones not available systemic OP trichlorphon and dichlorvos can be used.

**Prevention & Control**: In the endemic regions, the *Gasterophilus* fly egg infested hair of equines should be vigorously sponged with water at 40° to 48° C containing 0.06% coumaphos (or other

insecticides) for instant killing of the larvae. Vigorous sponging and warmth provide favourable conditions for hatching & insecticide kills newly hatched larvae.

**Nasal Bots in sheep and other hosts**

Profuse nasal discharge initially mucoid followed by haemorrhagic seen in ruminants due to migration of fly larvae. Paroxysms sneezing also seen in animals. Animals run from place to place, keeping their nose close to the ground, sneeze and stamping their feet, or shaking their head especially during the warmer hours of the day when the flies are most active.

**Causal agent**: Larvae of ***Oestrus ovis, Rhinoestrus cephalopena*** flies in ruminants , *Rhinoestrus purpureus* in horses.

**Treatment**:

1. Macrocyclic lactones like ivermectin injectable or per oral @ 0.2mg/kg b.wt; doramectin injection @0.2mg/kg b.wt or moxidectin injection @ 0.2mg/kg b.wt & latest compound in this category approved for cattle showing good efficacy & availability in market is eprinomectin.
2. Anthelmintics like rafoxanide (@ 7.5 mg/ kg b.w PO), closantel (@ 10 mg/ kg b.w.PO) or Nitroxynil (@15-20 mg/ kg b.w PO) can also be used for control of nasal bots.
3. OP trichlorphon and dichlorvos can be a good for treatment.

**Prevention and Control**: Being zoonotically important for shepherds special attention should be given in particular season in endemic areas. Flock treatment should be done first at beginning of summer then in midwinter to kill any overwintering larvae. Fly repellent can provide only temporary relief.

**Warble**

Warble (hypodermosis) is a condition produced by the infestation of larvae of a fly belongs to the genus *Hypoderma sp*. Adult fly are not parasitic. Fly lay its eggs on the fore limb of the cattle. Flies approaching for oviposition can frighten cattle making it move restlessly or aimlessly from one place to another. This can affect the feeding resulting on the poor weight gain and reduced milk production. Larvae ingested by the cattle on licking fore limb, will reach under the skin via migration and it produce a swelling of the skin called warble. Upon emergence the mature fly larvae make hole in the skin. Infected cattle in endemic regions may develop several hundred warbles. Sometimes the rupture of larvae inside the warble by pressure can result in anaphylaxis.

**Causal agent**: Larvae of ***Hypoderma bovis*** and ***Przhevalskiana silenis*** flies.

**Treatment**:

1. Larvae from back of the cattle can be removed by injecting 1 ml of 3% hydrogen peroxide solution using syringe without needle to avoid piercing of the larva. Most grubs emerge immediately leaving behind a cleansed cavity.
2. Application of petroleum jelly to opening of lesion proven to be successful in certain situation. It occludes the respiratory passage of larvae causing it to exit.
3. Trichlorophon and coumaphos are used as systemic drugs given orally or as pour-on along the animal's back. One application may be sufficient during summer. OP compounds like

trichlorophon appears to be less effective when used to treat goat warble than bovine hypodermiasis.

4. Macrocyclic lactones like abamectin, ivermectin, doramectin, moxidectin, eprinomectin proved to be highly effective against warble fly infestation.

**Prevention and Control**: A program of biannual treatment of flock with macrocyclic lactones can effectively control warble fly infestation.

**Cockle**

The sheep ked feeds on the blood of its host and therefore causes irritation to the sheep, leading it to rub, producing both loss and damage of the wool. It also makes firm, hard nodules that develops on the skin called a cockle and its faeces also stains the wool yellow thus reducing the value of the wool & hide.

**Causal agent**: ***Melophagus ovinus*** (Sheep ked)

**Treatment** : Dips, spray and pour on organophosphates (Diazinon, Fenvalerate, Malathion) and pyrethroids (Cypermethrin, Deltamethrin) can be used as per the manufacturer's recommendation after consulting a veterinarian .Under dosing can be proved ineffective and Under dosing and overdosing increases the pace of resistance.

**Prevention**: Pupae are often resistant to treatment so shearing is recommended to remove pupae and adults. Periodic dipping in insecticide solution can prevent ked infestation in large farms to great extent.

**Cutaneous myiasis**

The infestation of live vertebrate animals with dipterous flies larvae(maggots), which, at least for a certain period, feed on the host's dead or living tissue, liquid body substances, or ingested food. Majority of flies responsible for myiasis in India belongs to *Chrysomya bezziana* .Fowl smell, fresh wounds attract flies to feed & lay eggs on the edges of wounds where by larval emergence aggravate wound and may lead to toxaemia & death.

**Causal Agents**: Maggots of various flies like ***Chrysomya bezziana*** (blue green bottle fly), ***Lucilia cuprina*** (Green bottle fly) etc.

**Treatment** : 1.Conventional treatment is dressing with chloroform and turpentine oil (1:4) where turpentine oil serve as irritant so maggots comes out of wound and chloroform anesthetise them. In addition to prevent secondary infection and kill maggots Negasunt powder (coumaphos + propoxur + sulphanilamide) is used.

2. Commercial preparation like Ointments containing lindane + antibacterials or herbal preparation with or without turpentine oil are also available making the preparation irritant or non-irritant to tissues.

**Prevention and Control**: Systemic insect growth regulator, cryomazine and dicyclanil can give long lasting protection against cutaneous myiasis but highly expensive. In areas where fly infestation is high branding, dehorning and ear marking should be avoided during fly season. Mule's operation in high incidence area in sheep flock can be a big relief.

**Lousiness**

Lice are wingless permanent ectoparasites on animals. Lice bites can create significant signs of skin irritation and itchiness manifested by scratching,

biting, rubbing, and trauma of skin, which results in subsequent balding, hair-thinning, coat damage leading to dullness in hair coat, the condition known as lousiness. Massive populations of bloodsucking lice types can sometimes also produce severe anaemia (blood loss) and weakness in addition to this annoying skin irritation**.** Lice eggs commonly called as nits are found attached to their host's hair with specialized saliva. Nits infestation will give an ugly aesthetic appearance to the animal. Lice infestation is more common in winter and in hairy breeds.

**Causal Agents**: Biting (these large-headed lice species bite at the skin, hair and feathers of the host animal, feeding on the dander or skin/feather flakes of the animal host ) and Sucking Lice (these small-headed louse species drink the blood of their hosts to survive) .

**Treatment**:

1. OP like malathion, parathion, diazinon etc can be applied @ 0.2-0.5% or as per manufacturer recommendation.
2. Synthetic Pyrethriod cypermethrin Liquid available as 10% w/v and deltamethrin solution 1.25% w/v after proper dilution can be used effectively.
3. Amitraz Solution available as 12.5% w/v proven to be highly effective at proper dilution(0.05%).
4. Macrocyclic lactones like ivermectin , doramectin or moxidectin also found to relieve from lousiness.

**Prevention and Control**: Clipping of hair is highly suggestive. Grooming is a good remedy. Treatment should be repeated twice at 7 days interval so that larvae hatched from egg get killed.

**Tick infestation**

Among the soft and hard ticks, the later is more common on livestock though reports of spinose ear ticks in India are also available. Ticks are voracious blood sucker and vector of many pathogens of animals. Ticks can cause direct injury due to its bites and indirect effects due to the transmission of various pathogens. Severe tick infestation can cause anaemia, dermatitis, tick toxicosis, tick paralysis, poor growth rate and reduced production(Fig: 2). In india major tick species infesting cattle belongs to the genus ***Boophilus, Hyalomma*** and ***Haemaphysalis*** spp.

*Fig: 2. Heavy tick infestations in cattle ear resulting in anaemia, unthriftiness and poor productivity*

**Causal Agent**: Hard tick mainly

**Treatment**: 1. Synthetic pyrethroids like cypermethrin and deltamethrin being latest group of insecticides are found to be effective in most of cases. Resistance cases can be treated with Amitraz.

2. Ivermectin is drug of choice in majority of cases. Eprinomectin recently introduced in the market shows cross resistance to ivermectin so cases refractory to ivermectin are hard to respond to eprinomectin.

3. Many effective new generation insecticides are available as pour on or spot on preparation but more expensive.

**Prevention and Control**: It is mainly a menagement problem. In around 10 times dilution to recommended therapeutic dose, barn should also be sprayed with insecticides mainly in cracks and crevices. Gavac and TickGard vaccine are not found effective in Indian scenario so their import should be discouraged.

**Mite infestation**

Mites are much smaller than ticks and can not be seen without microscope. Clinical sign like skin irritation, vesicle or nodule formation, alopecia skin thickening often marked by abrasions, sores and not responding to antibacterial and antifungal drugs directly. The clinical case towards mite infestation which is often confirmed by skin scrapping.

**Causal Agent**: ***Psoroptes spp, Sarcoptes scabiei , Demodex bovis , D.equi, D.caprae,Chorioptes*** *spp.*

**Treatment**:

1. Benzyl benzoate (Miticidal) preparation should be used.
2. Ivermectin is drug of choice in case of *Sarcoptes* and *Psoroptes* but its use in demodicosis is a controversial issue.
3. Amitraz is given preferably in mange cases followed by cypermethrin or deltamethrin. Acaricide should be left on animal body at least 15-30 min for good results. Repeated treatment should be done after 2wks or in more severe cases weekly treatment is preferable.

## PREVENTION

Hair should be clipped before acaricidal treatment. A course of antibiotic should be given to inhibit bacterial infection especially in demodicosis. Before application of acaricide skin should be made grease free using suitable soap or shampoo preferably containing benzoyl peroxide or hydrogen peroxide.

## CONCLUSION

Ectoparasites are more or less managemental problem rather than clinical problem. Improved hygiene and prophylactic periodic or cyclic treatment with insecticide or acaricide in needful case can be a better approach. Insecticides are our assets that we got after a long research and development so only a judicious use can increase their longevity in market.

## REFERENCES

Soulsby, E.J.L., 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. (7th edition) 809 pp.,.London: Bailliere Tindall, Lea and Febiger, Philadelphia.

