TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY

STATE AGRICULTRAL MANAGEMENT AND EXTENSION TRAINING INSTITUTE (SAMETI)

SPONSORED TRAINING ON

DIFFERENT TYPES OF PLANT FEED TOXINS WITH REFERENCE TO LIVESTOCK FARMING AND ITS MANAGEMENT

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Introduction

Poisonous plants are a little group of plants that yield phyto-constituents, which exert harmful causes or effect death either presently or by purpose of cumulative activity of the toxic activity due to presence of known or unknown phyto-chemical principles in it and not by mechanical activity. In order to escape from the predators, plants produce a number of defence characteristics such as excessive secondary metabolites, thorns, spines, bad odour etc., but it will cause some unusual effects on animals which feed on them. It's because of pasture lands are existing with these type of plants.

Phytotoxins

The poisonous quality of complete plant or any plant part may be due to production of phytotoxic substances namely,

- Glycosides
- Phenolic toxicants
- Resins
- Tannins
- Saponins
- Proteins, aminoacids, amines
- Mycotoxins
- Alkaloids
- Carbohydrates
- Chelating poisons, metals, ketones
- Essential oil, picrotoxins, toxalbumins, etc.

Several of which are detrimental to man and animal life, at least under particular conditions. The most of the farmers are aware of the poisoning effect of plant species. They may cause some chronic difficulties like diarrhoea, dizziness, gastrointestinal problems, mouth sores.

A lot of study has been done on the vegetation of Tamilnadu and ethno-medicinal uses of plants but no work has been done particularly on poisonous plants of Tamilnadu

(Francis Xavier *et al.,* 2011; Poongodi *et. al,* 2011). A great number of tribal, shepherds and medicine men of the villages knew about the poisonous plants.

Alkaloids

These are organic basic substances with a bitter taste, examples of which are morphine, atropine, nicotine, quinine and strychnine. The alkaloids generally are irritating to the gastrointestinal tract producing **nausea, colic** and **diarrhoea** and also act on the central nervous system to produce **blindness, muscular weakness, convulsions** and **death**. Toxic alkaloids are found in the following plants; swamp and death camas, lupines, buttercups, marsh marigolds, larkspur, the nightshades, squirrel corn and Dutchman's breeches.

Cyanogenic glycosides

These are not themselves poisonous but in the presence of certain enzymes are hydrolyzed and produce hydrocyanic acid (HCN) which is highly toxic. HCN interferes with the oxygen exchange from the lungs to the body tissues so that various tissues including the brain are starved for oxygen and are consequently injured. The symptoms are **muscle tremors, difficult, rapid respiration** and **convulsions**. Often these are not seen because **death** occurs within minutes.

There are many factors that influence the amount of cyanogenic glycosides in plants. Some plant species normally have high levels, the highest levels occurring in early growth stages and decreasing as the plants mature. Climatic conditions, soil factors, shade and other factors that slow plant growth and development increase cyanogenic glycoside content. Low soil moisture, high nitrogen and low phosphorus all favor HCN production. Wilting, frost and other forms of physical damage to plants may induce a rapid increase in HCN content.

Saponin glycosides

Saponin glycosides produce a violent gastroenteritis with **vomiting, diarrhea** and **colic**. If the saponin glycosides are absorbed into the bloodstream, they cause a breakdown of red blood cells and injury to the central nervous system producing **convulsions** and **paralysis**. This form of glycoside is found in purple cockle, cow cockle, bouncingbet and pokeweed.

Mustard oil glucosides

Mustard oil glucosides found in plants belonging to the Mustard family cause severe gastroenteritis. Symptoms are **severe colic** and **purging.**

Nitrate

Nitrate poisoning of animals is actually nitrite poisoning occurring when nitrate is reduced to nitrite in the gastrointestinal tract. The nitrite is absorbed into the bloodstream where it reacts with hemoglobin to form methemoglobin. This compound, which is brown in color, is incapable of releasing oxygen. In acute cases of poisoning in cattle, 60 to 80% of

the total hemoglobin is comprised of methemoglobin. Sheep generally do not develop as much methemoglobin and are therefore more resistant to this form of poisoning.

The symptoms of acute poisoning are **trembling, staggering, rapid breathing**, and **death**. Chronic poisoning may result in **poor growth, poor milk production** and **abortions**. In cattle, there is evidence that vitamin A storage is affected.

Toxic plants

An example of acute toxicity plants are *Abrus precatorius* seeds causes coma and death as like *Nerium oleander, Jatropha curcas, Ricinus communis* seeds will also cause severe results when animals consume it excessively but consumption of a few seeds will only cause digestive problems.

Actually, the poisonous plants are rich in secondary metabolites so may the activity over medicinal treatment is considerably high. Sometimes the poisonous plants are used for food purposes after processing it. The poisonous plants occasionally used for suicidal purposes. The poisonous parts of great number of plant species were latex, seeds and root. Besides these, poisonous parts of some plants were leaves, flowers, fruits and root bark, tuber, stem bark and sometimes entire plant also.

Management

There are many plants which contain chemicals or which accumulate chemicals that are poisonous to livestock. The results of poisoning can range from minor irritations and slightly lowered animal performance to severe cases where the animal is in a great deal of distress and may die. Clinical symptoms, Diagnosis, treatment and post mortem findings of clinically importance toxic plants poisoning will also be elaborated during the training period.

There are many plant factors that contribute to the toxic principles in plants. Individual plant species and varieties may differ in their poisonous content from early growth to maturity. With some plants, there is an increase in their ability to poison with advanced stages of growth, whereas with others the danger lessens. The state of the plant when eaten may also be important. In some cases, damage to the plant or wilting may produce poisonous chemicals in the plant which were not present in the fresh material.

Animal factors also influence the ability of plants to poison. Different animal species are susceptible to different plants and poisons. The age of the animal is also important. Young animals are often more susceptible than older ones, but it isn't always the case. Animals may build up resistance to certain poisons by being exposed to small quantities at first. Then, if a large quantity is consumed, they are resistant because their metabolism has already adjusted to handle the poison. An animal that is hungry or has certain dietary deficiencies is more likely to eat toxic quantities of a poisonous plant than a well fed animal.

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PLANT FEED TOXINS WITH REFERENCE TO RUMINANTS AND ITS MANAGEMENT

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Introduction

Grazing is a normal routine for Ruminant livestock and while grazing the animals are exposed to a variety of poisonous plants particularly in the dry season when fodder availability is very much reduced in the grazing lands. Moreover, in countries like India grazing is practiced on roadside, communal lands, waste lands and in fallow lands. These areas depend primarily on the monsoon rains for the growth of various inherent plant species that are consumed by ruminants. Scarcity of fodder in these lands during dry seasons force the animals to consume anything which may include poisonous plants. Sometimes exotic toxic plant seeds are imported along with regular grains and these establish in an invasive manner in the areas were the animals are grazed. In some organized farms ruminant livestock are reared under intensive or semi intensive system under these circumstances also the animals could be exposed to a variety of toxins that are naturally present in the feed or acquired in the feed / fodder due to spoilage.

Common plant toxins

Ruminants are exposed to a variety of plant toxins. The ingestion of the toxic plant can lead to different types of adverse effects in the animal concerned starting from loss of appetite, digestive disturbances, and respiratory distress to the extreme of shock and death of the animals. Table 1 provides information on the toxins present in some common plants / shrubs / trees.

Table 1 Toxins present in some common plants / shrubs / trees

S.No	Name of the plant	Toxin	Symptoms of toxicity	Antidote
1.	*Ricinus communis*	Ricin	Cessation of rumination, gastro-intestinal irritation, abdominal pain, diarrhoea, tenesmus, dehydration, muscle twitching, dullness of vision, convulsions, and weakness.	Activated charcoal Intravenous hydration

2.	*Nerium oleander*	Oleandrin, Folinerin and Digitoxigenin	Ruminal atony, moderate tympany abdominal pain, frequent urination, bradycardia, tachycardia, depression, and weakness	Activated charcoal Adrenergic blockers along with atropine
3.	*Abrus precatorius*	Abrin	Gastroenteritis with vomiting and diarrhoea which then leads to circulatory collapse. Animal may exhibit local signs such as conjunctivitis and dermatitis	Activated charcoal Anti-abrin serum
4.	*Lantana camara*	Lantadene A and B	Cholestasis and hepatotoxicity due to the continuous absorption of toxins from the rumen. Photosensitisation develops due to the accumulation of phylloerythrin	Manual removal of the toxic rumen contents Activated charcoal Antihistaminics and antibiotics
5.	Cyanogenic plants Sorghum, Cassava, Sudan grass Plants containing over 200ppm of these glycosides are Categorised as toxic.	Linamarin, Lotustralin, Amygdalin, Dhurrin	Laboured breathing, dyspnoea, restlessness, tremors, terminal clonic convulsions and opisthotonus Death of the animal due to histotoxic anoxia.	Intravenous administration of a mixture containing 1 ml of 20% sodium nitrate and 3 ml of 20% sodium thiosulfate, given at a dose rate of 4 ml mixture per 45 kilogram body weight. In sheep, the recommended doses of sodium thiosulfate @ 660 mg/ kg can be given in combination with conventional doses of sodium nitrite @ 6.6 mg/ kg

6.	Nitrate containing plants Sorghum, Maize, Lucerne, Drought, cold weather, herbicide application, wilting causes the plants to accumulate more nitrate	Nitrate to Nitrite	salivation, tremors, staggering, bloat, dyspnoea,rapid and noisy breathing, chocolate coloured mucous membranes	Intravenous administration of methylene blue
7.	*Pteridium aquilinum*	Thiaminase inhibitors	High fever, with loss of appetite, depression, dyspnoea, excessive salivation, nasal and rectal bleeding, haematuria, haemorrhages on mucous membranes, thrombocytopenia, anaemia, leukopenia, plastic bone marrow and bladder tumors in cattle	Administration of thiamine hydrochloride, batyl alcohol, activated charcoal and saline cathartics
8.	*Leuceana leucocephala*	Mimosine	Hair loss, poor weight gain, hypothyroidism	Cud transplantation from adapted animal
9.	Cotton seed	Gossypol	Respiratory distress, impaired body weight gain, anorexia, weakness, apathy, and death	Heat treatment of cottonseed reduces the concentration of free gossypol
10.	Indigofera plants	Indospicine	loss in body weight and liver lesions Reproductive disorders abortions and stillbirths	-
11.	*Albizia stipulata* *Bassia latifolia* *Sesbania sesban*	Saponins	Frothy bloat	Wilting Washing with water

12.	*Accacia sp* *Terminalia sp* *Albizzia sp*	Tannin	Reduction in feed intake protein, digestibility, decreased wool yield & growth, decreased iron absorption	Alkali treatments include ferrous sulphate and polyethylene glycol-4000 (PEG-4000)

Source : Khan et al., (2019), Cristina et al., (2014), Kumar and Singh, (1984)

Mycotoxins in forages consumed by ruminants

Grazed forage, hay or silages are often contaminated by a wide range of mycotoxins and other fungal exometabolites produced by molds able to infect crops at the pre-harvest stage, during prolonged wilting in bad weather conditions or in silos, piles and bags post-harvest. Cases of performance reduction, illness and other diseases have been often associated with ingestion of mycotoxin contaminated forages. Therefore, it should be strongly recommended to analyze forages not only for nutritive and fermentative characteristics, but also for mycotoxin contaminations (Gallo et al., 2015).

Mycotoxin contamination of forages and cereals frequently occurs in the field following infection of plants with particular pathogenic fungi or with symbiotic endophytes. Contamination may also occur during processing and storage of harvested products and feed whenever environmental conditions are appropriate for spoilage fungi. Moisture content and ambient temperature are key determinants of fungal colonization and mycotoxin production. It is conventional to subdivide toxigenic fungi into "field" (or plant-pathogenic) and "storage" (or saprophytic/spoilage) organisms. *Claviceps, Neotyphodium, Fusarium* and *Alternaria* are classical representatives of field fungi while *Aspergillus* and *Penicillium* exemplify storage organisms (DMello and Macdonald, 1998).

Plant toxin degradation in rumen

Ruminants can develop adaptation mechanisms through rumen microorganisms to neutralise the effects of toxic secondary metabolites. Rumen microbial populations are able to gradually change with prolonged, increasing exposure to toxins, thus allowing gradual tolerance of the toxin in ruminants. Degradation pathways of a toxin in most cases involve a consortium of rumen microorganisms as the enzymes involved may not be present in a single rumen bacterial species. In the case where a single rumen bacterium is capable of toxin degradation, there is a possibility of the presence of distinct microbial strains of the same species in the rumen that contributes to the detoxification process. Ruminal inoculation with ruminal contents from adapted animals, enriched cultures of 3,4-DHP-degrading ruminal bacteria, have been used successfully to establish ruminal populations that are capable of degrading 3,4-DHP and preventing mimosine toxicity. However, toxin degradation by rumen microorganisms does not always result in the detoxification of the toxins. For example, the mycotoxin zearalenone (ZEA) was reported to be degraded by

rumen microorganisms but their metabolites were suggested to be more toxic compared to the parent toxin (Loh et al., 2020)

Factors influencing toxicity

- Plant factors - Individual plant species and varieties may differ in their poisonous content from early growth to maturity. With some plants, there is an increase in their ability to poison with advanced stages of growth, whereas with it is vice versa. The state of the plant when eaten may also be important. In some cases, damage to the plant or wilting may produce poisonous chemicals in the plant which were not present in the fresh material. In other cases, the poison is contained in the fresh plants but not dried ones. Certain parts of a plant may be poisonous and other parts not.
- Animal Factors - Animal factors also influence the ability of plants to poison. Different animal species are susceptible to different plants and poisons. The age of the animal is also important. Young animals are often more susceptible than older ones, but this is not the case always. Animals may build up resistance to certain poisons by being exposed to small quantities at first. Then, if a large quantity is consumed, they are resistant because their metabolism has already adjusted to handle the poison. An animal that is hungry or has certain dietary deficiencies is more likely to eat toxic quantities of a poisonous plant than a well fed animal.

