Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume– 6 | Issue - 11 | November - 2019 | Pages - 130

Urban farming

Emerging trends and scope

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 6, Issue-11 November-2019

Eutrophication- a threat to aquatic ecosystem

V. Kasthuri Thilagam[1] and S. Manivannan[2]

[1]Scientist, [2]Principal Scientist

ICAR – Indian Institute of Soil & Water Conservation,

Regional Centre, Udhagamandalam –643004, Tamil Nadu

**Corresponding Author: kasthurisk@gmail.com*

Water pollution is now becoming one of the most challenging environmental threats in the world. Nutrient enrichment in water bodies due to natural and anthropogenic practices are the major causeof water pollution. This process of nutrient accumulation or enrichment in water bodies is called Eutrophication.The word 'eutrophic' comes from the Greek word "Eutrophos" meaning well-nourished. This nutrient enrichment will results in excessive growth of algae or cyanobacteriae, and aquatic plants whichcreatesevere problems in the aquatic ecosystem. Phosphorus and nitrogen are the major nutrient which are responsible for aquatic plant and algae growth.These nutrients also supports the native aquatic life when they are in optimum. However, an over-abundance of these nutrients can over-stimulate plant and algae growth such that they create water quality problems.

Fig 1: Water body infected with the plants

SOURCES OF NUTRIENT ENRICHMENT:

Untreated industrial wastes and the domestic sewage are the major sources of nutrient enrichment from the urban areas. Indiscriminate use of chemical inputs for agriculture, soil erosion and runoff also responsible for the nutrient overload in the water bodies. Green Revolution in agriculture has introduced many high yielding varieties which requires higher amount of nutrients forincreased agricultural production. Hence the usage of chemical inputs particularly chemical fertilisers has increased many folds. The excess chemicals left in the soil will be carried along with water and soil during the process of soil erosion and deposited in the water bodies which eventually increases the nutrient concentration of the water bodies.

EUTROPHICATION PROCESSES

There are two kinds of eutrophication processes one is natural and another one is anthropogenic process.

Natural eutrophication:

This process depends only on the natural factors like local and natural features of the area. Over centuries, the nutrients and organic materials will built-up in the water bodies due to excess soil erosion and runoff and they are able to support more living organisms, including algae and other water living plants. The length of this process depends on the characteristics of the catchment area of the waterbody, topography and other climatic factors.

Anthropogenic or Cultural eutrophication:

This process is mainly associated with human activities which accelerate the eutrophication process (e.g. domestic and industrial sewage water, application of more quantity of fertilizers to the agricultural fields). Human-caused increase in biological productivity of aquatic ecosystem also referred as cultural eutrophication. It is also reported that aapproximately 15% of the Indian population contributes phosphorus-containing wastewater effluents to rivers and lakes, resulting in eutrophication.Phosphorus is the nutrient that can stimulate the algae growth in water bodies. Soil erosion caused by the mismanagement of lands, urbanization, deforestation and agriculture without proper soil conservation measures in sloppy lands.

Trophic status of the water body:

By assessing the 'Trophic status' of the water body we can know the level of eutrophication and water pollution. The total amounts of phosphorus and nitrogen, chlorophyll a and water transparency are usedas key-parameters in the detection of changes in an aquatic environment due to eutrophication. The following terms are used to describe the trophic status [Walmsley, 2000].

Oligotrophic -Nutrient concentrations will be very low to support aquatic animal and plant life.

Mesotrophic - Nutrient concentrations in intermediate levels, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems.

Eutrophic -Rich in nutrients, very productive in terms of aquatic animal and plant life and showing increasing signs of water quality problems.

Hypertrophic -Nutrient concentrations will be very high, the plant growth is determined by physical factors. In this condition water quality problems will be serious and almost continuous.

Table 1.The amount of total N and P in various eutrophicated water bodies

S.No	Eutrophic status	TP (µg/L)	TN (µg/L)	TNI
1	Oligotropic	5-10	250~600	0~30
2	Mesotrophic	10-30	500~1100	31~60
3	Eutrophic	30-100	1000~2000	61~100
4	Hypereutropic	>100	>2000	>100

(Source :Xiao-e YANG et al.,2008)

TN: Total nitrogen; TP: Total phosphorus, TNI: Total nutrient status index

THE CAUSESOF EUTROPHICATION

Point sources: Point sources are definitive, localized sources of nutrients and sedimentary pollution. Here the sources of nutrients are very close and they directly flows in to the water body eg: Waste water from industries, municipalities and Aquaculture.

Non point source / Diffuse sources: Nonpoint sources are diffuse sources of nutrients and sedimentary pollution. A primary nonpoint source of eutrophication includes runoff from domestic areas,Agriculture, forestry, Atmospheric deposition and Natural background load.