Urquhart GM, Annour J, Duncan JL, Dunn AM, Jennings. FW. 1996.Veterinary Parasitology 2 edition 307 pages. Wiley-Blackwell.

Elston D.M. Prevention of arthropod-related disease (2004). J. Am. Acad. Dermatol. 51 (6): 947-54.

Taylor M. A., Coop R. L., Wall R. L. (2015). Veterinary Parasitology, 4th Edition 1056 pages. Wiley-Blackwell

# Tritrophic Interactions and Their Implications in Pest Management

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Integrated pest management entails the manipulation of plant-herbivore-natural enemy interactions with the goal of regulating populations of the herbivore at levels below those at which economic losses occur. The physical, morphological, physiological and cultural characters of plants interact with the parasitoids and predators of insects by influencing their host seeking ability and affecting the efficacy by which they locate and utilize hosts. But recently, there has been a tendency by those involved in pest management to be principally concerned with effects on herbivores or interactions between just two trophic levels. Understanding of interactions between the different levels has not been prioritized. Most host plant resistance specialists are concerned mainly with ways in which resistance factors within or on the plant affect the development of herbivores, while the biological control specialist tends to concentrate on ways in which predators, parasitoids or pathogens are able to limit the abundance of and damage by herbivorous pests. Recent research bridging mechanistic and ecological approaches demonstrates that plant attribute can affect herbivores, natural enemies of herbivores and their interactions. Studies on tri-trophic interaction aim to identify the forces that influence the interaction between plants, herbivores and natural enemies and which thus affect species population density and community structure. Tri-trophic interaction research programmes are not only broadening in scope to search for the plant genes and plant metabolites involved in plant defense but also aim at understanding the parasitoids behavioral and neurobiological responses to variation in plant information. Multi-trophic interactions are those that link several trophic levels including plants, herbivores and predators, parasitoids or pathogens. These types of interactions are also referred to as tri-trophic interactions when they specifically involve three trophic levels.

**Important plant traits influencing enemy prey interactions**

- Plants act as an essential and interactive component of different trophic levels.
- Direct chemical and morphological defense against herbivores.
- Indirect defenses provided by parasitoids and predators.

- Variety of ecologically important traits that affect the outcome of enemy prey interactions.
- Plant attributes influence natural enemy efficiency
- Therefore, it is necessary to identify and group those plant traits according to their mode of action and describe how they function in a tri-trophic context.

**Plant attributes influencing enemy prey interactions**

1) Secondary metabolites
2) Nutritional resources
3) Morphological traits

**1) Secondary metabolites**

Secondary plant metabolites are compounds those mediate interactions involving plants and their biotic environment (Allelochemical). Plant metabolites classified into three classes.

A) Toxins
B) Digestibility reducers
C) Volatiles

**A) Toxin:**

Chemicals that have toxic properties when ingested and thus poison consumers *i.e.* Alkaloids, glucosinolates, cardenolides, furanocoumarins etc.Toxins often reduce the size of developing herbivores ultimately adversely affecting growth and development of natural enemies.

**B) Digestibility reducers:**

Secondary chemicals that reduce the nutritional quality of plant tissue for consumers by preventing access to nitrogen and other growth limiting resources.

- It includes protease inhibitors, tannins, lignin and silica.
- They reduce herbivore growth rates.
- Delayed development increases the amount of time that insects are retained in early larval instars and thus vulnerable to enemy attack.
- This concept has since been formalized as the slow growth high mortality hypothesis.

**C) Volatiles:**

Volatiles are low molecular weight chemicals that are readily emitted from plants into air, providing a distinct odour to foraging insects.

- Volatile profiles are species specific and provide reliable cues to the insects.
- Plant volatiles can be grouped into constitutive and induced compounds **(Atwal and Dhaliwal 2008).**

**2) Nutritional resources**

Many members of third trophic level are not exclusively carnivorous but also feed on various plant products, including pollen, food bodies and floral nectar.

- Adults of some parasitoid species are actually entirely dependent on plant supplied food sources.
- Availability of such food sources is important to supply not only energy for locomotion or flight but also to maintain high longevity and fecundity in many species of natural enemies.
- Other important effects of plant food source include increased attraction, retention and efficiency of natural enemies in targeted fields.
- Reducing plant damage (Atwal and Dhaliwal 2008)

**3) Plant morphological traits**

Influence the performance of herbivores, their natural enemies and their interactions. Impact survival of predators

and parasitoids but also their efficiency in locating and capturing prey

**a) Trichomes:** serve as physical barriers impending insect movement or glandular trichomes that express secondary compounds.

**b) Domitia:** several cultivated species have special structures that provide shelter for natural enemies. (leaf domitia and Ant domitia)

**c) Architecture:** Includes a wide range of variables such as leaf shape, petiole length, branching patterns, foliage density and phonological stage. Predators and parasitoids are less effective in architecturally more complex plants as it takes longer to search and thus locate prey on. (Atwal and Dhaliwal 2008)

**Trophic interactions mediated by semiochemicals**

Herbivory can be avoided or reduced by several defense mechanisms, including the production of substances from secondary metabolism. Within the large complex of these substances produced in plants, volatile compounds are important in influencing host-searching behavior of insects, which during their evolutionary process, have developed the ability of identifying such components and using them to perform their activities (Rhoades, 1979). Secondary chemical substances may affect the development of insects or act as chemical messengers. The term semiochemical was proposed by (Ashok *et al*. 2013) for volatile chemicals involved in the interactions between organisms. These chemicals may act as *allelochemicals* and include *allomone* and/or *kairomones*. Depending on circumstances, allomone and kairomones can repel the attack of insects or encourage others to feed. An example of an allelochemical having dual roles as allomone and kairomone is the substance *cucurbitacin* that may be an effective deterrent to most herbivores but also act as a feeding stimulant for beetles of the genus *Diabrotica* (Kogan, 1986).

**Plant-Herbivore-Natural enemy interactions**

**Host searching behavior in parasitoids and predators**

Parasitoids and predators of herbivorous insects base their host searching on volatiles both from their own prey as well as from other sources associated with them such as microorganisms or host plants. Chemical signals emitted by the prey are highly reliable because they provide precise information about location and abundance. However, these volatiles show low detectability over long distances. Therefore, to optimize the perception of chemical signals available in the environment, natural enemies use three distinct mechanisms: (1) the diversion of semiochemicals using volatiles indirectly related to the host (e.g. Pupal parasitoid identifies larval volatiles). (2) Associative learning, relating easy-to-detect stimuli to reliable slimuli but with low detectability. (3) Response to stimuli created by the specific interaction between the herbivore-prey and its host plant (Price *et al.* 1980).

**There are five main areas where manipulation of crop-pest-natural enemy interactions could provide substantial benefits in pest management systems.**

- Host plant quality
- Allelochemicals
- Crop diversification

- Exogenous interactions
- Genetic manipulation

**Host plant quality**

The effects of soil nutrient regimes and secondary metabolites present in plants are relatively well studied for herbivores, but studies focusing on their impact on parasitoids are rare. Nutritional quality of host plants can be important at every step affecting parasitoid preference and performance indirectly or directly. Plants are known to indirectly influence the foraging efficiency of parasitoids, while plants directly influence host acceptance, host suitability and host regulation. Host plant quality affects insect reproductive strategies: egg size and quality the allocation of resources to eggs and the choice of oviposition sites may all be influenced by plant quality as may egg or embryo resorption on poor quality hosts. Many insect herbivores change the quality of their host plants, affecting both inter and intraspecific interactions.

**Allelochemicals**

Role of natural enemies is greatly influenced by the diverse semiochemicals present in a given ecosystem. Plant genotype is the major detriment for the quality and quantity of allelochemicals revealed in any ecosystem by the plants and also it influences the semiochemicals released by the host insects. Synomones released by different plants and kairomones emanated from the host insects and their byproducts play a major role in improving the efficiency of both naturally occurring and released natural enemies.

**Role of synomones**

Picard and Rabaud (1914) were the first to report that synomones produced by host plants of insects influence the habitat selection behavior of natural enemies. Synomones mainly help the natural enemies in habitat location. Content varies both quantitatively and qualitatively in different varieties of the same crop. Different stages of a crop are also found to vary in their semiochemical compositions which in turn influence the host plant natural enemy interactions.

**Potential of host kairomones in enhancing the efficiency of natural enemies**

- Stimulation of host searching behavior
- Stimulation of ovipositional behavior
- Field application for enhancing parasitization and predation
- In screening natural enemies as potential bio-agent
- For monitoring natural enemies population

**Crop diversification**

The diversification of crop and neighboring environments is widely regarded as beneficial for biological control and sustainable agriculture systems. Habitats that are structurally, biologically or temporally diverse provide greater levels of habitat diversity which in turn diversifies the available prey, so increasing the abundance of natural enemies. Many ways in which diversification of crop environment can be undertaken. Most practical are polycultures or use of refugia.

**Exogenous interactions**

The application of exogenous substances, such as botanical extracts, may have different effects on pests and natural enemies that can be exploited as a bio-rational method in pest management.

**Genetic manipulation**

Many of the risks associated with using lures or phytohormones to attract natural enemies may be avoided through genetic engineering because plants can be selected for enhanced HIPV emissions only when attacked by herbivores.

Two approaches can be taken

**1) Selective breeding**

Where the natural variation in the production of HIPV's among plants can be exploited in breeding programmes to select the plants that enhance the foraging efficiency of natural enemies.

**2) Transgenic plants**

Where specific genes are incorporated to prime plants for an enhanced HIPV response. Transgenic plants with modified production of HIPVs will be more useful for manipulation of natural enemy behaviors.

## CONCLUSION

From fore going discussion it can be concluded that, in the interest of agricultural sustainability tritrophic manipulation, as a distinct approach in pest management is likely to be prioritized increasingly both by researcher and those responsible for the practical implementation of pest management programmes. Improving the understanding of multitrophic systems is critical to the development sustainable, less pesticide dependent or pesticide free pest management systems. This is because control techniques or target pests cannot be regarded in isolation. Manipulation of any single factor will tend to have knock-on effects on different trophic levels.