Conclusion

Prevention of consumption of poisonous plants is vital to safe guard grazing ruminant health. The most important aspect in prevention is by not allowing animals' access to plants which may cause poisoning. This may be difficult in the case of plants which are normally safe to eat at certain stages of growth but not at others. The known poisonous plants in an area these should either be physically removed or animals should not be allowed to graze there. Well fed animals are less likely to eat poisonous plants than animals which are hungry, hence, in times of drought offering supplementary feed will prevent the animal from consuming poisonous plants. During feed scarcity, there may arise a need to include some forages that are likely to contain toxins in the ration of animals, in such a scenario the concept of dilution can be practiced wherein the forage may be fed in small quantity, along with forage without toxins.

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TOXIC PLANTS & FEED TOXINS WITH REFERENCE TO MONOGASTRIC ANIMALS AND ITS MANAGEMENT

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Introduction

Pigs that are kept as livestock usually avoid eating poisonous forage plants. These plants tend to taste bitter, so pigs only eat them as a last resort if all other forage plants are eaten or destroyed.

Table 1: Poisonous symptoms of some toxic plants in horse and pig

Sl.No.	Scientific name	Tamil Name	Uses and poisonous symptoms
1	*Abrus precatorius* Linn.	Kundumani	Seeds is poisonous causing vomiting, cardiac poison, paralysis, gastroenteritis with purging and temperature fluctuation followed by death. Seeds are eaten by livestock, it causes vomiting, severe diarrhoea and weakness.
2	*Alangium salvifolium*	Alangimaram	Root bark decoction given internally in minute doses causes depresses heart; in large quantities produces unusual respiration.
3	*Argemone mexicana* Linn.	Pirammathandu	Fruits and seeds are narcotic. Fruits and seeds consumption in higher amount causes poisoning. If consumed by animals causes diarrhoea.
4	*Calotropis gigantea* R.Br.	Yerukku	Latex is given internally in fatal; The latex is injurious to eyes, causing blindness. It is used as fish poison.
5	*Cascabela thevetia* (L.) Lippold	Ponnarali	Seeds is highly poisonous; used for suicidal purposes. Seeds are used to poison and kill enemy's animals. Intake of seeds causes vomiting, burning and numbing sensation in mouth and throat.
6	*Cleistanthus collinus* (Roxb)	Oduvan	Leaves is extremely poisonous; used for suicidal and homicidal purposes. It is also used as animal and fish poison.

7	*Cuscuta reflexa* Roxb.	Sadathari	Plant extract causes abortion and vomiting. Villagers and tribals mix the plant with fodder to kill enemy's livestock
8	*Datura metel* Linn	Oomathai	Entire plant is poisonous. Fruits and seeds are toxic and used for committing offences. The leaves, fruits and seeds extract causes giddiness, fatal poisoning, dryness of throat,
9	*Gloriosa superba* Linn.	Kalappaikkilangu	Tuber decoction mixed with sugar is used as abortifacient. Intake of the tuber is vomiting, respiratory poison and fatal.
10	*Jatropha curcas* Linn	Kattamanakku	Latex is injurious to eyes. Leaves and seeds are purgative. If consumed by livestock or human beings particularly children, sense of burning in stomach and vomiting.
11	*Lantana camara* Linn.	Unnichedi	Eaten of animals causes severe injurious to liver, loss of appetite, weakness, failure of blood circulation and death.
12	*Melia azedarach* Linn.	Malaivembu	Leaves is poisonous, used for insecticide. It causes nausea, irritation and degeneration of the kidney and liver.
13	*Nerium oleander* Linn.	Sevvarali	Root and root bark are poisonous, causes cardiac poison, used for criminal and suicidal purposes. Seeds are used to poison and kill enemy's cattle.
14	*Parthenium hysterophors* Linn	Parthenium	Whole plant is poisonous. Leaves, flowers, fruits and seeds causes allergic dermatitis and eczema on contact. The plant when eaten by animals causes diarrhoea and death.
15	*Ricinus communis* Linn.	Aamanaku	Larger quantities of seed oil is poisonous causes fatal, diarrhoea, weakness of body and slow irregular pulse, kidney and liver damage, abdominal pain, allergic reaction of large sensitivity and vomiting in little amount treat constipation. The young leaves when eaten by goat cause severe diarrhoea followed by death.

16	*Strychnos nux-vomica* Linn	Yettikai	Leaves, stem bark, fruits and dried ripe seeds are poisonous causing spinal poison, severe vomiting, slow irregular pulse followed by death.

PLANTS TOXIC TO HORSES

Bracken fern

It contains thiaminase, which inhibits absorption of thiamin, which is vitamin B1. Thiamin is necessary to nerve function, and deficiencies can lead to neurological impairment. The relative toxicity of individual leaves is low—horses must consume hundreds of pounds to experience ill effects. However, bracken fern is unique among the toxic plants in that some horses seem to develop a taste for it and will seek it out even when other forages are available. Signs are related to neural dysfunctions resulting from vitamin B1 deficiency and can include depression, incoordination and blindness.

Large doses of thiamin over the course of a week or two can aid in the recovery of horses whose bracken consumption is discovered before the neurological signs are severe.

Sudan grass (Sorghum fodder)

The leaves and stems of Sudan grass contain a cyanide compound, which when metabolized inhibits the body's ability to absorb oxygen, in effect suffocating the animal; young shoots of grass contain the highest concentration of the toxin. Because horses do not metabolize the cyanide compound as efficiently as ruminant animals do, grazing healthy adult plants is unlikely to harm them, but circumstances that injure the plant—wilting, trampling, frost—can chemically liberate the cyanide within the leaves, rendering them dangerous to all species. Cultivated hybrids of Sudan grass typically contain less cyanide, if any. Both species can also accumulate toxic levels of nitrates if over fertilized. Cyanide concentration drops to safe levels when the grasses are cured for hay, but nitrates, if present, do not.

Signs are consistent with cyanide poisoning. The first indication is rapid breathing, which progresses to tremors, frequent urination and defecation, gasping and convulsions. Supportive drug therapy can offset the effects of less severe cyanide poisoning.

Oleander (Nerium oleander)

All parts of the plant contain the toxins oleandrin and neriin, which disrupt the beating of the heart. The leaves remain toxic when dried. About 30 to 40 leaves can be deadly to a horse.

Effects are usually seen several hours after ingestion and last over 24 hours. Signs include colic, difficulty breathing, tremors, recumbency and an irregular heart rate. The pulse may be either slowed or accelerated.

Horses can survive if treated early with supportive care, such as the administration of activated charcoal to inhibit further toxin absorption and the use of anti-arrhythmic drugs to stabilize the heart.

Yew (Taxus spp.)

All parts of the yew plant, except for the fleshy portion of the berries, contain taxine, an alkaloid that causes respiratory and cardiac collapse. The leaves remain toxic even after dried. A single mouthful can be deadly to a horse within minutes. Sudden death is the most typical sign of yew ingestion. Animals found alive may be trembling and colicky, with difficulty breathing and a slowed heart rate. There is no treatment for yew poisoning. Avoidance is critical; most yew poisonings occur when trimmings are thrown into a pasture after a pruning.

Trees

Equally toxic are cherry (black cherry, chokecherry, and fire cherry) peach and plum trees, all members of the Prunus species. These leaves also produce cyanide when wilted, affecting horses within a few hours of ingestion.

Foods can cause horse problems and can cause them to become very ill are

- Tomatoes.
- Garlic & Onions.
- Chocolate.
- Dairy Products.
- Bread Products.
- Meat.

Vegetables

If your horse consumes any of these three things in excess (**Cauliflower, Cabbage, Broccoli**), then it can lead to very bad gas and colic problems that could hurt them. Better to avoid these three vegetables.

Feed toxins of pet animals

They are very few foods which are inherently poisonous to dogs and cats.

Sl.No.	Type of food ingredients	Clinical symptoms
1.	Onion & garlic	Haemolytic anaemia / haemoglobinuria
2.	Cocoa	Vomiting, diarrhoea, tachycardia, ataxia, depression. 300 g of chocolate- death

3.	Benzoic acid	Hyperaesthesia and death
4.	Mushroom	Salivation, vomiting and Diarrhoea
5.	Algae	Water contaminated with blue-green algae. Hepatotoxins

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TOXIC MINERALS WITH REFERENCE TO LIVESTOCK AND POULTRY FARMING

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Introduction

Mineral elements are essential for animal health, survival and production due to their participation in physiological, structural, catalytic and regulatory functions of animal organism (Underwood and Suttle, 2001). These minerals should be balanced in the feed of animal. When these minerals are ingested in excessive doses by animals, they may cause acute poisoning, that occurs soon after ingestion, or may cause chronic poisoning, when animals ingest toxic doses constantly but at lower concentrations than those that cause acute poisoning, which can lead them to death. Toxic minerals, the term describes those minerals that present a certain risk to public (Human & Animal) health such as Lead, Arsenic, Cadmium, Mercury, Molybdenum, Copper, Selenium.

Toxic Minerals

Heavy metals have largest availability in soil and aquatic ecosystem and to relatively smaller proportion in atmosphere at particular vapors. These heavy metals are persistence, accumulate and not metabolized in other intermediate compounds and do not easily breakdown in environment. These metals are accumulating in food chain through uptake at primary producer level. Metals are entering the human and animal body either through inhalation or injection.

Ingestion of excessive mineral doses by animals can occur on several ways, as: mistake in balancing mineral supplements and/or complete feed, intake of plants that have high mineral concentration or it can be still obtained by use of fertilizers, herbicides, insecticides and fungicides on pasture or tillage where plants and/or grains will be used for animal feed. Moreover, decomposition of urban and industrial wastes, leaks and accidental spills of pollutants may result in accumulation of toxic mineral in the environment (Pereira, 2001).

Toxic Minerals: Sources and Maximum Permissible Level in Animal Feed

Toxic mineral	Sources	MPL in animal feed
Lead	a) Improper disposal of lead articles: Automobile battery casings, used batteries, oil lead paints, greases, etc. b) Industrial effluents (lead smelters): fumes contain lead oxide, which gets deposited in herbage and also contaminates water resources. c) Automobile exhausts: petrol contains tetraethyl lead and tetramethyl lead (antiknock ingredients). d) Drinking water supplied through lead pipes. e) Ingestion of plants treated with insecticide lead arsenate.	5 mg/kg
Arsenic	a) Release of arsenicals from Cu, Pb and Zn smelters: Contamination of herbage and water. b) Effluent water from thermal power plants: Contamination of herbage and water. c) Use of arsenicals as herbicides/weedicides, seed/grain dressings or wood preservatives. d) Use of arsenical dips for control of ectoparasites in sheep. e) Use of organic arsenical feed supplements as growth promoters. f) Inadvertent use of arsenicals as anthelmintics. g) Use of arsenicals in manufacture of computer chips and semiconductors.	2 mg/kg
Mercury	a) Contamination of herbage and water by mercurial effluent from metallurgy b) Accidental ingestion of seeds treated with mercurial fungicide and seed dressings c) Inadvertent use of mercurial ointments for skin lesion.	0.1 mg/kg
Copper	a) Ingestion of forage sprayed with $CuSO_4$ fungicide. b) Contamination of water and forages near Cu mines and processing industries. c) Feeding poultry droppings (as NPN source) from chicken treated with $CuSO_4$ d) Improperly blended salt licks or mineral mixture with high copper salts low in molybdenum or inorganic sulphates.	Horse- 800 mg/kg Pig- 250 mg/kg Cattle- 100 mg/kg Sheep and poultry- 25 mg/kg

Selenium	a) The consumption of plants that have high concentrations of selenium such as *Astragalus*, *Stanleya*, *Oonopsis* and *Xilorrhiza*. b) Due to soil and pasture contamination by industry wastes with high selenium concentration, c) Scarcity of rain also predispose animals to selenosis because during dry period does not occur selenium leaching from the soil, so this mineral accumulates in soil which consequently elevates its concentration in soil and plants.	Varying levels were reported
Cadmium	a) Ingestion of solder alloys, nickel-cadmium batteries, tyres, etc. b) Contamination of feeds/fodder/pastures with sewage and effluents from smelters. c) Indiscriminate use of shampoos containing cadmium sulphide.	0.5 mg/kg
Molybdenum	a) Ingestion of forage and water in Mb rich area. b) Contamination of herbage and water from industries and oil refineries. c) Excessive use of sodium molybdate (plant growth stimulant) in pasture or forage crops.	3 mg/kg

Lead

Lead (Pb) is highly toxic to animals and humans beings and is one of the most dangerous minerals to animal health. It is accumulated in environment by industrial pollution. Cattle are the species which are more frequently affected. When animals are acutely lead poisoned, this mineral is deposited specially in liver, renal cortex, endocrine system and medulla. In chronic poisoning, lead deposition occurs in bones. In addition to these tissues, lead is also deposited in brain, however, in lower concentrations compared to other deposition tissues (Patra *et al*., 2006). Lead is potentially toxic to haemopoietic system. It is also immunosuppressive, teratogenic and nephrotoxic. Common clinical signs are staggering gait, walking in circle, muscle twitching mainly in the head, ear and neck, gnashing of teeth, progressive incoordination of hindlimbs and after recumbency, ataxia, difficulty swallowing, salivation, foaming at the mouth, opisthotonos, colic, green diarrhoea and convulsions. Specific antidote therapy: Disodium calcium EDTA chelates bone Pb by forming a readily excretable complex through kidney (Na-EDTA should not be used), dose: 110mg/Kg divided in 2 treatments S/C or I/V daily for 3 days and repeat the course after interval of 2 days.