## REFERENCES

Ashok, B.J., Tambe, V.J., Raghavendra, K.V. and Undirwade, D.B. (2013). *J. Insect Science*, **26**: 42-50.

Atwal, A.S. and Dhaliwal, G.S. (2008). Agricultural pests of south Asia and their management, p. 91-93.

Kogan, M. (1986). Plant defense strategies and host plant resistance. *In Ecological Theory and Tntegrated Pest Management Practice*, ed. M. Kogan, 83-133. New York: John wiley & Sons.

Picard, F. and Rabaud, E. (1914). Sur le parasitisme externe des Braconides. Bulletin de la Societe Entomologique de France. **83**: 266-269.

Price, P.W., Bouton, C.E., Gross, P. and McPheron, A.E. (1980). Interactions among three trophic level: Influence of plant interactions between insect herbivores and natural enemies. *Annu. Rev. Ecol. Syst.* **11:** 41-65.

Rhoades, D.F. (1979). Evolution of plant chemical defense against herbivores. *In Herbivores: their interactions with secondary plant metabolites*, ed. G.A. Rozzenthal and D.H. Janzen, 4-48 New York: Academic Press.

# Pathophysiological Conditions Affecting Mammary Secretory Function in Domestic Animals

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The major problems for the dairy practices in the tropical countries like India are low milk yield & short lactation length of either pure exotic or crossbred dairy cattle. Many factors affect milk production in dairy cattle in tropical areas including high environmental temperature and humidity, low genetic potential for milk production in indigenous cattle & inadequate supply of food during the dry and hot summer season. In crossbred cattle, mechanisms of milk production are known to be inherited. Improved persistency of lactation can contribute to decreasing the cost of production system because of lactation persistency is associated with feeding & health costs including reproductive performance. It is well known that mammary growth during pregnancy is a prerequisite in all mammals. During pregnancy, the mammary gland is competing with many organs for nutrition to sustain growth. During pregnancy, maternal body functions are altered e.g. cardiac output and heart rate is adjusted to nourish the conceptus embedded in the uterus, while during lactation, general circulation & body fluid adjusts as per requirement. As glucose is the principal precursor of lactose, the decrease in milk lactose can be explained by the change in the mammary utilization of glucose. The physiological status, nutritional factors & the environmental factors are responsible for good or bad conditions of the mammary secretory activity. The altered sequence of events lead to the pathological conditions of the mammary glands that cause decreased milk yield and thus economic loss.

## MASTITIS

Mastitis is of greatest economic importance in the dairy cows, but the disease may affect any species and is handled in much the same way in all of them. Mastitis can be defined as inflammation of mammary gland due to

infection of the gland by bacteria or fungi. Technical factors that predispose the establishment of infection within the gland are the poor milking hygiene, milking machine faults, faulty milking management, teat injuries and teat sores.

**Types:**

A. *Peracute* ; in which swelling, heat, pain and abnormal secretion in the gland are accompanied by fever and other signs.

B. *Acute*; moderate/slight fever & depression.

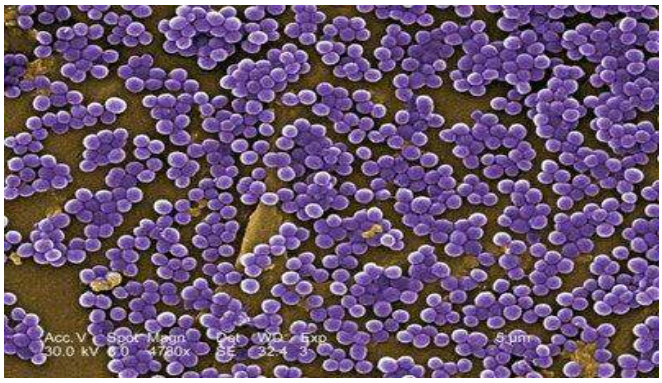
C. *Subacute*; changes are less marked.

D. *Subclinical*; inflammation within the gland is only detectable by diagnostic tests viz; California mastitis test (CMT), the Wisconsin mastitis test, the White side test and Electronic cell counter. In subclinical mastitis, there is decreased milk yield.

***Mastitis***

**Causes:**

The most common mastitis causing pathogens are *Staphylococci* and *Streptococci*. Yeasts like *Candida albicans* may also cause severe and chronic mastitis.The bacterial pathogens most commonly responsible for bovine mastitis (in approx. decreasing order of frequency) are; *Staphylococcus aureus, Streptococcus agalactiae, Corynebacterium pyogenes.* Less commonly mastitis may be associated with infection of the gland by *Nocardia spp., Clostridium, Mycobacterium spp.* and *Yeasts*.



***Staphylococcus aureus***

**Diagnosis:**

1. Clinical signs
2. Culture and identification of pathogens
3. CMT, WMT, White side test, Electronic cell counter. The SCC of ≥ 100000/ml milk gives an indication of mastitis.

**Treatment:**

1. Antibiotics (ampicillin, oxytetracycline, etc.)
2. NSAIDS
3. Oxytocin @ 10-20 IU to remove milk from the udder
4. Fluid therapy in severe cases

**Consequences of Mastitis:**

1. Economic loss due to decreased milk production
2. Losses due to investment on treatment of affected animals
3. In severe cases, udder of affected animal is surgically removed so permanent loss of milk secreting tissue occurs
4. Mastitis may also be contagious

**Bovine Ulcerative Mammilitis**

A severe ulcerative condition of the teats of dairy cows that can occur in outbreaks resulting in marked loss of milk production and a high incidence of secondary mastitis in affected herds. It is caused by Herpes virus very similar to the Allerton strain of group 2nd. The lesions commence as one or more thickened plaques of varying sizes on the skin of one or more teats. Vesiculation occurs quickly, leaving behind a dark brown scab. In some cases the teat wall is involved and often the lesion includes the teat orifice, predisposing to mastitis and blind teat. In early cases, the lesions before vesiculation is marked, intra-nuclear inclusions may be detected in the cells of dermis. Udder edema is a predisposing cause. Diagnosis is based on the signs and confirmed by histopathology or virus isolation from early lesions. Prevention and treatment includes isolation of affected animals. Prophylactic infusions for mastitis should be considered. Emollient ointments and Iodophore solutions (v/v 1:320) are useful.

***Bovine Ulcerative Mammilitis***

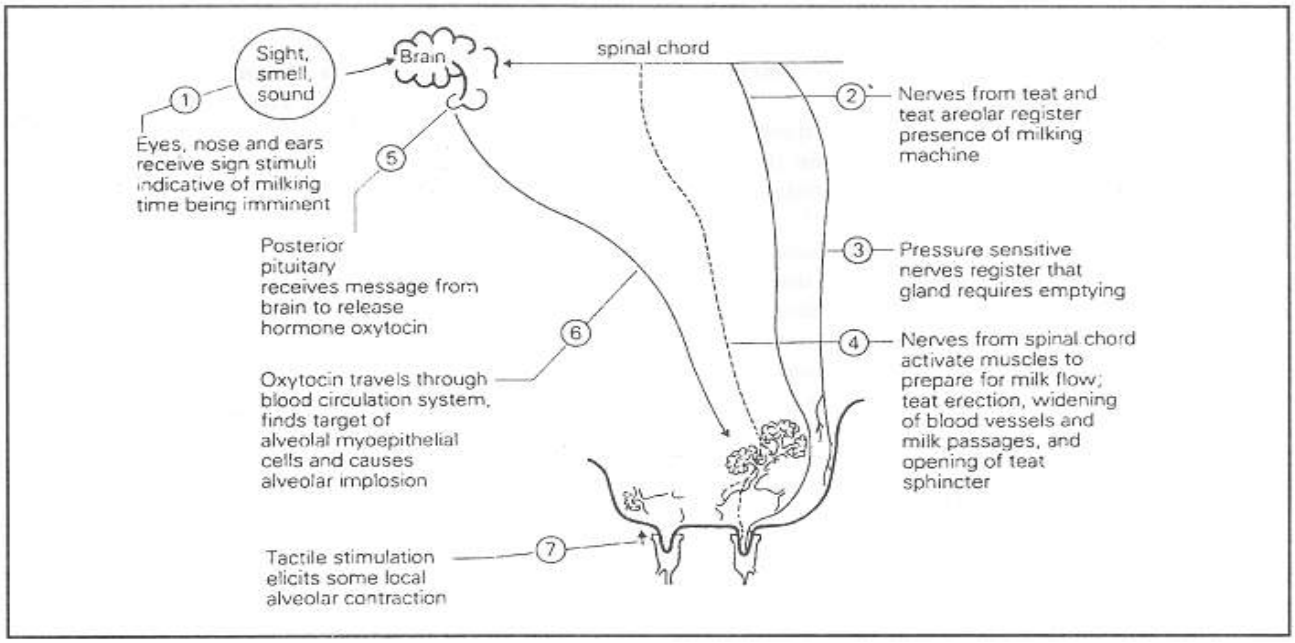
**Udder Edema (Physiological Udder Edema and Congestion)**

Udder Edema is observed in high producing dairy cattle prior to and after parturition. This problem can't be controlled satisfactorily, but several practices may help. Some veterinarians advise milking cows before parturition as a means of reducing the congestion and edema. Frequent milkings are useful. Massage and use of hot compressors and udder ointments for udder edema and to stimulate circulation and promote reduction of edema in udder tissues. When milk letdown fails, udder edema and congestion will appear to increase. In severely affected cows, the udder will often 'break down' and become pendulous. Anything that causes increased capillary pressure, such as decreased plasma protein, increased capillary permeability or lymphatic blockage can result in swelling and congestion of extravascular compartment. Udder Edema can be resolved by the use of diuretics like Furosamide, Chlorthiazide, etc.

***Udder Edema***

**Failure of letdown of milk**

Failure of milk letdown is observed occasionally after parturition in young dairy cattle. This condition may be caused by the pain and discomfort of a large and edematous udder. If unusual methods of massage, use of warm compresses, calf suckling and frequent milking fail to result in proper letdown of milk, the administration of posterior pituitary extract or oxytocin may be used. An exact milking and feeding routine is important in training heifers to develop a proper letdown habit.




*Mechanism of milk letdown*

## CONTAGIOUS AGALACTIA

A mycoplasmal disease of goats and sheep occurring in Mediterranean countries, Switzerland, USSR, Pakistan, India, etc. A febrile illness with a seasonal incidence coinciding with the onset of lactation, with low mortality and high morbidity (25%). Mastitis is common, the milk yield is reduced in amount and is either viscous and purulent, udder may atropy, arthritis often results with pain, inflammation of periarticular tissue and tenosynovitis. Sometimes there is keratoconjuntivitis. Diagnosis is made on history and clinical signs may be confirmed by isolation of *Mycoplasma agalactia* from infectious milk, eye or joint fluid or a Complement Fixation Test is done. For treatment Tylosin @ 2-5 mg/lb bw is given intramuscularly. Live attenuated or killed vaccines showed apparent success. Although Contagious Agalactia doesn't show high mortality, morbidity from this disease may be as high as 30-60%, a decrease or complete cessation of milk production occurs. Abortion in pregnant animals may lead to economic losses.

## METABOLIC DISTURBANCES

In dairy cattle, metabolic disturbances such as milk fever, ketosis, grass tetany,

udder edema, fat cow syndrome and retained placenta may be directly or indirectly related to nutrition. Most of these disorders occur at or shortly after parturition and represent a failure of the cow to adjust to the rapid onset and stress of milk production. At peak lactation of a high producing dairy cow, the mammary gland uses most of the glucose produced by the liver for lactose production. If the need for the glucose by mammary glands can't be met by gluconeogenesis and blood glucose levels drop significantly, lactational ketosis develops. while blood glucose levels are low, metabolic acids accumulate in the blood to produce metabolic acidosis.

**Miscellaneous Conditions Altering Mammary Secretory Activity**

Udder impetigo/acne, Blind quarters, Leakers, Agalactia, Complete teat obstruction, Spider teat, MMA syndrome (lactational failure in sows), Rupture of suspensory ligaments, etc.

## CONCLUSION

The disorders leading to defective mammary secretory activity such as mastitis, Mammilitis, edema cause great economic loss in terms of decreased milk yield and investment in terms of treatment and culling of affected animals. Adequate precautionary measures should be taken to evade these pathophysiological conditions to maintain proper animal health and milk yield. Dairy cows should be screened after every few months against contagious diseases. Nutritional status of animal should be monitored. Animals should be kept in well ventilated and stress free houses. Sanitary measures should be adopted. Indiscriminate use of antibiotics and hormones should be avoided as they cause stampede and addiction. High producers should be selected and low producers prone to diseases should be culled to maintain milk production.

# Nematode Management Strategies for Organic Farming and Precision Farming

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Organic farming is a method of agriculture where no synthetic fertilizers and pesticides are used (FAO, 1998) while precision farming can be defined as the use of information and information technology to make the implement management decisions at appropriate scale. Nematode management play important role in organic farming and precision farming.In nematode management it is important to remember that nematodes can move only very short distances on their own. Therefore nematodes are mainly spread through lack of sanitation and movement of infected soil and planting material. In order to limit a build-up of nematodes, planting equipment and tools should be properly cleaned, and in extreme cases could only be used for the same field. Furthermore only soil and planting material free of nematodes should be used, because once nematodes are introduced into a field they cannot be eradicated. After harvest infected plants should be destroyed to prevent the build-up of nematodes on these crop residues and therefore in the soil. Once they become established in a site, the nematodes will persist there, and management will be required on a regular basis.

**NEMATODE MANAGEMENT STRATEGIES IN ORGANIC FARMING**

**Four different strategies for nematode management are:**

1. Preventing the introduction and spread of nematodes by the use of nematode-free planting materials.
2. Using nonchemical, cultural, and physical control methods, particularly crop rotation and soil cultivation.
3. Encouraging naturally occurring biological control agents by understanding of cultivation methods and appropriate use of soil amendments.
4. Maintaining or enhancing the biodiversity inherent in traditional farming systems that use multiple cropping and multiple cultivars to increase the available resistance or tolerance to nematodes.

**The various tools for management of nematode in organic farming are**

**A) Resistant Plants and Rotation Crops:**

Nematode management is primarily a pre-planting activity. In order to protect the crop most

activities must be started two or three months before the scheduled planting date. Several pre-plant treatments are available for the organic farmer. The choice of a suitable crop cultivar can be a

critical decision. Host plant resistance achieved by traditional breeding programs can be a valuable protection against some nematodes. Two terms that are often used when talking about host plant resistance to nematodes are**"Tolerance"** and **"Resistance".** Tolerance means that the plant can withstand some damage caused by nematodes without experiencing significant yield reduction. In contrast, resistance means that nematode reproduction is very low or non-existent on the plant. Both provide protection for the crop plant, but the next crop following a tolerant plant could be damaged by the nematodes that survived on the tolerant plant. Different plant species or even cultivars of the same plant species can exhibit varying degrees of resistance or tolerance. The following vegetable plants are recommended as reasonably resistant to root-knot nematode: broccoli, brussel sprouts, mustard, garlic, leek, groundcherry, and rutabaga. In contrast asparagus, sweet com, horseradish, some lima bean varieties, onion are considered to be tolerant. However, the Crop rotation utilizes crops that are a poor or non-host to the nematodes found in an agricultural field. These crops can either be plants that provide a secondary cash crop grown in between cycles of the primary cash crop, or they could be cover crops that are not primary but provide benefits to the farming system such as nitrogen enrichment, nematode reduction, or possible additional income. In either case, nematode numbers are reduced simply because nematodes are deprived of a suitable host crop. This does not mean that nematode densities are reduced indefinitely, but a successful crop rotation should reduce nematode levels enough so that a following susceptible crop will produce sufficient yields and survive until the end of its regular growing season. Concept of a cropping system for managing nematode includes grass fallows, antagonistic plants and trap plants, cover crops that enhance the activity of beneficial soil fauna and flora, and shifts in the time for planting and/or harvesting of crops to limit nematode damage Popular cover crops are sorghum, sorghum sudan grass different grains such as oat and rye, many grasses, marigold, cowpea, and some tropical legumes such as sunnhemp and velvetbean. These cover crops are useful to reduce root-knot nematode population densities. Sorghum is often recommended as a cover crop to decrease population levels of root-knot nematodes, and is widely used for this purpose.

**B) Tillage:**

Tillage and the practice of fallowing fields may appear as alternatives to cover crops for nematode management. Tillage inverts and mixes soil and exposes deeper soil layers to the sun (Fig 1). This practice is meant to kill nematodes by

**Fig 1 Tillage operation for inverting, mixing and exposing soil to sun**

desiccation, since nematodes depend on moisture for survival. This practice may kill some of the nematodes that are in the upper soil layers, however it will not reach nematodes that have retreated into moderate or deeper soil layers. Nematodes can retreat to depths greater than 12 inches (30 cm), and can migrate upward once a susceptible host is planted. Once a field has been fallowed, nematodes will move into deeper soil layers to avoid drying and may enter an inactive stage that enables them to survive periods without food and in addition protects them from desiccation.

Fig2 Soil solarization byplastic sheets

**C) Solarization:**

A promising technique is the use of heat to decrease not only nematode densities, but also other harmful organisms and weed seeds. This can involve pasteurization, steaming, or solarization of the soil before planting. Of these, solarization is probably the most practical. It involves the covering of the soil with clear plastic. Transparent plastic sheets allow short-wave radiation from the sun to penetrate the plastic (Fig 2). Once the light passes through the plastic and is reflected from the soil, the wavelength becomes longer and cannot escape through the plastic. The trapped light facilitates heating of the soil to temperatures detrimental to most living organisms. There are different types of plastic sheets available, mainly differing in their thickness (insulation) and ability to let light through (transparency). Black, opaque, or translucent plastics are not suitable for solarization. Thin, transparent plastic sheets appear to achieve the best results. The plastic has to be sealed to prevent air movement underneath the plastic, which would prevent temperatures from rising sufficiently. The disadvantage of solarization is its negative impact on beneficial soil organisms, since they will meet the same fate as their harmful counterparts. But recovery is usually attained quickly through rapid recolonization. Furthermore, other beneficials such as Bacillus, Pseudomonas, and Trichoderma are able to survive the high temperatures generated by solarization.

**D) Biological Control:** Biological control is the management of plant-parasitic nematodes by living organisms such as bacteria, fungi, predatory nematodes, or other invertebrates. Biological control is mainly accomplished by attempting to build-up beneficial organisms through the use of various soil amendments. The introduction of beneficial soil organisms to the soil has only been attempted successfully in a few instances. e.g. *Pasteuria* spp., *Pseudomonas* spp., VAM fungi, *Glomus* spp.,*Trichoderma* spp., etc., Nematode-trapping fungi (fig 3)are also potential candidates for biological control Their adhesive knobs, rings, or net structures trap nematodes and kill them. Other types of fungi may parasitize

nematode eggs/cyst (Fig 4).

**E) Organic Amendments in Relation to organic amendments.** Organic amendments can improve the soil environment to aid biological control, benefit general plant health by helping with water retention and providing additional nutrients, and affect nematodes directly and negatively through detrimental decomposition products. In most cases when organic amendments are applied, they are helpful mainly as a plant nutrient source and do not directly aid in nematode management. However, even if nematodes are unaffected by the added amendments, plant health may improve due to other favorable properties of amendments. E.g. Neem cake, Karanj cake, etc.