Arsenic

Arsenic poisoning is second to lead as the most frequently reported heavy metal toxicant in food producing animals. Arsenic is present in the environment in two forms: inorganic and organic arsenicals. Inorganic arsenic is often incorporated into pesticides, which are the most common sources of arsenic poisoning in cattle. Arsenic toxicity causes loss of capillary integrity and dilation in GI tract which allows transudation of plasma fluids into the intestinal mucosa and lumen with reduced blood volume, hypotension, shock and circulatory loss (Radostits *et al*., 2006). The clinical signs include severe gastroenteritis, colic, staggering gait, extreme weakness, trembling, salivation, vomiting (in dogs, cats and pigs), increased thirst, projectile watery diarrhoea, possible blood in faeces, fast and weak pulse, hypotension, dehydration, oliguria or anuria, rumen atony, hind limbs paralysis, prostration, normal or subnormal temperature, coma and death in 1-3 days. Specific Antidote Therapy (heavy metal chelators) includes

1) BAL (Dimercaprol, British anti-lewisite): 2-4 mg/kg (in small animals 10% solution and in large animals 5% solution in 10% benzyl benzoate in GN oil) I/M three times a day for 2 to 3 days or until recovery.
2) D-penicillamine@ 10-50 mg/kg orally, 3-4 times a day for 3-4 days.

Mercury

Mercury as an environmental pollutant is a major concern today because of increased usage of fossil fuels and agrochemicals, which contain mercury. Mercury in any form is toxic. Organic mercurial compounds, due to their high affinity for sulfhydryl groups, combines with several membrane and intracellular proteins. They interfere with metabolic activity and prevent synthesis of essential proteins, leading to cellular degeneration and necrosis. Their most important target is brain. Inorganic mercurial salts cause direct tissue necrosis and renal tubular necrosis (Radostits *et al*., 2006). Acute exposure caused by inhaled elemental mercury can lead to pulmonary signs, which may progress to an interstitial pneumonitis with severe compromise of respiratory function. Chronic exposure of elemental mercury mainly causes neurological signs like depression, irritability, excessive shyness, vasomotor disturbances, salivation, gingivitis and tremors. Specific antidote therapy includes BAL@ 3 mg/kg I/M every 4 hr on first 2 days, every 6 hr on third day and every 12 hr for next 10 days or until recovery. D-penicillamine at 15-50 mg/kg orally can also be given.

Copper

Copper is an essential mineral element, being part of various enzymes and proteins. However, it is extremely toxic when ingested in excess. Copper is widely distributed in nature, being used in its various forms, and copper sulphate is used in agriculture as pesticides, fungicides and herbicides. Cattle and sheep are more susceptible to copper poisoning probably due to have lower efficiency to excrete copper. When copper is in excess binds to albumin forming a complex albumin-copper that is the active toxic

fraction. Then it rapidly accumulates within red cells that cause oxidative damage and intravascular haemolysis (Radostits *et al*., 2006). The poisoned animals may present the following symptoms: salivation, dehydration, depression, haemoglobinuria, abdominal pain, gastroenteritis with excessive blue-green diarrhoea or bloody faeces, hypothermia, tachycardia, jaundice, walking in circle, paralysis, ataxia, dyspnoea, shock and death. Daily feeding of ammonium molybdate @50-100mg and sodium sulphate @250-1000mg per animal for about 3-6 weeks will ameliorate the toxic condition.

Selenium

Selenium (Se) is an essential micromineral to animals and humans. This mineral element is part of several selenoproteins, including glutathione peroxidase (GSH-Px) that acts by removing free radicals, hydrogen peroxides or hydroperoxides and lipoperoxides which are formed during cellular metabolism. When animals ingest high doses of selenium, it can accumulate in organism and the intracellular redox cycle with thiols induces oxidative stress causing damage to cellular components and poisoning by this mineral element in animals and humans (Radostits *et al*., 2006). Chronic toxicity is common. Chronic selenium toxicity causes blind staggers and Alkali disease. Cattle affected by blind staggers have the following symptoms: drooling, pale mucosa, grinding of teeth, walking in circle, corneal opacity, blindness, generalized muscle paralysis (including muscles of tongue and swallowing), respiratory arrest and death. Cattle affected by alkali disease exhibit the following symptoms: poor appetite, staggering gait, anaemia, rough and dull hair, alopecia usually at the tip of tail, deformation of shells, laminitis, claudication and ataxia. There is no specific antidote however, 0.02 % Arsenilic acid in feed or Sodium arsenite in water at 5 ppm level can be given to reduce the toxicity.

Conclusion

Mineral toxicity is generally observed by decreased animal performance, anorexia, weight loss, and diarrhoea. In many cases, mineral toxicity can be overcome by simply readjusting rations to provide minerals at non-toxic levels. In extreme cases, however, mineral toxicity can lead to chronic problems and even death. In addition, indirect effects of an over-supply of minerals may lead to unsafe accumulation of minerals in meat and milk, and may also impact the environment. Excess levels of heavy metals viz., As, Cd, Pb and Hg cause severe toxicity to both human and animal kingdom apart from damaging the environment. Though some heavy metals are essential for animals, plants and several other organisms, all heavy metals exhibit their toxic effects via metabolic interference and mutagenesis. Careful attention should be given to the formulation of mineral supplements, and the specific mineral balance of supplements should account for mineral concentrations in feed and water.

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PLANT FEED TOXINS IN COMMERCIAL / UNCONVENTIONAL FEEDS FOR LIVESTOCK INDUSTRY AND ITS DETECTION

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Introduction

Feeds are the main input for the livestock health and production. More than 70% of the total cost for livestock production is spent towards feeds. Presently, there is a shortage of 36% concentrate and 44% fodder. There are many feeds available on local basis which are not commonly used in livestock feeding. These feeds are not used commonly because of presence of many toxic compounds which indirectly and directly cause harm thereby affectingproduction. The use of unconventional feeds is very limited, either it is included at its safe level or it can be used after processing. Therefore, we can use toxin rich unconventional feeds in safe levels to reduce cost of production and also spare the conventional feeds for livestock feeding.

Toxins present in commercial feed ingredients

Maize

Maize needs to be graded according to size and shape. Maize should be looked for damaged kernels, foreign material, insect infestation and normal color. Moisture (<12%) and mycotoxin analysis is very essential to maintain quality.During cultivation, fungi may infect the maize in flowering stage. Major toxins that contaminate maize preharvest are deoxynivalenol, zearalenone, fumonisins, HT-2, T-2 toxins and Afaltoxins. Avoiding usage of these contaminated maize in livestock feed manufacturing is very important to lower the adverse effect of mycotoxin ingestion.Analysis report of the maize samples used in feed mill at CFTU, kattupakkamindicate that98.40 %, 17.02 %, 1.06 % and 8.51 % of maize samples were contaminated with Aflatoxin B_1, Aflatoxin B_2, Ochratoxin and citrinin, respectively (Nanthini, *et al*., 2016). Nearly 57.3 % samples of maize had Aflatoxin B1 above the FDA regulatory level (FDA - 1994) of 20 ppb. Hence, maize can be checked for aflatoxin, Citrinin, cyclopiazonic acid, Ochratozin.

Sorghum

Tannin analysis in sorghum in terms of catechin equivalents and also screening of mycotoxins are required for evaluating the quality.Small grains like sorghum can be contaminated with *Fusariumgraminarum* which produce Deoxynivalenol, Zearalenone or nivalenol toxic metabolites and it accumulates in the grain during cultivation. Sorghum can also be checked for T2 - toxin, Zearalenone, Citrinin, cyclopiazonic acid, Ochratoxin.

Protein feedstuffs

Soybean meal

Soybean meal quality depends on protein. Soya bean meal contain antinutritional factors like trypsin inhibitor. Consumption of this trypsin inhibitor from soya bean meal cause deleterious effects like reduced growth, low production and pancreatic hypertrophy. This toxin can be detoxified by heat treatment or by flowing steam for 60 min or by autoclaving 5 Lb / in^2 for 45 minutes. Hence, meals are to be checked for proper processing. Over processed samples can be best identified by protein solubility tests in 0.2% KOH i.e.73 to 85% solubility. Urease activity is normally identified for under processed samples. Normal urease activity in properly processed soybean meals will be between 0.01-0.35 pH units.

Ground nut oil cake

*Aspergillusflavus, Aspergillusparasiticus*are the fungi commonly present in groundnut oil cake and produce aflatoxin B1, B2, G1 and G2. Generally, ground nut oil cake is contaminated with 5 -35 µg of aflatoxin. This aflatoxin in contaminated feed stuff is converted and metabolized into AFM1 in milk.

Sunflower oil cake

Sunflower meal contains high levels of cholorogenic acid, a tannin like compound, that inhibits activity of digestive enzymes (trypsin, chymotrypsin and lipase). Addition of methionine and choline are required to counteract the effect of cholorogenic acid. Cholorogenic acid is a precursor of ortho-quinones that occur through the action of the plant enzyme polyphenol oxidase. These compounds react with lysine during processing in the gut. So, the requirement of both lysine and methionine are thus increased when sunflower meal is used in the diet. Generally, sunflower meal is co-contaminated with multimycotoxin like ochratoxin, citrinin and aflatoxin.

Rice bran

Rice hulls contain high NDF (700g / kg). Presence of hulls in rice bran increases both NDF and silica content. Main adulterants in rice bran are mineral powder (limestone) sand, zeolite, tapioca waste powder and paddy husk etc.

Feed ingredients commonly affected by mycotoxins during storage and in field condition

S. No	Feed ingredients	Mycotoxins produced in field	Mycotoxin produced in storage
1.	Maize	DON, Fum, Zea	Zea, Afla
2.	Oats	DON, HT- 2, T- 2, NIV	OTA, Cit
3.	Barley	DON, NIV, Zea, HT-2, T-2	OTA, Afla, Cit
4.	Rice	-	Afla, Sterig, OTA

5.	Wheat bran	DON, NIV	OTA
6.	Cotton seed meal	Afla, Tenua	Afla
7.	Groundnut meal	Afla, Zea	Afla, OTA, Cit
8.	Maize grass	Afla	Roq, Pat, Zea
9.	Rye grass	Spor, Lol, Pasp	-
10.	Tall fascue	Ergot	-
11.	Red clover	Slaf	-

Toxins and its effect

Aflatoxin	Damage liver and causes growth suppressioin
T2 toxin	Oral lesions in poultry
Ochratoxin	Kidney damage Poultry and pigs are prone to ochratoxin, whereas dairy animals can tolerate it even at higher levels because of its biotransformation by ruminal microbes
Vomitoxin	Feed refusal factor. Mainly affects pigs
Zearalenone	Affects reproductive organs
Fumonisins	Nervous disorder in horse
Ergot alkaloids	Produce nervous disorder and necrosis of legs and tail in livestock.

Toxins present in Unconventional feed ingredients

Rape Seed / mustard cake

Rape seed / mustard cake is very common protein rich ingredients used in for livestock feeding. It has very good protein and amino acid composition. However, it contains many incriminating factors i.e,.

- Glucosinolate,
- Irusicacid,
- Goitrin etc.,

Papas *et al.,* (1979) reported the presents of thiocyanatein the rape seed meal which was about 28.78% of total glucosinolate. However, upon hydrolysis of glucosinolates of rape seed meal by addition of thioglucosidase, thiocoanate level decreased to about 50% of original level.

They also studied the excretion of thiocyanate through milk and urine and reported that 89.2 percent of thiocyanate intake was excreted through urine and 3.84% was excreted through milk, which showed the major excretory route of thiocyanate is urine.

Saha and Singhal (1994) reported that the overall average content of thiocyanate in the milk sample of crossbred cows, Sahiwal cows, Murrahbuffaloes and goat was 15.95, 15.62, 14.87 and 15.44mg / L, respectively when fed 40% mustered cake included in concentrate mixture.

Cotton seed cake

Inclusion of whole cotton seed cake (WCS) which contains gossypol showed depression in milk protein percent. Adecrease in milk protein output due to WCS feeding might be due to excessive rumen protein degradability, as well as by a decrease in microbial proteins synthesis cost by the toxic effectsWCS lipids, and by post-absorptive mechanisms (Depeters and Cant, 1992)

Karanj cake

In India availability of karanj cake is around 1,30,000tonnes / year (Ministry of Agriculture, GOI, 1992). Crude protein varies from 24-38% depending on type of cake and the method of oil extraction. It is moderately rich in all essential amino acids. Major anti-nutritional factor present is **karanjin** which limits in utilization as animal feed. Panda (2004) reported that alkali (1.5% NaOH) processed solvent extracted Karanj cake can be incorporated in the broiler chicken diet at 6.43% replacing 12.5% of soybean meal nitrogen up to 4 weeks of age without any adverse effect on the performance.

Castor oil cake

Despite rich in protein (CP, 35 – 40%), castor bean meal is rarely used as animal feed due to presence of incriminating factors such as **ricin** (0.22 – 1%), **ricinine, allergen** and **chlorogenic acid**. But after detoxification, it can be readily used as protein source for ruminants (Reddy *et.al.,* 1986), and chicks (Shrivastave, 1987). Lade, 2007 reported that castor bean meal after processing with 2% salt (NaCl), 0.25% lime and 24h water soaking were found promising for livestock feeding.

Neem seed cake

Neem seed cake is available after the extraction of oil from the seeds. Neem seed cake (NSC) is a unconventional protein rich feed. Which can be utilized as animal feed ingredients after processing. Sastry*et.al* (1997)reported that sun dried, ground alkali treated and urea ammoniated seed kernel cake was found suitable in feeding to cattle and buffalo calves. It is observed that mixing of deoiledneem seed cake beyond 5% level in replacement of groundnut cake causes mortality in chicks. However, processed neem seed groundnut cake causes mortality in chicks. However, processed neem seed meal at 20% level in chicks and layers ration did not show harmful effect on the performance. It is found that the cost of feed per kg live weight gain was lower due to feeding detoxified neem seed cake than with the conventional feed in Nellore sheep (Madhavi*et.al.,*2006)

Common Adulterants in feeds and fodders

Adulteration in defined as the admixture of a pure substance with some cheaper and low quality substance. It is done intentionally usually to make money in costly feed ingredients like oil seed cakes and feeds of animal origin like fish meal, adulteration is done by spraying urea in order to make their protein content. However sometime brains, molasses are also added. Besides urea, oilseed cake are adulterated with husk, nonedible oilseed cakes.

Common, Adulterants of Different Feed Ingredients

Feed ingredient	Adulterants
Groundnut cake	Groundnut dust, urea, non-edible oil cakes
Mustard cake	Argimonamaxicana seeds, fibrous feed ingredients, urea, Glucosinolates
Soyabean meal	Urea, raw soybean, trypsin inhibitor
De-oiled rice bran, wheat bran	Ground rice husk, saw dust
Fish meal	Common salt, Urea, sand
Mineral mixture	Common salt, marble powder, sand, lime stone
Molasses	Water
Maize	Cobs
Rice bran	Marble grit
Cotton seed	Gossypol
Linseed, cassava	Cyanogernic glycosides
cereal and oilseed meals	Phytic acid

Tests normally conducted on feed ingredients

Some of the tests normally conducted on feed ingredients are listed below. It should be noted that the individual plant/ Company may add or delete some of the tests depending on its need.

1. Grains : Moisture, Mycotoxins, Thyrum
2. Oil meals : Moisture, Protein, Fibre
3. Rice bran : Moisture, Fat, Fibre
4. DORB : Moisture, Protein, Fibre, AIA, Mycotoxins
5. DCP : Moisture, Calcium, Phosphorus, Fluorine
6. LSP : Moisture, Calcium, Fluorine

Analytical procedures for identification of Plant Protein and Animal Protein Feed

Carbohydrates from plants contain starch and cellulose. When it reacts with iodine and chlor-zinc iodine solution, the starchy tissue releases a blue color and plant fibre or cellulose develops a purple brown color when examined under a microscope.

1. Mix 1-2g test sample with 100 ml boiling water or boil the mixture for 2-3 min. Place a few ml of the cooled mixture in test tube and add 5-6 drops of iodine solution. If starch is present, the mixture turns blue.
2. Spread 1-2g test sample into a petri dish. Add 5-6 drops of chlor-zinc iodine solution and let it stand for 10 min. A purple brown color indicated the presence of plant fibre, whereas yellow indicated animal fibre(protein) using a microscopic examination.

Dioxins contamination in animal feed

Dioxins and dioxin – like compounds are created by the manufacture of chlorine and such chlorinated compounds as chlorinated phenols, PCBs, Phenoxy herbicides, chlorinated benzenes, chlorinated aliphatic compounds, chlorinated catalysts andhalogenated diphenyleither.

Dioxins are produced as a unintentional byproduct of many industrial process. Forest fires also release dioxins and are deposited into the leaves of trees. Dioxins are highly toxic. Even minute amounts of dioxin cause damage to the nervous system and liver, apart from causing cancer. They can cause birth defects as well as mimic hormones that disrupt reproduction and human development. Dioxins released into the environment reach the food chain and get accumulated in fat. By far, the greatest exposure to dioxin (over 90%) is from food. These include fish meals fish oil, recovered vegetable oil, grease and many byproducts from the food industry and milk products. When these are included in animal rations, dioxins get concentrated in animal products.

Spot test

Application of spot test for testing the feed ingredients is simple and can be done at sampling point easily before subjecting samples for elaborate chemical tests. The spot tests are mostly targeted towards anti-nutritional factors, adulterants and contaminants, which are definitely harmful for the animals. Some of the important spot tests are given below.

Detection of Thiram

Thiram (Tetramethylthiuram disulfide) is a fungicide used as a seed protectant during storage and germination of seeds. When such seeds are available to feed, the animals will lead to intoxication.

- Take 100g sample in 250ml conical flash.
- Add 50 ml chloroform and shake for 5 minutes.

- Filter the contents through Whatman No.1 filter paper.
- Sometimes, Charcoal is added to avoid natural colour interference.
- Then add few crystals of cuprous iodide to the filtrate and shake.
- Filtered chloroform extract turns amber to brown color within 1 to 2 minutes which is an indication of presence of thiram in the sample.

IDENTIFICATION OF TOXIC PLANTS AND THEIR IMPORTANCE ON ANIMAL HEALTH

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Plants are the primary source of food for animals and provide essential nutrients; yet, they also contain a wide range of toxins. Poisonous plants are one of the leading causes of livestock disease around the world, resulting in enormous economic loss.

There are over 700 poisonous plant species in India, which belong to over 90 flowering plant groups. India has one of the highest rates of poisoning in the world, with an estimated 50,000 people dying each year as a result of toxic exposure. While there are plants in the world that are used to treat various diseases. The majority of poisonous plants do not kill animals. Animals, on the other hand are subjected to long term poisoning. Repeated exposure over time causes this poisoning. Some plants, on the other hand, can produce acute poisoning with a single harmful exposure. Fortunately, this sort of poisoning is uncommon and some plants give food and therapeutic benefit when dried or cooked, but they can be deadly poisonous while consuming fresh (Boesche Roger, 2003).

Plants add a touch of colour and fragrance to our daily lives. they also inject an element of anger in our lives and they cannot move to escape their predators. As a result, all plants have alternative ways of defending themselves against herbivores. Some plants have physical characteristics, such as thorns, while others are toxic. Physiologically poisonous chemicals in plants are usually a defensive mechanism against predation, have a distinct, disagreeable odour or taste, and are not grazed preferentially. Most of the defense characters are thorns, spines, bad odour, leathery leaves, resins and latex. These all are generally causes the common poisonous effects such as skin disease, vomiting, digestive upset, nausea, diarrhoea, mouth edema, weak pulse, sleepiness, chronic ulcers, salivation and slow appetite. Chemical defenses of plants against consumption by herbivores are determined by non-nutrient compounds such as fibre, lignin, cellulose, toxicants or essential oils and other volatile substances. Some volatile substances are overtly toxic others are merely unpleasant. Some of the poisonous plants cause serious problems like coma, die and blindness.

Even though many of the medical substances produced by plants, some of them have been reported as toxic. Plants may cause toxic effects or even death as a result of accidental exposure by skin contact/absorption, eye exposure and inhalation or accidental ingestion of the plant parts (seed, fruit, root, etc) while owner usually does not even suspect their toxic nature. Plants affect animals in many ways although symptoms and lesions differ depending on the amount of the plant consumed. The common symptoms

however include chronic illness debilitation, decreased weight gain, abortion, abdominal discomfort, salivation, congenital defects, photosensitization and sudden death can occur without the presentation of clinical signs.

Nearly half of these poisonous plants are also 'weedy' or invasive and threat to human and animal health as well as cause environmental and or economic damage. Animals have the gut defense system which keeps them safe from poisoning and the skin defense system which keeps them safe from physical harm. Humans are built the same way. The best way to assure that forage is as safe as possible is to keep these plants out of your fields and pastures. Proper weed identification is crucial. It is very necessary to known about the poisonous plants its poisonous effect and how they are looking like in the agricultural field, what are the poisonous parts (Pavithra *et al.,* 2017)

Plant poisoning is due to either accidental ingestion of material eaten along with grass or consumption of poisonous plants when pasture is dry while most poisonous plants remain green all the year round. It is also more likely to occur in animals which have been moved from one place to other place.

Currently and rapidly diagnosing a plant poisoning is often extremely difficult. In many cases initial clinical signs are nonspecific (such as diarrhea) and post-mortem lesions may be absent. However, diagnosis of plant poisoning of livestock depends on the history, clinical syndrome observed, post-mortem lesions, evidence that plants have been grazed, and remains of toxic plants in the gastrointestinal tract. In addition, specialized veterinary toxicology laboratories may provide testing for plant toxins and should be consulted. Thus, the best way to support a diagnosis of a plant poisoning is to confirm the presence of a toxic plant in the animal's environment, and to confirm that the plant has been ingested.

Awareness of poisonous plants growing in a certain geographical region and their associated clinical signs are instrumental in making a diagnosis and initiate treatment. It is important to establish an accurate diagnosis in order to provide adequate treatment to affected animals, carefully and accurately assess the potential for the transfer of toxins into edible products and prevent further exposures. Most importantly, recognition of poisonous plants in hay or forage may help prevent plant poisonings in animals.

An example of acute toxicity plants are *Abrus precatorius* seeds causes coma and death as like Nerium oleander, Jatropha curcas, Ricinus communis seeds will also cause severe results when animals consume it excessively but consumption of a few seeds will only cause digestive problems. Actually, the poisonous plants are rich in secondary metabolites so may the activity over medicinal treatment is considerably high. Sometimes the poisonous plants are used for food purposes after processing it. The poisonous plants occasionally used for suicidal purposes so it clearly shows that the peoples are little aware of the effect of plant and plant parts.

The results of study done by Pavithra *et al.,* 2017 indicated that herbs are commonly caused poisonous than other life forms such as shrubs, climbers and trees. The poisonous parts of majority of plant species were leaves, whole plant, seeds, latex and root. The analysis of poisonous plant part shows that spiny plants are more dominant followed by latex, odour, leathery leaves, viscid and succulent. It is better to avoid eating all plants that have colored or milky juices and also to avoid all unknown white or red fruits.

The chemical nature of the poison is also very important when considering poisonous plants. Some common poisonous compound found in plants include glycosides, alkaloids, oxalates, oils, minerals, resins and nitrates. Some of these poisonous affect the nervous system, some the blood and still others the intestinal track or the heart . The Solanaceous species *Datura stramonium* poisoning many animals contaminated feed, so it should be eradicated from pasture when possible. It causes diarrhoea, depression, loss of appetite and loss of condition (Table 1).

Table 1: List of major poisonous plants with poisoning effect

S. No.	Botanical name	Habit	Poisonous part	Poisoning effect
1.	*Abrus precatorius*	Climber	Seeds	Nausea, Liver failure
2.	*Aerva lanata*	Herb	Whole plant	Skin disease, Urinary tract
3.	*Aerva javanica*	Herb	Whole plant	Renal toxicity
4.	*Agave cantula*	Shrub	Fluid, thorns	Dermatitis, itching
5.	*Alternanthera paronychioides*	Herb	Whole plant	Effect mouth
6.	Alternanthera pungens	Shrub	Whole plant	Digestive problems
7.	Argemone Mexicana	Herb	Spines	Spiny
8.	*Calotropis gigantea*	Shrub	Latex	Latex injurious to eyes
9.	Canna indica	Herb	Leaves	Hallucination
10.	*Cardiospermum halicacabum*	Climber	Whole plant	Allergic reactions
11.	*Carica papaya*	Tree	Leaves,fruits	Consumption leadsabortion
12.	*Cassia auriculata*	Herb	Leaves	dark or red urine
13.	*Catharanthus roseus*	Herb	Whole plant	Digestive problems
14.	*Celosia argentea*	Herb	Inflorescence	Irritation
15.	*Cleome gynandra*	Herb	Whole plant	Severe nausea
16.	*Cleome viscosa*	Herb	Whole plant	Weakness
17.	*Corchorus fasicularis*	Herb	Leaves	Salivation when eat it inbulk

18.	*Croton bonplandianum*	Herb	Whole plant	Diarrhea, Mouth burning sensation
19.	*Datura metal*	Herb	Whole plant	Narcotic, Hallucination
20.	*Datura stramonium*	Herb	Whole plant	Memory loss, coma
21.	*Eclipta prostrata*	Herb	Whole plant	Affect digestive system
22.	*Ipomea carnea*	Herb	Leaves	Bioaccumulation
23.	*Jatroba curcas*	Shrub	Leaves, Seeds	Unconsciousness
24.	*Lantana camara*	Shrub	Berries	Affect lungs, nervous system
25.	*Lawsonia inermis*	Shrub	Leaves,seeds	Narcotic poison
26.	*Leucas aspera*	Herb	Leaves	Irritation
27.	*Mukia maderaspatana*	Climber	Leaves	Urinary trouble
28.	*Nerium oleander*	Herb	Whole plant	Digestive upset
29.	*Nicotiana tabacum*	Herb	Whole plant	Coma and die
30.	*Opuntia stricta*	Shrub	Prickle	Prickly, weakness
31.	*Parthenium hysterophorus*	Shrub	Whole plant	Allergic dermatitis
32.	*Prosopis juliflora*	Herb	Spines	Thorns cause blindness
33.	*Ricinus communis*	Shrub	Seeds	Stomach irritation,Diarrhea
34.	*Solanum nigrum*	Shrub	Berries	Nausea, Abdominal pain
35.	*Solanum trilobatum*	Herb	Spines	diarrhea, salivation
36.	*Tridax procumbens*	Herb	Leaves	Stress
37.	*Vitex negundo*	Shrub	Leaves	Severe diarrhea
38.	*Wedelia chinensis*	Herb	Leaves	Mouth blisters
39.	*Wrightia tintoria*	Tree	Latex	Cause dropsy
40.	*Xanthium indicum*	Herb	Thorns, Seeds	Gastrointestinal irritation

In Tamil Nadu, a total of 40 plants were identified and documented to have a poisonous effect on livestock. The poisonous plants frequently complained were *Abrus precatorius, Datura stramonium*, *Lantana camara* and *Parthenium hysterophorus*.