Fig 3 Nematode spp trapped by Fungi

Fig4 Nematode eggs/cyst parasitized by fungi

**F) Management of Infected Plants:**

Once plants are infected with nematodes, there is little that can be done to remove or reduce nematodes. Therefore, prevention and sanitation are critical to controlling nematodes. The improvement of plant health is an important cultural technique to lessen detrimental effects on plants caused by plant-parasitic nematodes. Proper irrigation, fertilization and organic amendments as surface mulches or soil incorporated are important. Furthermore, removal of weed hosts and old crop plants immediately after harvest can reduce nematode densities for the future. Nematodes are a long-term pest, which cannot be eradicated once they become established in a site. They can only be kept at low levels with carefully selected management tactics that are often specific to the managed site. There

**Biological Control:**

Biological control is difficult in soil, because it is a complex environment. Many of the possible organisms that could provide biological control lack specificity and therefore will not focus on a particular organism and may even interfere with beneficials. Therefore biological control of nematodes is achieved mainly by conservation of existing biological control; meaning that the soil environment is modified to aid the survival and reproduction of nematode natural enemies that are already present. Primarily this is accomplished through the addition of

are a variety of additional methods that may have some effect on nematodes. These include methods such as use of rhizobacteria, chitin, sesame residues, flooding, or microwave energy. Some of these (flooding, microwaving) may be restricted to specialized situations. Amendments such as chitin or sesame residue may provide nutrients that are beneficial to overall plant health regardless of any effects on nematodes.

**Nematode Management strategies in Precision Agriculture**

Modern computerized harvest-management and data systems offer new opportunities for more precise management of nematodes and general crop production. This technology has the potential to improve water use and limit fertilizer and pesticide application on a spatial and temporal basis as dictated by soil fertility and, more important, differential spatial crop yields. Based on early results, this management tool should allow specially prescribed nematode control in high-intensive crop production such as *Radopholussimilis* on banana and root-knot nematodes on potato. Approaches that focus on a harvest index to locate environmental stress should be able to relate nematode kinds and numbers to poor yield and other stress factors. This approach is now being used in some banana operations in which fruit is harvested in small subunits and yield data are recorded and analyzed by computer. Poor-yielding sections can be examined for nematode densities and other potential problems.

**A) Nematode Identifications and Population Assessments**

The tools of rDNA technology, especially when allied with traditional taxonomic characters and host differentials have greatly facilitated identification of nematode species. Continuing restrictions in the size of samples and numbers of nematodes that can be examined make it very difficult to fully diagnose the nematode species present in large fields. However, this new technology should facilitate a more complete characterization of the diverse nematodetrophic groups and species.Geostatistical analyses could be interfaced with improved sampling apparatus for moreprecise measurement of data on nematode population.

Image analysis has been adapted to count specific nematodes.

**B) Genetically Engineered and Traditional Host Resistance**

There has been considerable progress made in engineering host resistance to nematodes, genetic mapping, and diagnostics. However, genetically engineered resistance to nematodes is still at the developmental stage in contrast to the recently deployed herbicide- and insect-resistant cultivars of cotton, soybean, and other crops. One strategy involves transformation of plants with a transgene (s) encoding a product detrimental to the target nematode or that suppresses the expression of key plant genes involved in the nematode-host interaction. Candidate genes for this strategy include collagenase, genes expressed in the development of specialized feeding cells induced by species of Globodera or Heterodera (syncytia) and Meloidogyne (giant cells). Constructs of the root-specific TobRB7 gene in tobacco have been used to develop promising root-knot nematode-resistant genotypes .

Linking this gene with a BARNASE gene resulted in root knot-resistant plants, but difficulties were encountered in recovering resistant lines from progeny of the transformants. Transformed plants with an antisense TobRB7 construct also exhibited root-knot resistance; root-gall development was about 70% less in than susceptible plants. A second approach for engineering nematode-resistant plants involves identifying, cloning, and introducing natural plant-resistance, genes into susceptible crop plants. Exciting results with this strategy were recently reported with *Heteroderaschachtii* on sugar beet. In one major development, Cai*et al* cloned the cyst-resistant gene in wild Beta species. A transformed, normally susceptible sugar beet line exhibited the typical incompatible resistant reaction. Similar progress is being made with the Mi gene, which confers resistance to the common Meloidogyne species and populations attacking tomato. With the wide host range of these nematodes, the transfer of the Mi gene to numerous crop species, for which root-knot nematodes affect major crop yields, has great economic promise.

# Physiological secretion of Mammary gland-Protein Polymorphism

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The major goals of the dairy cattle breeding are the search of an economically efficient way for the improvement in milk production and the qualitative milk traits. Selection and breeding of animals with desirable genotypes is of crucial importance for the genetic improvement of dairy cows. Milk proteins are usually divided into two great "historical" groups, depending on their behavior by acidification at pH 4.6. The soluble fraction, named "whey protein", is constituted by several different proteins; the most important ones are α-lactalbumin (α-La) and β-lactoglobulin (β-Lg). The insoluble fraction, named "whole casein", is constituted of four different native caseins (Cn): αs1-(CSN1S1), αs2-Cn, β-Cn and k-Cn (CSN3). Each of the protein is presented by at least two genetic variants. Genetic variants of milk proteins differ from each other by one or more amino acid residues in the polypeptide chains, which is due to various types of mutations in the genes encoding them. There are several methods for genotyping milk protein polymorphisms; however, the most frequently applied one is the PCR-RFLP assay. The alleles of a particular gene can be identified through their restriction profile.

## GENETIC POLYMORPHISM

The term "genetic polymorphism" defines the fact that each milk protein presents two or more forms genetically determined by autosomal and codominant alleles. The absence of dominance is very useful, because homozygous individuals present in the electropherogram has only one variant for each protein, while heterozygous ones has both variants, so that the count of the gene frequencies for a population results very easy. Studies on milk protein polymorphism have been developed with various different finalities; to point out milk protein chemical evolution and find some eventual similarity with other proteins; to verify relationships between different species or breeds; to monitor variations that happens in the time or in the space for a particular animal population and the most important aim is the biological significance of genetic variants.

**Milk protein polymorphism:**

Milk protein polymorphism was firstly

reported by Aschaffenburg and Drewry (1957). Relationship between genetic variant of milk protein and production traits for livestock animal by Hall in 1974. After that many investigations were completed by several researchers in this area.

**Importance of Milk Protein polymorphism:**

- It serves as an important component of genetic diversity, and is helpful in the conservation, exploitation and utilization of animal breeds.
- The kinship of different animal breeds (or types) can be estimated and the origin and differentiation of animal breeds can be determined by using the cluster figure developed from the gene frequency of polymorphic milk protein.
- Serves as an assisting tool to select excellent breeding animals, the quality of animal production and milking traits could be improved according to the linkage relationships between milk protein polymorphism and milking traits (Zhu and Zhang, 2000).

## GENETIC FEATURES OF MILK PROTEIN

Almost 95% of the proteins in milk is coded by only 6 structural genes (Martin et al., 2002). The 4 caseins, αs1-CN, β-CN, αs2-CN, and κ-CN, are respectively coded by 4 genes (*CSN1S1*, *CSN2*, *CSN1S2,* and *CSN3*) tightly linked in a 250-kb cluster (Ferretti et al., 1990; Threadgill and Womack, 1990) mapped on chromosome 6 (Hayes et al., 1993), whereas the whey proteins, α-lactalbumin (α-LA) and β- lactoglobulin (β-LG), are coded by *LAA* and *LGB* genes, mapped on chromosomes 5 (Hayes et al., 1993) and 11 (Hayes and Petit, 1993) respectively. Extensive genetic variation in cattle has been identified and characterized by thorough investigation of milk protein genes.

## STUDIES ON MILK PROTEIN VARIANTS

### Cattle

In cattle, CSN1S1 and CSN3 group of caseins and LGB were focused because of great effect on milk production and milk constituents (Erhardt, 1996). The dominant role of genetic variants of CSN3 gene due to its influence on the formation, structure and stabilisation of the casein micelles which in turn have an advantage in cheese production (Farrell et al., 1996). In bovine milk, the CSN3 protein is calcium-insensitive because it contains only one phospho-seryl residue and prevents the precipitation of the other three caseins. Some milk proteins are potential allergens (especially CSN1S1) because they are missing in human milk (EFSA, 2004; Crittenden & Bennett, 2005). LGB is the major whey protein of ruminant species. Even though its biological functions are not well studied it may have a role for the phosphate metabolism in the mammary gland (Hill et al., 1997). LGB also have a role for the transport of retinol and fatty acids in the gut because of its resistance to gastric digestion *in vivo* and remains intact after it passes through the stomach (Yvon et al., 1984).

### Goat

Goat milk contains 4 caseins (αs1-, αs2-, β- and κ-) linked with each other encoded

respectively by autosomal genes: CSN1S1, CSN1S2, CSN2 and CSN3. They are located on Chromosome 4 in the following order: αs1-, β-, αs2- and κ-. The CSN1S1 gene encoding αs1- casein has the most complex construction and has a number of polymorphic sites. The gene CSN1S1 in goats presents the highest level of variability of all the casein genes among all species of ruminants that have been analysed. So far 16 genetic variants of αs1-casein were identified: A1, B1, B2, B3, B4, C, E, F, G, H, I, L, M, N 01 and 02. They probably evolved from 4 original alleles: A, B1, B2 and W. These different alleles are associated with 4 levels of protein synthesis in milk. A high level of αs1-casein (3.5-3.6 g/l) synthesis is connected with "strong" alleles: A, B1, B2, B3, B4, C, H and L. "Medium" alleles determine the protein synthesis at the levels of 1.1-1.6 g/l, while "weak" alleles are associated with the synthesis only at the amounts of 0.45-0.6 g/l. "Null" alleles (01 and 02) account for trace amounts or complete absence of this casein fraction in milk (Caravaca et al., 2008; Moatsu et al., 2006; Veress et al., 2004). The frequency of strong alleles exceeds in local breeds whereas international breeds have more medium and null alleles. Goat's CSN1S2 locus is characterized by a much higher genetic diversity compared to cattle or sheep. So far 8 alleles such as A, B, C, E and F are the "normal" alleles, D is an intermediate allele and "null" alleles linked to the absence or synthesis of αs2-casein at trace levels.