 	 
Abrus precatorius	***Datura stramonium***
 	 
Lantana camara	***Parthenium hysterophorus***

The majorly described predisposing factors for the occurrence of plant poisoning were feed shortage, nutritional deficiency and excessive consumption. The common poisoning seasons indicated were at the end of rainy season and during drought time. The plant parts that caused poisoning were leaves of plants. Findings by Pavithra *et al.,* 2017 revealed that bloating and other Gastro intestinal disturbances, salivation, bloody urine and in appetence were among the frequently manifested signs in poisoned livestock. Toxic plants can adversely affect every organ system and pose a risk to animal health and production. Research is needed not only to determine which plants represent a potential risk for animal health and production but also to investigate their phytochemistry and toxicology.

Conclusion

Phytopoisoning or plant poisoning is one of the livestock health problems that is challenging the health of livestock. Hence, proper range management should be practiced to decrease the danger of plant poisoning to animals and all concerned bodies should collaborate on pasture development programs to minimize the risk of enforced consumption of livestock on poisonous plants due to feed shortage.

Recommendations

- The removal of poisonous plants from grazing area should be advised to livestock owners.
- Preventing livestock from grazing toxic plant-infested pasture.
- Before feeding, hay and other feed materials should be thoroughly scrutinised for the presence of potentially hazardous weeds.
- Providing sufficient feeds to animals during drought seasons to avoid exposure to plant poisoning when hunting for supplies.

- ❖ The community should be made aware of the practise of intensive livestock management in order to reduce the risk of plant poisoning in the field.
- ❖ Livestock owners should pay special attention to the area where their animals graze during the early spring season since numerous dangerous plants sprout and appear on the grazing field. It is suggested that a thorough examination be carried out to determine the epidemiology of plant poisonings.

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PREVALENCE OF FEED TOXINS OF PLANT AND ANIMAL ORIGIN

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Introduction

Animal feeds are routinely subject to contamination from diverse sources, including environmental pollution and activities of insects and microbes. Animal feeds may also contain endogenous toxins arising principally from specific primary and secondary substances produced by fodder plants. Thus, feed toxins include compounds of both plant and microbial origin. Although these toxins are often considered separately, because of their different origins, they share several common underlying features. Thus, particular compounds within both plant and microbial toxins may exert antinutritional effects or reduce reproductive performance in farm animals. Furthermore, the combined effects may be the result of additive or synergistic interactions between the two groups of compounds.

PLANT TOXINS

Many plant components have the potential to precipitate adverse effects on the productivity of farm livestock (D'Mello, 2000). These compounds are present in the foliage and/or seeds of virtually every plant that is used in practical feeding. Typical concentrations for selected toxins are given in the table. Plant toxins may be divided into a heat-labile group, comprising lectins, proteinase inhibitors and cyanogens, which are sensitive to standard processing temperatures, and a heat-stable group including, among many others, antigenic proteins, condensed tannins, quinolizidine alkaloids, glucosinolates, gossypol, saponins, the non-protein amino acids S-methyl cysteine sulphoxide and mimosine, and phyto-oestrogens.

Plant toxins: sources and concentrations

Toxin	Principal sources	Typical concentrations
Lectins	Jackbean	73 units/mg protein
	Winged bean	40-320 units/mg
	Lima beans	59 units/mg protein
Trypsin inhibitors	Soybean	88 units/mg
Antigenic proteins	Soybean	-

Cyanogens	Cassava root	186 mg HCN/kg
Condensed tannins	Acacia spp.	65 g/kg
	Lotus spp.	30-40 g/kg
Quinolizidine alkaloids	Lupin	10-20 g/kg
Glusosinolates	Rapeseed	100 mmol/kg
Gossypol	Cottonseed	0.6-12 g/kg (free)
Saponins (steroidal)	*Brachiariadecumbens; Panicum spp.*	-
S-methyl cysteine sulphoxide	Kale	40-60 g/kg
Mimosine	Leucaena leucocephala	145 g/kg (seed) 25 g/kg (leaf)
Phyto-oestrogens	Clover; lucerne; soybean	-

Lectins

Lectins are proteins capable of damaging the intestinal mucosa. In contrast to most other dietary proteins, lectins resist digestive breakdown and substantial quantities of ingested lectins may be recovered intact from the faeces of animals fed diets containing one of a number of legume seeds (D'Mello, 2000). The prime example of a lectin with potent antinutritional and toxic properties is concanavalin A, a component of the jack bean. Lectins are also present in other legume grains including the winged bean and soybean. Concanavalin A enhances the shedding of brush-border membranes and decreases villus length, thereby reducing surface area for absorption in the small intestine. With other lectins, the lamina propria of the intestine may become infiltrated with eosinophils and lymphocytes. The overall effect is reduced nutrient absorption, but immune function may also be impaired.

Proteinase inhibitors

The proteinase inhibitors are typical examples of heat-labile factors with antinutritional activity. They constitute a unique class of proteins with the ability to react in a highly specific manner with a number of proteolytic enzymes in the digestive secretions of animals. The trypsin inhibitors of soybean are now well characterized (D'Mello, 1995) and are important determinants of nutritive value. Proteinase inhibitors are also present in other leguminous seeds such as field beans, winged beans, pigeon pea and cowpea. Effects in animals include reduced protein digestion and endogenous loss of amino acids, with the overall result that performance is impaired.

Antigenic proteins

Certain storage proteins of legume seeds are capable of crossing the epithelial barrier of the intestinal mucosa to elicit adverse effects on immune function in farm animals. In the case of the soybean, the antigenic proteins have been identified as glycinin and conglycinin. The antigenic proteins are characterized by their resistance to denaturation by conventional thermal processing procedures and to enzyme attack in the digestive tract of mammals. The most striking effects of antigenic proteins are embodied within the "immune hypersensitivity" syndrome. This condition occurs after feeding heated soybean to sensitized calves and piglets (D'Mello, 1991). The component antigens provoke extensive local and systemic immunological reactions together with severe intestinal damage. The resulting effects include abnormalities in movement of digesta, impaired nutrient absorption and a predisposition to diarrhoea.

Cyanogens

Cyanogens occur widely in plants and in diverse forms. In sorghum and cassava, the predominant cyanogens are, respectively, dhurrin and linamarin. The latter compound is also present in linseed. Cyanogens are glycosides that readily yield HCN and it is this latter molecule that causes dysfunction of the central nervous system, respiratory failure and cardiac arrest (D'Mello, 2000). Metabolizable energy values for poultry tend to be lower in untreated cassava root meal, presumably because of its cyanogenic potential.

Condensed tannins

Tannins belong to a group of phenolic compounds with a molecular weight in excess of 500 daltons. Condensed tannins (CTs) are a subset of this group and are widely distributed in leguminous forages (Table 4) and seeds and in sorghum. Cattle and sheep are sensitive to CTs, while goats are more resistant. Adverse effects may be seen in sheep when CTs, including those in lotus or in browse legumes such as Acacia species, comprise a significant part of their diets. Primary effects include impaired rumen function and depressed intake, wool growth and live-weight gain. However, at moderate levels (30 to 40g/kg legume dry matter), CTs may result in nutritional advantages in respect of increased bypass protein availability and bloat suppression in cattle. At higher levels (100 to 120 g CTs/kg legume dry matter), reduced gastrointestinal parasitism in lambs has been reported (D'Mello, 2000).

Quinolizidine alkaloids

The quinolizidine alkaloids occur in lupins and include lupinine, sparteine and lupanine. Bitter cultivars contain relatively high levels of total alkaloids and are not suitable as animal feedstuffs because of their negative effects on intake. In addition, cattle consuming certain lupin species during pregnancy may produce calves with multiple congenital deformities.

Glucosinolates

Glucosinolates are glycosides of particular significance in brassica forage crops such as kale (D'Mello, 2000). Removal of glucose from glucosinolates by plant or microbial enzymes (myrosinase), results in the release of a diverse array of compounds which undergo further breakdown to yield a number of toxic metabolites. The most common breakdown products are isothiocyanates and nitriles but, depending on such conditions as pH, temperature and metallic ion concentrations, a number of other metabolites may also be produced. These products may then cause organ damage, goitrogenic effects or reduced feed intake, particularly in non-ruminant animals.

Gossypol

Gossypol pigment occurs in cottonseed in free and bound forms. In whole seeds, gossypol exists essentially in the free form, but variable amounts may bind with protein during processing to yield inactive forms. Free gossypol is the toxic entity and causes organ damage, cardiac failure and death. Cottonseed meal fed to bulls can induce increased sperm abnormalities and decreased sperm production.

Saponins

Saponins are divided into two groups: steroidal saponins, which occur as glycosides in certain pasture plants such as *Brachiaria decumbens* and *Panicum species*; and triterpenoid saponins, which occur in soybean and alfalfa. Many hepatogenous photosensitization conditions in sheep have been attributed to the intake of forage plants containing steroidal saponins. In contrast, triterpenoid saponins from alfalfa reduce feed degradation in the rumen.

Amino acids

A wide range of non-protein amino acids occur in the foliage and seeds of plants. Forage and root brassica crops contain S-methyl cysteine sulphoxide (SMCO), while the aromatic amino acid mimosine occurs in the foliage and seeds of the tropical legume *Leucaena leucocephala* (D'Mello, 2000). Uncontrolled feeding of brassica forage to ruminants causes organ damage with haemolytic anaemia, which is attributed to the intake of SMCO. Abrupt feeding of Leucaena to sheep causes shedding of fleece, reduced intake, organ damage and death. In cattle, loss of hair, excessive salivation, lethargy, weight loss and enlarged thyroids are common features of *Leucaena* toxicity.

Phyto-oestrogens

Phyto-oestrogens are a diverse group of isoflavonoid compounds found primarily in forage and grain legumes .In clover, formononetin is the major form of phyto-oestrogen. Phytooestrogens are actively metabolized in the rumen to form products that vary in their biological activity. Formononetin is converted into a more oestrogenic compound. Phyto-oestrogens have been associated with "clover disease" in sheep, which is characterized by low ovulation and conception rates (D'Mello, 2000).

MICROBIAL TOXINS

Salmonella

A very serious source of contamination usually overlooked is that of rodent contamination of stored ingredients. There are approximately 1200 serotypes of salmonella organisms that inhabit a great variety of warm and cold blooded animals, including fish. Of these, approximately 80 serotypes have been definitely associated with diseases. Animal by-product derivatives are the worst offenders and the primary source of salmonella contamination in mixed feeds. Fish meals represent the next highest source of salmonella contamination. Attention has thus far focused on feeds being the means of perpetuating the salmonella cycle (rat to faeces to by-products to feed to fish). Attention also should be given to the role of soil, water, contaminated feeding equipment, and wild birds and terrestial animals as contributing to the presence of salmonella organisms in a given environment.

Antinutritional Factors

Any discussion on adventitious toxins has to include the antinutritional factors in plant proteins. Nearly all sources of plant protein possess associated factors which must be eliminated by special processing techniques to make them of maximum nutritional value. For example, for over fifty years, soybeans have been known to be improved by heat treatment.

Soybeans

Factors present in raw soybeans can markedly affect the intestinal tract of animals and influence the digestion and utilization of many nutrients. Inclusion of small amounts of soybean meal will depress growth rate, increase pancreas size, decrease fat absorption, and metabolizable energy of the diet of fish. In addition, it has also been found that the feeding of raw soybeans causes the gall-bladder to contract, increases excretion of bile acids, lowers intestinal proteolytic activity, and affects methionine metabolism. Raw soybeans also contain protein which cause agglutination of red blood cells in vitro. It appears that the haemaglutinins (lectins) of raw soybeans are responsible for some of the decrease in efficiency of feed utilization. Apparently these lectins are all capable of causing release of intestinal membrane-bound lipases and amylases, causing these digestive enzymes to be eliminated in the faeces, thereby reducing their digestive capabilities. Fortunately, all of these factors can be destroyed or reduced to minimal levels by proper heat treatment.

Other vegetable protein sources

Groundnuts contain trypsin inhibitor activity which is not destroyed by heat treatment. This is thought to be due to the fact that the inhibitor activity resides in the tannins which are a part of the groundnut skin. cottonseed contains gossypol and fatty acids with a cyclopropene ring which causes nutritional difficulties. Linseed meal contains an antipyridoxine factor and a cyanogenic glycoside. Rapeseed meal contains glucosides which

when hydrolyzed yield a goitrogen. Most all plant protein sources contain phytic acid which can interfere with both mineral and protein availability. Particular attention must be paid to mineral supplementation when formulating fish diets containing fairly high amounts of plant protein. Even though the temperature which destroys heat labile growth inhibitors is high, minimum protein damage is involved at these high temperatures provided the optimum peak of temperature is reached for a very brief period of time. The brevity of the period at peak temperature is more important than any other factor in obtaining! optimum protein quality.

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PLANT FEED TOXINS AFFECTING POULTRY PRODUCTION

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Professional knowledge is a superimposition over common senses. Many a times technocrats strong in fundamental concepts sustain in profession than hitech scientist. I think good management practices with quality feed can solve most of the emerging and remerging diseases in poultry farms. With this view in mind, let us refresh some of the basic understanding of the feed ingredients used in the feed of poultry, which can directly or indirectly help you to improve the health of the birds.

Cereal grains

- Cereal grains are essentially carbohydrate concentrates, the main component of the dry matter being starch.
- The **crude protein ranges from 8-12%,** deficient in certain essential amino acids, particularly **lysine and methionine.**
- The phosphorus content is higher, being 0.3-0.5%, but part of this is present as **phytates.**
- This property of gluten is considered to be the main reason why finely ground wheat is unpalatable to animals.
- Wheat if finely milled forms a pasty mass in the mouth, and may lead to digestive upset.
- Millets are cereals, which produce small grain and have higher percentage of fiber .e.g. Sorghum, Bajra, etc.
- Sorghum is similar to maize is chemical composition except that sorghum is slightly higher in protein and low in oil than maize. Whole grain can be given to sheep, pig and poultry but are usually ground for cattle.
- Bajra resembles sorghum in its nutritive value contains 8-12% crude protein, is rich in tannin content. As the seeds are hard, they should be ground or crushed before being fed to cattle.

Milling by-products

Bran: It is the outer coarse coat of the grain, separated during processing e.g. Rice bran, wheat bran, maize bran etc. Because of the fibrous nature and low digestibility bran is used only to a limited extent in pig and poultry feed.

Hulls: Outer covering of the grain, generally not utilized as livestock feed.

Polishing: By-product of rice, consisting of a fine residue that accumulates during polishing of rice kernel contains about 10-15% protein, 12% fat and 3-4% crude fiber. It is an excellent source of energy and vitamin B complex. Due to high fat content rancidity can pose problem.

Fats and Oils

- Animal fats contain a high amount of saturated fatty acids and are less digested. Vegetable oil (sunflower oil, ground nut oil, rice bran oil etc) and marine oils (cod liver, Sardine) contain a high amount of unsaturated fatty acids and adding these oils to feeds may lead to the development of rancidity which can cause the destruction of a number of fat soluble vitamins.
- Rancidity can be prevented or reduced by adding a number of antioxidants (Vitamin E, BHT)

Protein supplements

Groundnut oil cake or peanut oil meal:

- It has about 45% protein and 10% oil in expeller variety. It is deficient in lysine, methionine and cystine.
- Particularly in warm rainy season liable to contain a toxic factor – Aflatoxin a metabolite of fungus *Aspergillus flavus*.

Soybean oil meal

- The protein (44%) contains all the indispensable amino acids, but the concentrations of cystine and methionine are sub-optimal.
- The cake is used for all kinds of livestock including poultry upto 30% of the ration.
- As with most other oil seeds, raw soyabeans have a number of toxic, stimulatory and inhibitory substances.

A **goitrogenic material** is found and its long term use may result in goiter in some animal species.

1. It also contains **antigens,** which are specially toxic to young pre-ruminants.
2. It contains **protease inhibitors** of which six have been identified. Two of these, the ***kunitz* anti-trypsin factor and the *Bowman-Brik* chymotrypsin inhibitor** are of practical significance. Trypsin inhibitor affects the digestibility of proteins specially in monogastric animals.
3. A **haemogglutinin,** agglutinates red blood cell in rats, rabbits and human beings but not in sheep and calves.
4. Soyabeans also contain **genistein,** a plant estrogen, which may account, in some cases for part of the high growth inducing properties.

Fortunately, these inhibitors and other factors like saponins are inactivated by proper heat treatment during processing.

Coconut meal (Copra meal)

- The crude protein content is low (20-26%) and poor in lysine and histidine.
- The oil content of coconut meal varies from 2.5 to 6.5% ,the higher oil meals tends to get rancid and thus will cause diarrhoea. Hence low oil content type should be preferred.
- Due to poor quality of protein and high fiber, its use should be restricted in swine and poultry rations. If it is fed to monogastric, it should be supplemented with lysine and methionine

Cotton seed meal

- Cotton seed may contain from 0.3 to 20g/kg dry matter of a yellow pigment known as **gossypol.**
- Gossypol is a polyphenolic aldehyde which is an antioxidant and polymerisation inhibitor and is toxic to simple stomached animals.
- The general symptoms of gossypol toxicity are depressed appetite and loss of weight, death usually result from circulatory failure.
- Addition of one per cent calcium hydroxide or iron salts to the diet decreases the Gossypol toxicity.

Sunflower seed meal

- The meals are useful sources of protein (30%) which is low in lysine but has about twice as much methionine as does soya protein.
- The meal is palatable but is laxative and has a very short shelf life.
- The expeller variety of sunflower meal or cake tends to produce soft pork and it also makes the butter soft if fed in large amounts in cows because of the character of the oil it contains.

Mustard cake (Sarson)

- The deoiled type can be used for poultry upto 5 per cent of the ration and for pigs the amount may go as high as 10 per cent.
- The calcium and phosphorus content are much higher, being about 0.6 per cent and 1.0 per cent.
- **Glucosinolates or goitrogens** are the antinutritional factor present in the mustard cake.

Sesame seed meal (Til Cake)

- Sesame seed meal is produced from what remains following production of oil from sesame seed and the meal is extensively used for all classes of livestock including poultry
- Contains about 30 % protein which is rich in leucine, arginine and methionine and low in lysine.
- There are three varieties – white, black and red. Nutritive value is highest in white while lowest in red variety.

Rape seed meal / Canola seed meal

- Contains more fiber (14%) with low ME . Low in protein content than soyabean meal, Calcium : Phosphorus are favourable.
- Grown in Europe fed to pig and poultry, contains **glucosinolates** which may lead to goiter, liver and kidney dysfunction.

HARMFUL NATURAL CONSTITUENTS AND CONTAMINANTS IN FEEDS

Animal feeds are routinely subject to contamination from diverse sources, including environmental pollution, activities of insects and microbes.

Environmental contaminants

A wide range of organic and inorganic compounds may occur in feedstuffs, including pesticides, industrial pollutants, radionuclide and heavy metals.

Fungal contaminants

Aspergillus is the predominant genus in feeds. Other species include *Penicillium*, *Fusarium* and *Alternaria*, which are also important contaminants of cereal grains. Fungal contamination is undesirable because of the potential for mycotoxin production.

Mycotoxins

Mycotoxins are those secondary metabolites of fungi that have the capacity to impair animal health and productivity. The diverse effects caused by these compounds are considered under the term **"mycotoxicosis".** Mycotoxin contamination of forages and cereals frequently occurs in the field following infection of plants with particular pathogenic fungi.

Aflatoxin

Aflatoxins are the most potent toxic, mutagenic, teratogenic and carcinogenic metabolites produced by the species of *Aspergillus flavus* and *A.parasiticus* on food and feed materials. Aflatoxins B_1, B_2 and G_1 produce hepatotoxicity. The occurrence of these toxins in food and feed materials and their consumption has caused not only health hazards

in animals and humans, but also resulted in economic losses, especially to the exporting countries.

Type of naturally occurring toxins / anti nutritional factors

On the basis of the type of nutrient affected and the biological response produced in the animal of the toxic factors can be classified into five major groups as follows:

Substance depressing digestion or metabolic utilization of protein:

- Protease inhibitors
- Lectins or Ricin (hemagglutinins)
- Saponins
- Polyphenolic compounds (TANNINS)

Substance reducing the solubility or interfering with the utilization of mineral elements

- Phytic acid
- Oxalic acid
- Glucosinolates
- Gossypol

Substance inactivating or increasing the requirements of certain vitamins and hormones

- Antivitamins A, D, E, K and anti-pyridoxine
- Mimosine (Anti hormone)
- Cyanogens :
- Nitrate and Nitrite
- Moulds and mycotoxins in animal feedstuffs

1. Substance depressing digestion or metabolic utilization of proteins

Protease inhibitors

Substance that inhibit proteolytic enzymes and thereby growth of non-ruminants are distributed throughout the plant kingdom but are particularly abundant in seeds and legumes. In the case of soybeans identification of two main groups or protease inhibitors have recently been made namely: (1) ***Kunitz***inhibitors have few disulphide bonds and specificity towards trypsin (2) ***Bowman-Brik*** inhibitors has a high proportion of disulphide bonds, inhibiting both trypsin and chymotrypsin. The inhibitory substances are mostly heat labile and thus before feeding any leguminous grain to non-ruminants, the situation is generally corrected by proper heat treatment.

Lectins or ricin (hamagglutinins)

This important group of anti-nutritional factor are found in both plant and animal tissue. A toxic fraction capable of agglutinating human red blood cells. Lectins are protein in nature, resistant to digestion by pancreatic juice. Although very resistant to destruction by dry heat, lectins are destroyed by the same conditions as those used to inactive protease inhibitors.

Saponins

The important common forages which have caused saponin poisoning of livestock are lucerne, white clover, red clover and soybean. Saponins or Sapogenins are either steroids or triterpenoids, which are the break down products of certain glycosides. They are bitter in taste, foam forming and inhibit the action of proteolytic enzymes and cholinesterase. They also cause haemolysis of red blood cells. Water soaking and rinsing will remove the components in the feedstuffs. In ruminant saponins have been suggested as being involved in formation of bloat by altering the surface tension of the ruminal contents due to entrapment of countless bubbles of fermentation gases throughout the ingesta.

Polyphenolic compounds (tannins)

Also known as tannic acid, gallotannin and gallotannic acid. It is now defined to include those naturally occurring compounds having high molecular weight (500-3000) and containing a sufficiently large number of phenolic hydroxyl groups (1 to 2 per 100 molecular weight) to enable them to form effective cross-links between proteins and other macromolecules. Chemically tannins may be grouped two broad categories: (1) **Hydrolysable tannin** and **(2) Condensed tannins.**

Properties of Tannins

1. The most important property of tannins is undoubtedly their capacity to bind proteins; they are thus inhibitors of enzymes.
2. They cause low palatability of some herbage plants
3. They are also markedly astringent – that is they cause a dry or puckery sensation in the mouth, probably by reducing the lubricant action of the glycoproteins in the saliva.

2. Substance reducing the solubility or interfering with the utilization of mineral elements

a) Phytic acid

Phytates are the salts of phytic acid. Phytic acid is formed due to combination of six phosphate molecules with Inositol, a cyclic alcohol with six hydroxy radicals like that of hexose sugar.

About half of more of the phosphorus in cereal grains is in the form of phytin. The availability of phytin phosphorus to all non-ruminants is influenced by the level of vitamin D, calcium, the calcium to phosphorus ratio, amount of zinc in the feed, alimentary tract pH and other factors.

b) Oxalic acid

In both the vegetable and animal kingdoms oxalic acid is found as free and in salt forms. Plants which are particularly rich in oxalates include beet, spinach and a number of agro-industrial by-products used as livestock feed ingredient. The excess oxalate combined with feed calcium to form insoluble calcium oxalate and then become unavailable for absorption or excess oxalate (20-30 mg per cent) may be absorbed from the rumen into the blood stream where it can combine with calcium to produce hypocalcaemia. The insoluble calcium oxalate may then crystalise in various tissue, specially kidneys and rumen wall.

c) Glucosinolates (Thioglucosides)

Glucosinolates are responsible for the pungent flavour found in some cultivated plants belonging to the *Cruciferae,* specially the genus *Brassica,* which includes cabbage, turnips, rapeseed, mustard seed. Their main biological effect is to depress the synthesis of the *thyroid hormone* (Tryroxine and Triiodothyronine), thus producing goiter. An adequate supply of iodized salt is another preventive measure specifically in areas where non-ruminants consume goitrogenic substances in a large dose.

d) Gossypol

Gossypol pigments are polyphenolic compounds found exclusively in the pigment glands of cottonseed. The physiological effects of free gossypol. In addition to reduced appetite and loss or body weight, include accumulation of fluid in the body cavities, cardiac irregularity, reduced oxygen carrying capacity of the blood and an adverse effect on certain liver enzymes. It causes olive green discolouration of egg yolk.

3.Substance inactivating or increasing the requirements of certain vitamins:

Anti Vitamin A

Raw soybean contain an enzyme **Lipoxygenase,** which catalysis oxidation of carotene, the precursor of vitamin A.

Anti-Vitamin D

Rachitogenic activity of isolated soya protein (unheated) has been founded with chicks and pigs.

ADULTERANTS

Undesirable substances getting incorporated in the feed intentionally or accidentally

Accidental adulterants

Most of the feed ingredients for livestock are agricultural or allied products / by-products. During the course of their processing many unwanted materials such as husk, cobs, hulls, stones, mud, pebbles, sand and weed seeds can get accidentally incorporated. These are called as accidental adulterants. The presence of these adulterants may increase the crude fibre / silica contents of the ingredient and thereby reduce the digestibility and nutritive value of the ingredient. Some weed seeds may also contain deleterious principles, which may cause harm to the animals.

Intentional adulterants

As a fraudulent practice in order to make more profit the wholesale dealers/ retailers may intentionally add husk, cobs, hulls, stones, mud, pebbles, sand, weed seeds and also some chemical substances like urea to increase the weight or nutritive value by default. The presence of these may cause harm to the animals or alter the nutritive value.