5 alleles of goat's CSN2 gene were identified that are associated with different levels of β-casein in milk. Alleles A, B and C are connected with normal contents of this protein, while alleles 0 and 0' are linked with undetectable or trace amounts (Ibeagha-Awemu et al., 2005). Goat κ-casein gene is composed of 5 exons, out of which the portion encoding the mature protein is located in the exon 3 (9 amino acids) and exon 4 (162 amino acids). It is assumed that the κ-casein gene is not evolutionary correlated to milk proteins sensitive to calcium, although it is linked with them. Goat's LAA and LBG genes encoding 2 major whey proteins, respectively, α-lactalbumin and β-lactoglobulin, are characterized with much lower genetic variation in comparison to the genes observed in cattle. Goat's LGB gene is located on chromosome 11q28. Sheep and goat β-lactoglobulin differs itself from bovine β-lactoglobulin only in 6 positions (Strzelec & Niznikowski, 2009).

**Sheep**

The research on the analysis of milk protein polymorphism in sheep is limited to the study of the gene polymorphism of αs1-casein and β-lactoglobuli (BLG). BLG gene in sheep is located on chromosome 3 and three alleles can be found within its area: A, B and C. Sheep milk contains 4 casein fractions: αs1-, αs2-, β- and κ- encoded by the genes: CSN1S1, CSN1S2, CSN2 and CSN3. These genes are localized on chromosome 4. So far 8 alleles of CSN1S1 were identified: A, B, C, D, E, F, G and H (Vlaic et al. 2011).

**Buffalo**

Buffalo milk is characterized by the

presence of all 4 casein fractions (αs1-, β-, αs2- and κ-) encoded by 4 closely linked autosomal genes (CSN1S1, CSN2, CSN1S2 and CSN3) that are mapped on chromosome 7 (Iannuzzi et al., 2003). BLG gene is mapped on chromosome 12 (El Nahas et al., 2001).

**Association of Genetic variants and composition of milk**

**Cattle:**

i. β-lactoglobulin is considered to be an important genetic marker of quantitative traits.
ii. Most authors link the variant B of β-lactoglobulin with the higher contents of total protein, casein, fat and dry matter in milk (Barłowska, 2007).
iii. Milk with AB heterozygotes of β-lactoglobulin has the most digestible protein which may be associated with better rearing of offspring from cows with this genotype (Litwinczuk & Krol, 2002).
iv. Analysis of genotype of αs1-casein and β-casein indicates no significant relation on cow productivity (and contents of protein and casein in milk).

**Goat:**

The most know polymorphic protein in goats is αs1-casein.

a. In most studies, no significant correlation between the variants of αs1-casein and milk productivity because of a strong influence of various factors such as age, stage of lactation etc.
b. A propitious relationship between "strong"αs1-casein genotypes and contents of fat and protein in milk was reported (Barłowska et al. 2007).
c. Genetic variants of αs1-casein are not only associated with the protein contents in milk but also with their quantitative proportions both within αs1-casein and the rest of proteins from casein group.
d. Milk from goats with "strong" alleles of αs1-casein contains more Ca and Zn (Krzyzewski et al., 2002).
e. Significantly higher degree of hydrolysis of protein was determined in the milk of goats characterized by "weak" variants of αs1-casein (Ryniewicz et al., 1998)

**Sheep**:

Most studies conducted on ovine milk concern the association of polymorphic variants of αs1-casein, β-casein and β-lactoglobulin on the chemical composition of milk.

1. Sheep with CC genotype of αs1-casein are characterized by higher contents of base composition.
2. Milk obtained from CC homozygotes of αs1-casein contained significantly more protein and dry matter in comparison to AC and BC heterozygotes.
3. BC genotype of α1-casein was associated with a higher milk production (Mroczkowski et al., 2002).
4. AB heterozygotes of β-casein corresponded to a higher milk production whereas AA homozygotes correspond to higher contents of protein and dry matter (Mroczkowski et al., 2004).

**The modification of milk composition through genetic engineering**

In dairy biotechnology, genetic engineering plays a major role in modifying the chemical composition of milk in order to increase the health benefits and technological parameters of milk. The mammary gland is a bioreactor which allows manufacturing of proteins of foreign species. Introduction of new or the development of existing milk protein genes may helps in altering milk composition and favours the increase in nutritional value of milk and also improve the properties of milk which may be useful as a raw material in processing industry (example by genetic modification of milk it is possible to increase the heat resistance). It is also possible to use the process of "humanization" of cow's milk by the partial replacement of the cattle proteins with those of a human. An important modification of milk is a reduction of lactose contents which adversely affects the quality of cheese and other dairy products and is not well tolerated by many people as a food ingredient. The decrease of lactose contents in milk may be achieved by inactivating or reducing the expression of α-lactalbumin gene or by introducing active in the mammary gland lactase gene or bacterial β-galactosidase gene (*lac*Z gene). Studies are also conducted towards reducing or eliminating the contents of the main allergen of cow milk, which is β-lactoglobulin, through the inhibition of expression of BLG gene (*knock-out*). This protein is not present in human milk. The progress in the identification of genetic engineering methods utilized in dairy biotechnology will depend, in the near future, not only on the development of molecular biology but mainly on the social acceptance of the research in this area.

## CONCLUSION

The great variation highlighted in the genes, proteins, and peptides that are so important for dairy production is a crucial element in providing milk with different properties at the level of the protein system. This is important for technological use and nutraceutical value of dairy products. Designing milk with different protein structures appropriate for its specific use is becoming more and more feasible for dairy industry and is an important task for animal geneticists to improve finally the economic income of dairy farmers.

Eventhough many milk producing farm animals are present, excessive milk protein polymorphisms in cattle has been studied extensively, it is growing continuously with aim

- To discover further new variants
- Characterisation of new variants
- To understand the role of new variant on productive, nutritional and technological properties.

# *Bos Frontalis*: Pride of Arunachal Pardesh

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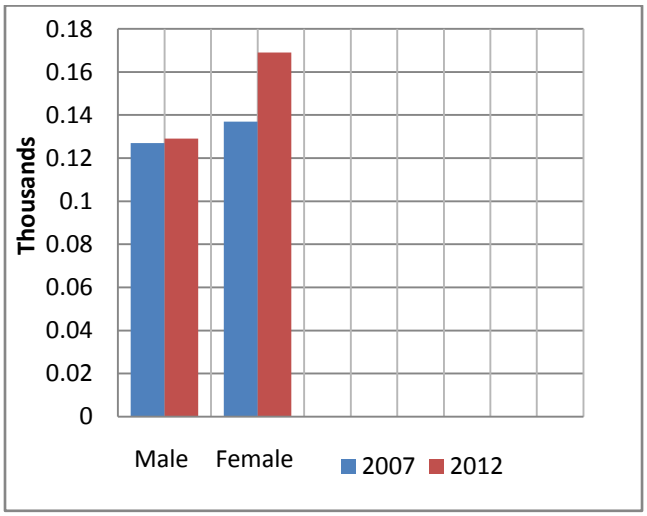
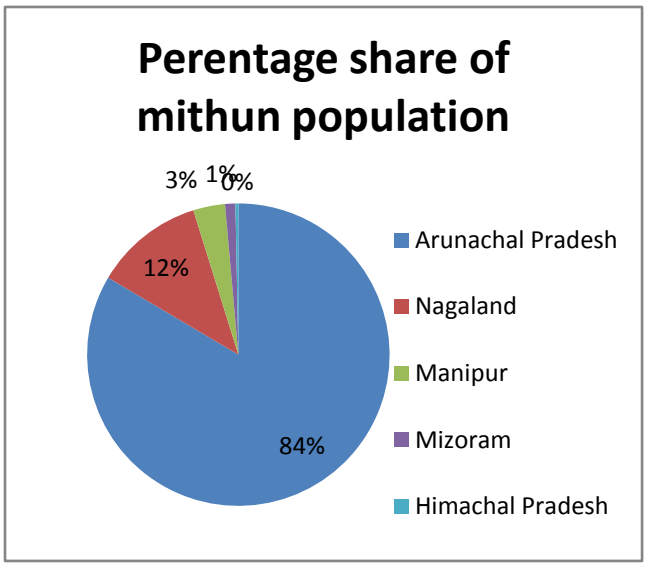
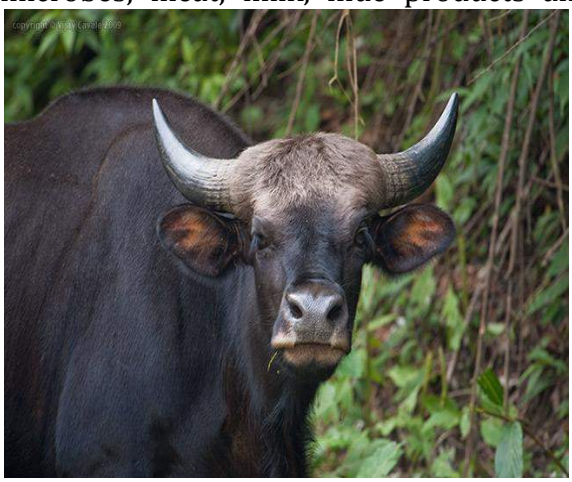
*Bos Frontalis*, a atypical bovine species of the North-eastern Hill Region of India and some parts of Bangladesh, northern Burma and in China. It is commonly known as Mithun. Being possessing many cultural importance and Mithun is considered as a status symbol for tribal people. According to 2012 census, Arunachal Pradesh has having about 83.48 per cent of total population, contributing (2,49,000) of its total population (about 2,98,264) in the country, Nagaland is with second highest population of 34,871. The total population of Mithun in India has been increased to 0.29 million in 2012 from 0.18 million in 1997. In India, there are four strains of mithun are found in india these are categorized on the bases of distinct they belong i.e. Arunachal strain, Manipur strain, Mizoram strain and Nagaland strain. These different strains are distinguished by their distinct physical and genetic features. Mithun are normally found at elevated forested areas ranging from 300 to 3,000m above sea level. Forest cover in Mithun rearing states showed declining trend touching 9.3 million hectare in 2009 from 11.9 million hectare of 1997.

**Mithun Population In India (Graph-1& Pie chart-1)**



There is ample scope for improvement in this species in various aspects like reproduction and production traits, rumen microbes, meat, milk, hide products and



disease resistance. Now a day's animals of this species are facing many challenges for the existence like inbreeding, crossbreeding with cattle and habitat destruction due to wrong agricultural practices.

**Economic significance of mithun rearing**

Mithun usually reared in semi domesticated condition in the jungle. Mithun produces around 1-1.5 kg milk per day per animal. Consumption of the Mithun milk is not a routine practice among the tribal people;. It contains 3.4 to 17 per cent of fat, 6.8 to 22.2 per cent SNF and 4.4 to 9.8 per cent protein. Mithun is a colossal bovine with average body weight 450 kg. Mithun is mostly used as a sacrificial animal in many customary rituals.

The concentration of growth hormone in Mithun's blood plasma is 30- 90 ng/ ml which is much higher as compare with other livestock animals due to which have rapid growth rate of 300-600 gm per day. Meat of mithun is delicious and known as beef. The dressing percentage of mithun varies according to age. At the age of 4-5 years maximum dressing percentage is 45-55 per cent. The hide of this animal is commonly consumed by the people along with meat. Mithun hide and skin are having more value in tanning industry due to their toughness and longevity, therefore utilized for the production of high quality goods like shoes, garments, bags, jackets, purses, attractive ornamental things and furniture covers etc. Mithun is used as meat animal

and sacrificed occasionally for religious and social ceremonies.

**Rearing systems of mithun**

Mithun usually reared in free range system. Practice of rotational grazing by shifting their animals from one region to other hilly areas of the mountains is also seen. The tribal people usually do not provide any additional balanced ration. Mostly mithun owners keep these animals in a community herd and assassins mithun grazer to take care of their animals under free range conditions. Wooden materials which are locally available are used for constructing houses. The space requirement is 5-6 square meters for young mithun and for the adult mithun it is approximately 8-9

square meter. Mithun are completely depending on the pasture land and available jungle fodder. Mithuns are normally browsers rather than grazers therefore it doesn't require pasture land like other bovines. Mithun feed on leaves forest trees, young plants and grasses.

In order to avoid the mineral deficiency salts are provided for licking in the form of mineral blocks near water sources is the common practice in hilly region. In the flush season they get abundant of green fodder in the form of grass, herbs and shrubs, whereas during the lean period there is a scarcity of feed and higher amount of concentrate ration is required to be done to feed animal. The concentrate ration is having 15 percent crude protein and 70 percent total digestible nutrient fortified with mineral mixture. For lactating Mithun require no additional feed as they are low milk producer animals. The animals under semi-intensive system may be provided the feed and other supplements in the shed in late evening and early in the morning. The total water requirement is approximately 9-12 percent of body weight. For better production and performance scientific feeding is required.

**Breeding practices in Mithun**

Mithun is having no definite breeding season. Mithun bred throughout the year. Mithun is polyestrous animal. The adult female shows estrus cycle in every 19-24 days. It is difficult to detect heat in Mithun females by clinical symptoms as the expression of estrus behavior is silent. The standing heat period of 4-16 hours ranging is seen. Most important problem this species face is inbreeding in hilly areas. This problem of inbreeding can be easily solved by replace the breeding bull once in a 3-5 years. In Mithun the ovulation takes place between 28-32 hours after the onset of estrus. Tribal people commonly bring back the pregnant mithun female before parturition and after parturition send it back to jungle. The first mithun calf (mohan) born from cryopreserved mithun embryo at national research center on mithun, jharnapani, nagaland, india on May 12, 2012. Embro transfer technology is imported in mithun breeding since past 5 years in NRC (mithun), jharanpani along with other breeding strategies.

**Table-1:Average of various Reproduction parameters**

| | |
|---|---|
| **Age at puberty** | 18-24 months |
| **Age at first calving varies** | 35-40 months |
| **Gestation period** | 290-320 |
| **Service period** | 50-100 days |
| **Calving interval** | 400 days |

**Physical and Chemical Properties of Leathers**

The skin of mithun was removed manually after slaughtering the animals and used for the production of good quality leather. Physical characteristics like tensile

strength, grain crack strength and ball bursting strength of bag leather were higher in mithun leather, showing unique in strength properties compared to cattle leather. The chemical analysis showed that the bound organic matter, protein and chromium content were more in mithun leather compared to cattle leather. Superior physical and chemical property of mithun leather is because of better genetic potential in mithun for production of good quality leather).

**Diseases**

As other bovines Mithun suffers from various infectious diseases like Foot and Mouth disease (FMD), Infectious Bovine Rhinotracheitis (IBR), Bovine Viral Diarrhea, Tuberculosis, Para-tuberculosis and Brucellosis. Proper attention should be given the disesease prevention programmes like regular deworming and vaccination for keeping animal healthy. Treatment of ailing animal is required to keep the Heard healthy. Infestation of leech is common in mithun, and treatments using Ivermectin injection is usually done if left untreated Death may occur. Other non-infectious diseases like tympany, anemia, debility, hypovitaminosis are very commonly observed and needs proper attention and supplementation of essential feed suppiments to overcome these ailments.

## FUTURE PROSPECTIVE

As per livestock census 2012, there is continuous increase in past years of mithun population in India. Considering commercial potentialities, It is expected that demand of mithuns will increase in the near future all over the world. Mithun milk have ample of scope for preparation of different delicious milk products as it is superior from nutrition point of view compare to other livestock species. Besides, Mithun hide and skin bears very good quality comparing leather having more value in tanning industry. Due to its toughness and longevity, it is utilized for the production of many utility and ornamental goods. Expensive leather products made up of Mithun leather fetch good price in national and international market. Mithun being the endemic species demands the timely care and attention at all levels. Trend of past few years shown that the uses of Mithun is shifted towords more commercial than cultural purposes. Hence, there is an urgent need to conserve this rare animal. Genetic resource of the Indian origin have great significance and require the appropriate conservation programmes. Strong innovative steps are to the demand of present situation to provide suitable package of practices or the scientific innovatives to the mithun rearers to exploit its inbuilt potentials of milk, meat and work power in the hilly states, particularly Arunachal Pradesh, where the mithun considered as pride animal.

# Assessment of Crop Residues as Livestock Feedstock for Biobased Economic Farming

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India is an agrarian country and generates a large quantity of agricultural wastes. Indian agriculture produces about 500-550 million tonnes (Mt) of crop residues annually. This amount will increase in future as with growing population there is a need to increase the productivity also. Agricultural residues are the biomass left in the field after harvesting of the economic components i.e., grain. Large quantities of crop residues are generated every year during harvest periods and also processing of farm produce through milling also produces large amount of residues. These residues are used as animal feed, thatching for rural homes, residential cooking fuel and industrial fuel. However, a large portion of the crop residues is not utilized and left in the fields. The disposal of such a large amount of crop residues is a major challenge. The residues of rice, wheat, cotton, maize, millet, sugarcane, jute, rapeseed/mustard and groundnut crops are typically burnt on-farm across the country. The open field burning of rice straw and other crop residues emits species such as $CO_2$, nitrous oxide ($N_2O$), CH4, CO, non-methane hydrocarbons (NMHC), NO*x*, $SO_2$, particulate matter (PM) and few others species. Researchers found that most of the particulate released due to agriculture crop residue burning (ACRB) are smaller than 10 microns ($PM_{10}$), and easily enter into the lungs.

**Generation and Use of Crop Residues in Indian Agriculture**

According to Ministry of New and Renewable Energy (MNRE), Govt. of India approximately 500 Mt of crop residues are generated every year. Depending on the crops grown, cropping intensity and productivity in different regions of India, there is a large variability in generation and end use of these crop residues (Fig 1 and 2). The crop residues generation is the highest in Uttar Pradesh (60 Mt) followed by Punjab (51 Mt) and Maharashtra (46 Mt). Among different crops, cereal crops generate 352 Mt residues followed by fibre crops (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt). The cereal crops (rice, wheat, maize, millets) contribute 70% (rice 34% and wheat 22%)

of crop residues. Among fibre crops, cotton generates maximum (53 Mt) with 11% of crop residues. Coconut ranks second among fibre crops with 12 Mt of residues generation. Sugarcane generates 12 Mt i.e., 2% of crop residues (comprising of tops and leaves) in India. A large amount of residues are, in addition, generated from fruit, vegetable and fodder production.

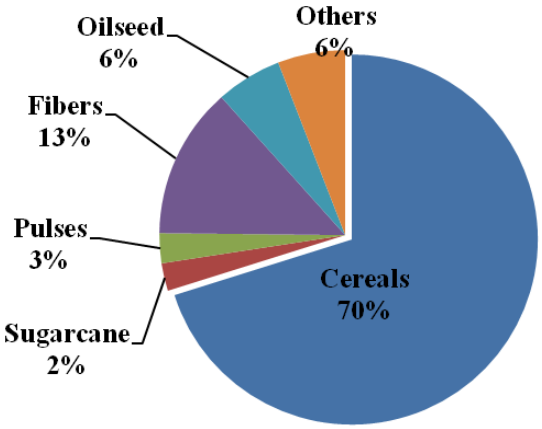


*Fig. 1. Contribution of various crops in residue generation in India (MNRE, 2009)*

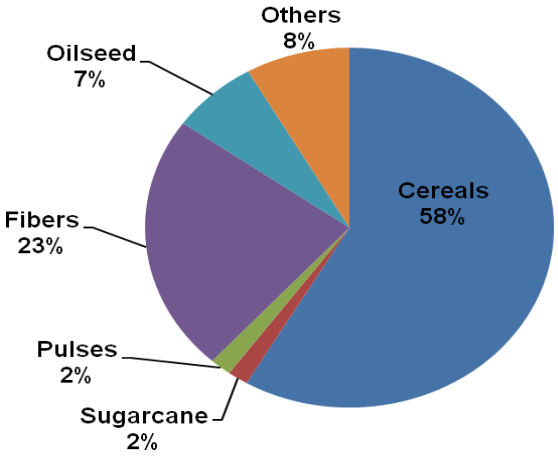


*Fig.2. Surplus of various crop residues in India (MNRE, 2009)*

The unutilized crop residues i.e., total residues generated minus residues typically used for various purposes are burnt on-farm. Estimated total crop residues unutilized in India is 84-141 Mt yr-1 where cereals and fibre crops contribute 58% and 23%, respectively. Sugarcane, pulses, oilseeds and other crops contribute to the remaining 19%. Out of 82 Mt surplus crop residues from the cereal crops, 44 Mt is from rice crop followed by 24.5 Mt from wheat crop, which is mostly burnt on-farm. In case of fibre crops (33 Mt of unutilized residues) approximately 80% is cotton residues and are subjected to on-farm burning (Table 1).