PRINCIPLES OF TREATMENT FOR PHYTOTOXICOSIS IN LIVESTOCK

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Plants besides being a source of feed and fodder for livestock also contain substances like alkaloids, glycosides, toxalbumins, essential oils, resins, bitter principles etc., and these substances play a vital role in toxicological effects of the plant. When contact or ingestion of a plant hinders or destroys normal processes causing distressing symptoms, pathology or mortality it is called a **toxic plant**. The active toxic principles in the plants are called as **Phytotoxins**.

Livestock being indiscriminate eaters ingest non-food plants along with food specially in scarcity periods. Lack of grazing areas in our country compliments the problems of plant toxicity. Plant toxicities may be described in various methods. One of the methods is to describe the toxicity on basis of individual plants as mentioned below,

1. Cyanogenetic Plants.
2. Lantana Camara.
3. Strychnous nuxvomica
4. Ricinus comunis
5. Parthenium hysterophorus
6. Ficus tsjahela
7. Mimosa invisa

The plant toxicities are region specific and appropriate treatment regime for various plants is yet to be established.

General therapeutic management

In many cases, specific diagnosis is not possible; treatment has to be symptomatic, but if poisoning is suspected any of the following can be tried

- **Purgatives**: eg. up to 500 g Epsom salt (magnesium sulphate) in 1 litre of water for large animals per oral. It causes movement of water into the intestines from the body resulting in diarrhoea helps expel plant materials in intestine.
- **Kaolin** (fine white clay powder) is mixed in water till it is a milky liquid. For a large animal use about 200g Kaolin, Per Oral, as needed

- **Charcoal powder**a handful of it in a bottle of clean water Per Oral. It may inactivate poisons in GIT.
- Milk or coconut milk, ground cereals or rice mixed with water Per Orally.
- 6 **eggs** and half kilo of **sugar** mixed with about 1 litre of water administered Per Orally.
- Animals which are depressed may benefit from the administration of stimulants.
- Sedatives for excite/ hyperactive animals.
- In some cases, as discussed further (eg Prussic Acid Poisoning, or Nitrate/Nitrite Poisoning) the specific antidote must be administered.

Prevention of plant poisoning

Making sure animals are well fed and healthy. As these are much less likely to scavenge for food and consume phytotoxic agents.

- Avoid pastures with known poisonous plants
- Avoid fertilised pastures
- Avoid pastures sprayed with herbicides

Some of the common phyto toxicites and their therapeutics are discussed as follows:

Cyanogenetic Plants

Plants containing hydrocyanic acid (HCN) or cyanogenic glycosides are called cyanogeneticor cyanogenic plants. Cyanide may be present in a free form (HCN) or in a bound form (cyanogenic glycosides).Cattle and buffaloes are the most susceptible species. Young or immature plants have higher HCN levels.

young sorghum grass

Almond, Bamboo, Cherries, Linum, Sorghum (sudan-sorgum hybrid or sorgum grass), Cassava, Cotton, Beans, White Clover and Rubber tree are highly cyanogenic. The other cyanogenic plants include Lotus,linseed meal, etc. Acute cyanogenetic plant poisoning causes **cytotoxic anoxia** by inhibition of cellular cytochrome oxidase enzyme. Post-mortem changes commonly include: Congestion and/or haemorrhages in abomasum, small intestines, trachea, lungs and heart. Unclotted bright Red Blood, Bitter almond smell of ruminal contents. Laboratory analysis of stomach orRuminal contents, liver and muscle reveals presence of HCN.

Diagnosis

- Includes history of sudden death following grazing, signs of acute anoxic syndrome, bright red coloured blood and mucous membranes.

- Post-mortem lesions.
- Presence of HCN in the suspected plant or ruminal contents (picrate paper test).

Treatment

- Immediate oxygen therapy if possible and hydroxo cobalamine.
- Removal of source of exposure.
- Sodium nitrite intravenous at 10mg/kg, every 2-4 hrs.
- Followed by Sodium thiosulfate upto 30g/cow, given orally or intraruminally helps detoxification of remaining HCN in rumen.
- Sodium thiosulfate (heavy dose) combined with p-aminopropriophenone (1-1.5 mg/kg)
- P-aminopropriophenone at 1-1.5 mg/kg if used alone.

Lantana camara

Lantana camara plants bear coloured flowers: red (highly toxic), pink, white, yellow or intermediate are present in various regions in Indian subcontinent. Ingestion of lantana foliage causes hepatotoxicity due to pentacyclic triterpenoids called läntadenes it may also cause secondary photosensitization.

Lantana (Lantana camara)

Diagnosis:

It is based on History, Clinical signs like Ruminal stasis, Animal goes off-feed within a couple of hours of consumption of lantana foliage and severe constipation. In 24-48 hours development of severe icterus occurs. Icteric conjunctiva, vaginal and rectal mucous membranes are noticed. Clinical pathology denotes an Increase in plasma bilirubin (conjugated type), hemoglobin, urea and erythrocyte and leukocyte numbers. Post mortem lesions include changes like; inflamed liver with ochre tinge, distended gall bladder, dry and undigested rumen contents.

Treatment

No specific antidote is available hence treatment generally is symptomatic

- Stop further exposure of the animals to noxious weed.
- Keep the animal in well shaded areas away from direct sunlight, if photosensitization develops.
- Administer intravenously excessive amounts of glucose saline solution.
- Hepatoprotective agents for liver support.
- Removal of toxic ruminal contents by rumenotomy.

- Saline purgatives facilitate removal of gastro-intestinal contents
- Replace the ruminal contents with a suspension containing electrolytes, chaffed forage and rumen liquor from ahealthy animal,
- Single dose of activated charcoal 2.5 kg of powdered activated charcoal in 20 litres of multiple electrolyte solution by stomach tubeto prevent further toxinabsorption.
- Antihistamines and antibiotics if Photosensitization lesions or secondary-bacterial infections are suspected.

Strychnos nuxvomica

Strychnos nuxvomica (Loganiaceae) or powdered form of nuxvomica used as a bait to kill dogs, foxes or rats. It consists of Strychnine (indole alkaloid) found in the Strychnos nuxvomica seeds. Major site of action of strychnine is the recurrent inhibitory interneurons (Renshaw cells) of the reflex arc in the spinal cord and medulla. Strychnine is a competitive glycine receptors antagonist it interferes with glycine receptors mediated post synaptic inhibition at these sites.

Diagnosis: includes history, clinical signs, laboratory investigation (myoglobinuria), post mortem lesions (rigor mortis onset is rapid), detection of strychnine in urine samples, stomach contents, liver kidneys or suspected baits._

Treatment

- No specific antidote available .
- General line of treatment includes 75% chloral hydrate solution intravenouslyfor calming the animal and seizure control.

Ricinus communis

Castor bean or castor oil plant generally used in residual cake containing two lectins –Ricin-1 and ricin -II. Ricin II is more toxic.

Diagnosis is based on history of consumption, clinical signs like nausea, vomiting, signs of abdominal pain and gradual development of diarrhoea followed by enteritis, bloody diarrhoea and icterus.

Post-mortem lesions include: Intense gastroenteritis, haemorrhages of the GI mucosa, mesenteric lymph nodes swollen, generalized congestion. hepatic and renal degeneration. Foci of necrosis in the spleen, lymph grands, intestine and stomach may be noticed. Pulmonary haemorrhages, oedema and emphysema may be noticed and the trachea /or bronchi are filled with frothy oedematous fluid.

Castor oil plant *(Ricinus communis)*

Treatment

- Anti-ricin serum from a previously hyperimmunised animal.
- Gastric lavage for toxin removal from GIT using saline purgatives (sodium sulphate).
- Use of activated charcoal.
- Symptomatic treatment. To restore circulatory volume using blood transfusion, plasma expanders, adequate intravenous infusion of electrolytes containing fluids help promote urinary excretion of ricin. Mannitol in oliguric cases. Urinary alkalizer (sodium bicarbonate) to prevent Hb precipitation in the tubules.

Parthenium hysterophorus

Parthenium hysterophorus

The toxic principles are sesquilerpene lactones which cause allergic dermatitis. The major sesquiterpene lactone of Parthenium weed is parthenin. Secretion of parthenin into milk gives it a bitter taste.

Diagnosis: No specific method of confirmation of Parthenium toxicity. History of grazing in fodder fields heavily infested with the weed. Appearance of skin lesions.

Treatment

- Treating the cutaneous lesions by giving anti pruritics and anti-septics.
- Liver tonics for hepatic function.
- The animals should immediately be shifted to normal fodder

Ficus tsjahela

Ficus tsjahela

This is one of the most common plant inWestern Ghats. It causes severe neurotoxicity. Signs like convulsions, cycling movements, unable to get up, hurried respiration etc. Treatment is intravenous fluids and antiepileptics

Mimosa invisa

This is another non thorny weed grown in areca nut plantation. Causes severe nephrotoxicity and Perineal oedema. The prognosis is poor once the perineal oedema appears. The stool will be very hard, laboured breathing, the oedema extends up to the brisket region.

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PHYSICAL EVALUATION OF FEED INGREDIETNS TO OVERCOME MYCOTOXIN PROBLEM IN LIVESTOCK FEED PRODUCTION

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The compound feed plays a major part in deciding the cost of production of milk, egg and meat. It constitutes about 60-65% percent of total costs. The efficiency of feed utilization in the livestock and poultry birds is dependent upon the quality of feeds. The quality of compounded animal feeds is based on the raw materials (cereals, cereal by products, oil seed meals, marine feeds, agro industrial by products) used to formulate the ration. The fast growing livestock industry with its improving high yielding genetic potential competes with human population for high quality feed such as cereals and other feed ingredients which are already short supply in our country. Physical evaluation of feed ingredients and finished feeds needs to be viewed through the various feed ingredients, processing of feed ingredients, finished feeds and lastly field results that give feed back information.

Mycotoxins are the secondary metabolites of moulds that colonise on growing crops harvested and stored feed ingredients and feeds. These mycotoxins have affected the health of both man and animals for many centuries. These toxins in feed have been associated with impaired performance of livestock such as decrease in milk production, decrease in weight gains, drop in egg production, decrease immunity, disease outbreak, and thereby heavy mortality.

PHYSICAL EVALUATION METHODS

In the feed manufacturing process, evaluation of the feed ingredients is important for maximize the livestock production. Small feed manufacturers and farmers preparing own feed cannot afford to have a feed quality control laboratory of their own. However, they also can maintain good quality feed by following the simple field methods of feed quality control. These methods will supplement and complement the laboratory techniques. The field techniques also helps in choosing the right laboratory tests to be carried out; because carrying out all tests will not only uneconomical but also time consuming. The physical methods are mainly based on organoleptic evaluation by using the sense of vision, touch, hear, smell and taste.

A. VISION

Visual examination of feed stuffs is the best among organoleptic tests. It is also having wider application. An experienced person can judge the quality of feed stuffs, especially grains, bran, fish etc., with fair degree of accuracy by visual examination.

1. COLOUR

Change in color of the material gives an indication of the storage condition, maturity, contamination due to sand, possible use of insecticides or fungicides (dull and dusky appearance) and presence of toxins. In sorghum(jowar), orange to red color sorghum is high in tannins and is not suitable for feeding monogastric. Dark varieties of jowar (grown in Maharashtra) are lower in ME value than the white jowar. The fiber and oil content but not the color (yellow to light brown and dark brown) determines nutritive value of rice polish. Browning or blackening of the ingredient due to heat damage or improper storage reduces the nutritive value, high oil fish on storage turns black due to heating (oxidative rancidity).

Fig. 1. Good quality maize

Fig. 2. Fungus maize

Fig. 3. Good quality soyabean meal

Fig. 4. Fungus soyabean meal

2. Size

Size of the grain is an indicator the energy value. The smaller the grain, the lower the ME value, because of increased proportion of the seed coat. Weight of a fixed number of grains can be used to evaluate the cereals (weight of 100 or a unit volume of grains). This technique is called a test weight.

3. Homogeneity

The presence of contaminants like other grains, husks, brokengrains, sproutedgrains, weed seeds and weevil infested seeds will lower the nutritive value. Also, the presence of

feathers or fluff or rat or bird excretamay not reduce the nutritive value but may also be a source of infection. Adulteration of oil seed meals with fibrous materials will lower the nutritive value and be easily detected on closer examination.in rice polish, contamination or adulteration with husk can be visually identified. Exposure to heat either during processing or due to storage can produce toxic products like gizerosine in fish meal or other biogenic mines in meat meal. White fish is preferred over dark fish, due tobetter keeping quality because of lesser oil content. Clumps in mineral ingredient are not suitable for premixing.

Mouldy grains will have greenish, grayish or blackish discoloration; especially at the germinal tip. Prolonged or improperly stored feed stuffs with high moisture level led to clump and cake formation as well as mould growth and bumping appearance.

B. Touching

Dryness and high moisture in an ingredient can be detected by feeling or touch. Clumps can be due to high moisture content or improper storage or due to packing immediately fresh warm solvent extracted meal. Those clumps due to packing of warm material crumble on application of light pressure, but those formed due to excess of moisture are hard.

Rice polish retains the shape of fist if the crude fibre level is below 12% and disintegrates if the fibre level is high. Place 5g of rice polish, rice bran or deoiledriece bran in left palm. Take a pinch of it and rub between fingers. If it is too course and rough, it may be concluded that the bran is adulterated with paddy husk.