*Table 1. Crop residue production in India (Ministry of Agriculture, 2010-11)*

| Crop residues | Million tonnes |
|---|---|
| **Paddy Straw** | 122.21 |
| **Wheat Straw** | 97.76 |
| **Cereal Straw** | 52.01 |
| **Sorghum Stover** | 27.16 |
| **Bajra Stover** | 37.52 |
| **Maize Stover** | 60.09 |
| **Gram Haulms** | 29.48 |
| **Pulses Haulms** | 11.94 |
| **Groundnut Haulms** | 13.62 |
| **Mustard Straw** | 14.86 |
| **Sunflower Straw** | 20.94 |
| **Oil Seed Straw** | 6.26 |
| **Cane Tops** | 84.18 |

There are large uncertainties in the data on generation of crop residues, their uses, the remaining surplus and on-farm burning. Besides the estimates of MNRE (2009), Pathak (2004) estimated that annually about 525 Mt crop residues are available in India, out of which about 125 Mt are surplus. Pathak *et al*. (2010) estimated that about 90 Mt of crop residues are burnt on-farm and this figure is close to 85 Mt when the coefficients developed by the Inter-

Governmental Panel on Climate Change (IPCC) are used.

## CURRENT USES OF CROP RESIDUES

The crop residues are used as animal feed, composting, thatching for rural homes and fuel for domestic and industrial uses. Main conventional uses of cereal straws are given below,

Within Agricultural sector:

- Soil improver
- Animal fodder supplement
- Animal bedding
- Mushroom production (growth substrate)
- Frost prevention in horticulture
- Strawberries (preventing damage to the fruit)
- Compost industry

Outside the Agricultural Sector:

- Thatching
- Traditional building materials, fibre boards,
- Insulation material
- Energy (heat, power, fuels)

**Advantages and Disadvantages of using Crop Residues as Livestock Feedstock**

Among the crop residues, rice straw and wheat straw constituents the major part which can be utilized as feedstock in the ration of livestock. The following is the assessment of various aspects of rice straw and wheat straw, when used as a feedstock for the bio based economy, as discussed.

***Strengths***

- Rice straw and Wheat straw are available in many countries around the world
- Rice straw and wheat straw are the most abundant agricultural residues in the world (next to residues from maize production, and sugar cane)
- Straw is a "Non-food" feedstock: it does not play a large role in current food or animal feed markets
- Straw exhibits a high cellulose content
- In general terms, there is a positive environmental impact of using straw, especially when straw collection and use replaces open field burning

***Weaknesses***

- There are high Costs associated to collection, handling, and transport of straw
- Straw has a high carbon to nitrogen ratio, and low degradability
- The high ash concentration makes straw less attractive compared to clean wood and biomass grasses, as fuel
- The ash composition of straw, make straw less favourable compared to wood or biomass grasses (in particular for thermal conversion)
- Nutrients are extracted from the field when straw is collected on annual basis, these need to be replenished
- In many countries the supply chain of straw is very fragmented (especially in developing countries with small farm sizes)

***Opportunities***

- Increased grain production in the world leads to more straw being produced
- Increased legislative efforts to ban open field burning of straw will make straw available for the bio based economy
- Development and implementation of technologies for 2nd generation bio fuels may lead to a higher demand for straw
- Limiting 1st generation bio fuels in favour of 2nd generation bio fuels may increase demand for straw as a feedstock

- Straw is an underutilized by-product which means that it offers an opportunity to produce bio fuels without concerns for competition for food and indirect land use changes

**Improvement of poor quality roughages**

The crop residues especially straws are low in available energy, nitrogen, minerals and vitamins. The straws are not readily consumed and their utilization is limited by the low voluntary intake. When these straws are fed alone, they cannot sustain effective animal production, since these are consumed in very less amounts (1.5% of body weight). To improve the nutritional as well as palatable quality of these straws, there are various methods:

1. Supplementation with deficient nutrients
2. Enrichment with urea and molasses or supplementation with urea molasses liquid supplements
3. Ensiling with animal waste such as faeces and urine
4. Supplementation with green roughages either leguminous or non leguminous
5. Supplementation with legume straws
6. Different Treatments

Physical treatment of straws

1. Chopping
2. Grinding,
3. High pressure high temperature method,
4. Soaking,
5. Pelleting,
6. Wafering
7. Irradiation

Chemical treatment

1. Alkali treatment – NaOH, Ca (OH) $_2$, KOH, $NH_4OH$
2. Ammonia- Gaseous, Aqueous, Urea-Ammoniation
3. Acids- $H_2so_4$, $Hno_3$
4. Salts – NaCl, $Na_2CO_3$
5. Gases- chlorine, $SO_2$
6. Oxidizing agents – $H_2O_2$, $O_3$

Biological treatment

1. Fungi
2. Enzymes

Physico- chemical methods- combination of physical and chemical methods

**Densified Total Mixed Ration Block/ Densified Complete Feed Block Technology**

Feed blocks are a solidified block of agro-industrial by-products or mixed feeds used for feeding animals. A complete feed block would contain feedstuffs and mineral and salt mix to provide all nutrients in a balanced manner. A complete feed block is nothing, but a TMR presented in a block form. Straw or crop residue based densified complete feed blocks are gaining momentum in India and other developing agrarian countries. The DTMRB technology has mostly been developed in India, through the collaborative efforts of animal nutritionists and feed technologists. Since the fibrous crop residues are low density feeds, apart from difficulties in its handling and transportation, making a densified block from this loose and lighter stuff is challenging. The first step in the process of making straw based feed blocks is the grinding of concentrate ingredients, followed by their mixing and addition of the feed additives. This is then followed by mixing of these ingredients and straw in proper proportions along with addition of molasses in a specifically designed TMR

mixer, taking care that mixing is uniform and ingredients are not separated due to gravity. Finally, the weighed quantity of the mixed stuff is transferred into a hydraulic press to get the final product – the DTMRB.

**Advantages of the DTMRB Technology**

The densified complete feed block technology offers a variety of benefits to the farmers and the feed manufacturers. This could be a

1. Promising technology for the regions where there is a perennial shortage of green forage and the dry forage is also in short supply and is being transported from outside.
2. A promising way to feed a balanced ration to ruminants
3. An efficient nutrients delivery system – less feed wastage
4. Time as well as labor saving – respite to women
5. Feed as blocks require lesser storage space
6. Densified feed cheaper and easier to transport
7. Better way to manage crop residues and reduce pollution
8. Improved productive and reproductive performance
9. Lesser methane emission from animals
10. Better health status
11. Feed banks can be set up as a pre-emptive disaster management measure
12. Scope for value addition – blocks as a vehicle for medicine or neutraceutical administration
13. Better economic returns through providing stability in feed and milk prices

**Densified Straw Based Feed Pellets**

Recently, a variant of the densified feed block technology has been developed. Using this technology, densified total mixed ration is delivered as pellets and not as blocks. This technology is particularly useful for those materials that are hard. Also it is a useful technology for regions in which feed milling plants are operating at a low capacity and biomass is available in abundance. Straws that are highly lignified with hard fiber can be easily crushed and converted into TMR pellets. Straws of wheat, soybean, mustard and cotton can be used for production of straw-based pelleted feed. The feed pellets may contain 30–35% crushed straw, 10–12% molasses, 35–40% de-oiled rice bran, 10–15% oilseed meals, 1% each of urea and common salt, 1.5% calcite powder and 1% mineral mixture. If 6–8 kg of these pellets is fed per animal per day, it is possible to support body maintenance and 3–4 kg per day milk production. Depending up on the level of milk production, level of roughage component can be reduced and that of concentrates increased. Flat-die has the potential to pelletize almost all kinds of straws having chop length up to 40 mm provided the proportion of straw is maintained below 50% in the feed mixture. Straw internodes are crushed thoroughly and the die of sizes 20 to 32 mm diameter is used in the pellet making plants. Using the device, hay and straws such as bagasse, groundnut shells, cotton balls, maize,

millets, alfalfa etc along with other concentrate feed ingredients such as oil seed meals can be pelletized.

Major benefits of densified feed pellets are:

- Highly lignified biomass can be enriched and densified in the form of pellets which otherwise is difficult to handle.
- Densified pellets are more palatable than the straws/crop residues.
- Because of high bulk density, storage and transportation costs decrease.
- Wastage (up to 20%) is reduced.
- Fire hazards are reduced.
- Shelf life of the biomass increases.

Usually, the biomass with soft stem is considered to be more suitable for making densified feed blocks, while, the biomass that is more hard and lignified can be handled more effectively through the pellet making technology. Pellets can be stored in bulk while blocks always need wrappers or high density polyethylene bags to retain their shape. During long storage sometimes blocks tend to swell back. Also, mechanical aeration and fumigation in bulk stored pellets is easier as compared to blocks, when densified biomass is required to be stored as buffer stock for longer duration of time (2–3 years). Feed pellet units can be used for production of straw-based feed pellets as well as for production of concentrate feed pellets. Straw-based block production units could be in use only for few months after the crop harvest season.

## REFERENCE

Gadde, B., Bonneta, S., Menke, C. and Garivait, S. 2009. Air pollutant emissions from rice straw open field burning in India, Thailand and the Philippines. *Environ. Pollution,* 157(5): 1554-1558

Pathak, H, Bhatia, A. and Jain, N. 2010. Inventory of greenhouse gas emission from agriculture. Report submitted to Ministry of Environment and Forests, Govt. of India.

Walli, T.K., Garg M.R. and Harinder P.S.M. 2012. Crop residue based densified total mixed ration – A user-friendly approach to utilise food crop by-products for ruminant production. FAO Animal Production and Health Paper No. 172. Rome, Italy. pp. 3