In broken rice containing bran, if a significant amount of the bran particles adhere to the palm, it is oil containing polish and the ME value will be higher but they cannot be stored for a longer period. If only a few particles are adhering, then the ME value will be lower.

When we put our hand deep into a bag of feed ingredients, if the moisture level is below 12% we may not feel temperature differential, between inside and outside the bag. If the moisture level is high , the grains inside the bag are cooler/warmer in winter and hotter during summer, than the outside temperature.

Fish with more moisture is heavy, dark, more flexible and moist to touch.

C. Hearing

The sound like spilling of coins when grains, especially of maize, are dropped indicates dryness. Whereas high moisture grains will give soft dull sound. When the grain is bitten, a characteristic sound will be heard if it is dry.

D. Smelling

The mill manager should familiarise himself with the normal smell of the ingredients; any change in the smell should be viewed with suspicion. Sour odour is indicative of fermenting or mouldy grain or insect infestation. Musty odour indicated the presence of

boring insects or fungal contamination. Odour similar to petroleum products is suggestive of excess of pesticides or fungicides. By smelling, the rancidity developed due to prolonged/ improper storage of rice polish, fish meal, silk worm pupae meal, fat, oil and other oil rich feed stuffs can be detected. Heat damaged ingredients can be easily detected by their smell even when there is no visible change in colour. In good quality meat –cum-bone meal, the tallow smell is similar to that of ghee if it is of good quality and fresh. Leathery smell in meat cum bone meal indicates contamination or adulteration with leather meal.

E. Tasting

Each ingredient has a different taste; any change in taste can be detected. Bitterness in grains, soybean meal, sunflower oil meal and groundnut meal indicates the presence of mycotoxins.

By biting and chewing the grains and / or oil cakes, one can easily determine the moisture level in them. A dry feed stuff will be crisp, hard and brittle to bite. By tasting, the freshness of the feed and feed stuffs could be evaluated easily. Fresh feed stuffs, especially rice polish will have desirable taste. On storage, the oil or fat in the feed will undergo rancidity, leading to undesirable burning taste due to the presence of free fatty acids.

Rice bran or rice polishing adulterated with paddy husk have a bland or throat burning taste; with feeling to spit the fibrous portion immediately.

By biting and tasting the oil cakes, one can find the freshness, rancidity, mould and mustiness, and adulteration if any. At present most of the oil cakes are adulterated with rice bran, caster seed, rubber seed, kapok seed and other cheaper oil seeds. Most of the adulterations can be detected by chewing and tasting.

The level of salt can be detected by tasting the ingredient and the feed. A salt taste comparable to that of pickle is equivalent to about 5% salt level. Salt taste comparable to that regular dishes may have 2-3% salts.

FIELD TESTS

Fish meal

The fish meal available in the market is mostly an admixture of less than 50% fish of the worst quality, squilla, and prawn heads, crabs, shells and other sea waste. To increase the protein level in such fishmeal, urea was added previously. But at present these are adulterated with meat meal, leather meal, silk worm pupae meal, feather meal, hair meal etc. which is rich in protein but with poor digestibility. The poor performance of the birds in farms using fishmeal is mainly due to its very poor quality and digestibility. Besides the above adulteration, the fishmeal contains lot of sand and salt. To detect this, mix about 25 grams (handful)of fishmeal in about 100 ml of water in a big glass tumbler. Stir well with a spoon or stick. Taste a drop of this water. If the salt taste is comparable to that of soup, the fish meal will be having about 4-5% salt. Then pore down the supernatant fluid and assess

the quantity of sand left at the bottom of the the glass tumbler. This will give a fair idea about the sand and silica level in the fish meal.

Rice polish

Hold sufficient quantity of rice polish in hand and tight the fist/grip. Then release the fingers. In a good quality rice polish, the impressions of the finger will remain, without crumbling. Moreover, the rice polish must be fresh with fine aroma and taste, soft to touch and free from weevil attack and rancidity.

Grains

Examine for their colour, consistency. weevil attack and other foreign materials like sand, stones, cobs, husk, bran etc. Examine the germ portion of the grain for mould growth. Randomly examine 50 to 100 grains from different bags for mould growth, if any. If more than 10% of the grains show visible mould growth, it may be rejected. If 3-10% of the grains are affected send the sample to laboratory for mycotoxin estimation and confirmation.

By biting, touching and shaking , the moisture level can be assessed with fair degree of accuracy. If more precision is needed, weigh 100g of ground grain to one-gram accuracy, fry it in a frying pan with constant stirring for about 10 minutes. Do not char it. Cool and weigh again; which will be the dry matter level in it.

Oil cakes

By organoleptic tests, the quality, freshness and adulteration level in oil cakes can be assessed with fair degree of accuracy. The moisture level can be estimated as in the case of grains. By seeing the colour, smelling and chewing one can assess the extent of roastingof the soybean meal, which is essential to denature the trypsine inhibitor and other anti nutrients.

Test to assess husk level

Winnowing is the best method to detect husk in the feed stuff. Husk separated from a weighed quantity of the material allowed to fall against blowing light wind can be weighed.

Sieving

Sieving differentiates contaminants based on particle size.

Test weight

This gives an idea of the bulk density of the ingredient. As bulk density increases, nutrient content also increases. A litre measure of the ingredient is weighed to arrive at the test weight or bulk density. For example in maize, the normal test weight is 725 to 775 kg /100 litres or one litre weighs 0.725-0.775 kg. Oil cakes have to be ground to pass through 1mm or 2 mm sieve before performing test weight. The level of the moisture also influences the test weight. The test weight of the ingredient estimated can be compared

with a standard. The standards for the materials can also be developed in the mill itself by recording the test weights of the best material received in each category.

Advantages of field tests

1. These tests are quick and instant.
2. Helps in purchasing or rejecting the feed stuffs on the spot.
3. Does not involve any cost.
4. Problems like adulteration, rancidity, weevil attack, caking and other spoilage can more easily be detected by organoleptic tests.
5. These tests will decide the type of laboratory tests to be carried out.

Disadvantages

1. Needs more experience in assessing the quality, organoleptically.
2. Organoleptic and other field tests may not be acceptable in case of legal disputes.

Importance of quality control through Laboratory testing

1. Ensuring purchase of raw materials which should meet contract specifications
2. Precisely knowing the proximate and chemical compositions of the purchased raw materials.
3. Quantifying toxic substances, if any
4. Finding the adulterants and contaminants in the raw materials
5. Making a fair payment for the raw materials based on their composition.
6. Ensuring to work out a balanced ration on lease cost basis and
7. Enhancing the productivity.

Conclusions

1. Rapid field tests are suitable, both for small and large feed manufacturers, while purchasing the feed stuffs.
2. Field tests are money and time saving.
3. Field tests will decide the nature of laboratory tests to be carried out.
4. Field tests will supplement and complement the laboratory tests.
5. Laboratory tests are more accurate and this method adopted for medium and large scale operations.

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ROLE OF TANUVAS FEED TECHNOLOGIES ON COMBATING FEED IMBALANCE

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Combating Ruminal acidosis through TAUVAS Supplement

TANUVAS GRAND supplement

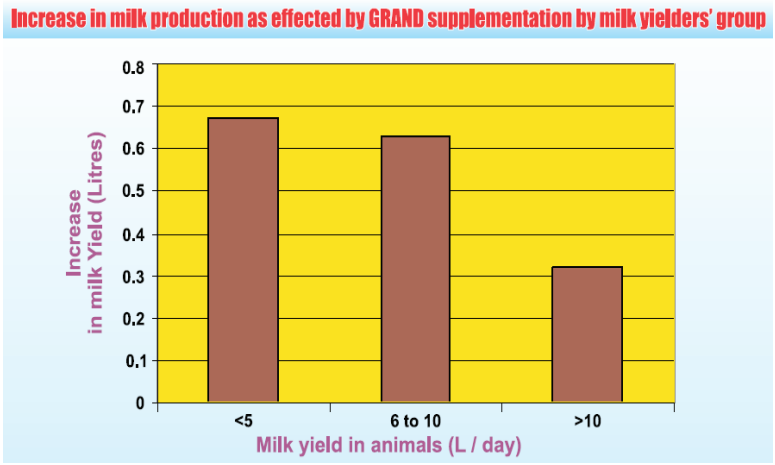
Ruminants (cow, buffalo, sheep and goat) have complex and very specialized digestive system. Ruminants have four stomachs out of which a large fluid filled sac containing microorganisms is called rumen wherein most cellulose digestion occurs. In ruminants, rumen microorganisms play an important role in facilitating the digestion of the feed and fodder and further get digested in the lower gut to provide quality microbial protein to the animal, it is imperative to support the nutritive requirement of these beneficial microorganisms to facilitate digestion of low quality feed and fodder as well as to reap the high quality microbial protein that is provided by them. A technology to promote the livelihood of downtrodden through enhancing milk production by TANUVAS GRAND Supplement was developed during 2013 by this Department.

G stands for Gruel, R stands for rooted, A stands for Additive, N stands for Nourishment and D stands for Drops.

Survey on the Tamil nadu feeding pattern of cows revealed that about 67% of the farmers possessing low yielding cow feed on gruel based unbalanced feed. Often the gruel includes kitchen waste, table waste etc., which do not support the rumen microorganisms. It is pertinent to note that rumen microorganisms play an important role in facilitating the

digestion of the feed and fodder that the cow consumes. In addition these microorganisms also get digested in the lower gut and provide quality microbial protein to the animal. Since rumen microorganisms play an important role in facilitating the digestion of the feed and fodder and further get digested in the lower gut to provide quality microbial protein to the animal, it is imperative to support the nutritive requirement of these beneficial microorganisms to facilitate digestion of low quality feed and fodder as well as to reap the high quality microbial protein that is provided by them.

Field trial was conducted in six districts covering over 5000 cows to assess the effect of TANUVAS GRAND supplementation on milk production. It was observed that upon 20 ml of GRAND supplementation per animal per day, the milk yield started to increase from seventh day itself. It was concluded that TANUVAS GRAND supplement is beneficial to nitrogen deficient diet and is more effective when diet contains sufficient energy. TANUVAS GRAND supplement increases milk production by 500 ml to 700 ml /day/cow in majority (84%) of cows. Apart from increase in milk yield TANUVAS GRAND supplement improves the gut health and prevents SARA (Sub Acute Ruminal Acidosis). The effect of TANUVAS GRAND supplement on milk yielding capacity of cows is presented below:



The effect of TANUVAS GRAND supplement varies according to the level of milk yield. It has profound effect on cows yielding less than 10 litres of milk/day.

GRAND is an aqueous solution and 20 ml (Morning 10 ml & Evening 10 ml) are required per day per cow to cater to the needs of rumen microorganisms.

The cost of 20 ml of GRAND is only one rupee as against Rs. 10 being the revenue generated for 750ml of additional milk / day. This also prevent the occurrence of Sub Acute Rumen Acidosis (SARA) and laminitis in dairy cows fed high level of soluble carbohydrates.

This technology have also crossed Indian border and proved to be useful in increasing 1000 ml of milk in Malawi and Africa.

Our results have proved that TANUVAS GRAND supplement works well under the following conditions and are considered as the criteria for selecting target farmers.

- Cows that are fed on Gruel based diet. Gruel includes kitchen waste, table waste, rice washing water. In Tamil gruel is referred as "Pulicha thaneer", "Kazhane thaneer", "kanjee".
- Cows that are fed with cereals (either ground or boiled) in addition to gruel.
- Cows in milking and are within nine months of post calving.
- TANUVAS GRAND supplement is also recommended to milking pregnant cows that are within nine months of post calving period.
- TANUVAS GRAND supplement is suitable only to unorganized farm having less than four cows.
- TANUVAS GRAND supplement is also recommended to cows yielding less than 10 liters of milk / day.

NUTRITIONAL APPROACH THROUGH ANIONIC SALTS TO REDUCE MILK FEVER

The demand for calcium in dairy cows is greater in early lactation during transition phase. This can cause milk fever, metabolic disease in dairy cows. To counteract the situation, a nutritional approach to mobilize the stored calcium in the bone is needed.

Mechanism

A nutritional approach to manage milk fever involves monitoring specific minerals in the dairy cow's diet. The minerals are sodium and potassium which are cations having positive charge and chloride and sulphur which are anions having negative charge. Cations in the diet promote alkaline metabolic state whereas anions promote a more acidic metabolic state. The acidic metabolic state can reduce the incidence of milk fever. The transition cow's diet has to be calculated for sodium, potassium, chloride and sulphur levels. Supplementation of anions lowers the blood pH, mobilizes the calcium from the bones and helps to prepare the cow to meet more calcium demand required for milk production immediately after calving. This process will help to reduce the incidence of milk fever in dairy cows.

Dietary Cationic Anionic Difference (DCAD) approach

The calculation for DCAD (Dietary Cationic Anionic Difference) requires converting the various anions and cations in a cow's diet into milliequivalents (mEq). For the cows in transition period, the cow's diet should be in negative charge (-10 to -15 mEq/100g DM). The normal feeding pattern of cows in Tamil Nadu have a DCAD of about +200 meq / 100g of diet dry matter which is cationic in nature. Common feeds and fodders typically have a higher DCAD whereas hydroponic fodders have negative DCAD value. The DCAD of a diet can be lowered by increasing anions. Reducing the DCAD value of diet to -10 to -15 mEq/100g DM creates a consistently measurable metabolic acidosis, which is marked by a reduction in urinary pH. This can be achieved by feeding anionic salts in cow's diet. This will mobilize calcium from the bones and increases the serum calcium level thereby the incidence of milk fever can be reduced.