SOIL EROSION AND NUTRIENT ENRICHMENT

Though soil erosion is a natural process but intensity of erosion in agricultural land is many times higher than the natural conditions, and are often much higher than rates of soil formation (Edwards, 1988). Soil erosion neither caused by natural agents or induced by the anthropogenic activities will cause both on-site and off-site effects which are dangerous to all living things in the earth.

1. On-site effects like loss of fertile top soil which in turn leads to reduction of crop productivity.

2. Off-Site effects like increased siltation in the water bodies that reduces the storage capacity of the water bodies. Along with the sediment soil nutrients also deposited in the water bodies which enriches the nutrient concentration. The nitrogen, phosphorus and carbon, is transported with the sediment and through transformations this will be easily available to the aquatic plants and algae and ultimately degrades the water quality (Cullen, 1995). These suspended sediments and the aquatic plants will not allow the sunlight to penetrate inside and thereby adversely affect the water living organisms like fishes. They also reduce the dissolved oxygen level in the water which decreases the ability of the organisms to breath and feed and the biodiversity.

IMPACT OF EUTROPHICATION ON ENVIRONMENT:

Eutrophication has now become a widespread problem for freshwater ecosystems.This process creates major ecological, social and economic impacts whichinclude oxygen depletion, massive fish kills, loss of biodiversity, decreased water potability and excessive growth of toxic algal blooms (Schindler and Vallentyne, 2008).

- Nutrient enrichment in water bodies encourages the excessive growth of plants which increase the evapotranspiration from the waterbody leads to decreased water level.
- Due to nutrient availability in the water body the toxic cyanobacteria will grow profusely and they will make the water unpotable.
- As the algae have short life spanand die soon, to decay this dead organic material bacteria population will increase and use the oxygen present in the water. Hence the oxygen level will decrease and the organism living in water bodies will die eventually.
- The excess growth of algae and other plantscan result in decreased water clarity, a reduction in sunlight penetration and a decrease in oxygen levels and this condition is known as anoxia. This anoxia condition can cause the death of fish and other aquatic organisms.
- The algal blooms also release neurotoxins, hepatoxins, dermatoltoxins, gastrointestinal toxins and cytotoxins and these toxins are hazardous to both humans and animals.
- The aquatic biodiversity will get affected or altered
- Reduced the aesthetic value due to heavy weeding

CONTROL OR MANAGEMENT OF EUTROPHICATION

The present climate change scenario and blooming human population are the potential factor to accelerate the problem of water pollution. Hence, there is an immediate need by the policy makers to find out the ways and means to minimize the intensity of Eutrophication problems and ensure the conservation of natural resources. The responsibility of every single citizen also very crucial for minimising the problem

- Catchment areashould be treated with proper soil and water conservation measures to reduce the nutrient load from sediment and runoff
- Farmers in the agricultural water shed should be educated to apply soil test based fertilisers and avoid excess chemical inputs
- Regular de-siltingof water bodies will helps to keep the waterbodies in hygienic condition
- Weeding or removal of unwanted plants from the water bodies
- Aquatic weedscan be effectively used for production of organic compost
- Proper domestic waste management and disposal to the designated sites
- Regulating the sewage disposal mechanism

Control and management of eutrophication is a complex issue that requires collective efforts of scientists, policy makers, and citizens to reduce the nutrient inputs

in waterbodies and restore the nature as well as to conserve the very precious natural resource to meet out the demand of burgeoning population.We should aim at providing high quality water and zero-tolerance to degradation of natural resource.

Synthetic seed technology

Sridevi Ramamurthy

Department of Seed Science and Technology,
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.
Corresponding Author: agrirose.28@gmail.com

Synthetic seeds also known as artificial seeds or synseeds are defined as artificially encapsulated somatic embryos, shoot buds, cell aggregates, or any other tissue that can be used for sowing as a seed and that possess the ability to convert into a plant under in vitro or ex vitro conditions and that retain this potential also after storage. The technology designed to combine the advantages of clonal propagation with those of seed propagation and storage. The concept of synthetic seed was first conceived by Murashige (1977) and first synthetic seeds were produced by Kitto and Janick (1985) in carrot. Redenbaugh *et al.* (1984) developed a technique for hydrogel encapsulation of individual somatic embryos of alfalfa.

Figure 1. Synthetic seeds

PARTS OF SYNTHETIC SEED

A typical synthetic seed has the following parts such as: (a) **Plant propagule** (somatic embryo or shoot bud) (b) **Matrix**, is a gelling material encapsulating nutrients, growth regulators, anti-pathogens, bio-controllers, and bio fertilizers (c) **Seed shell** these are the artificial seed coats prepared with complex mixture of alginate-gelatin.

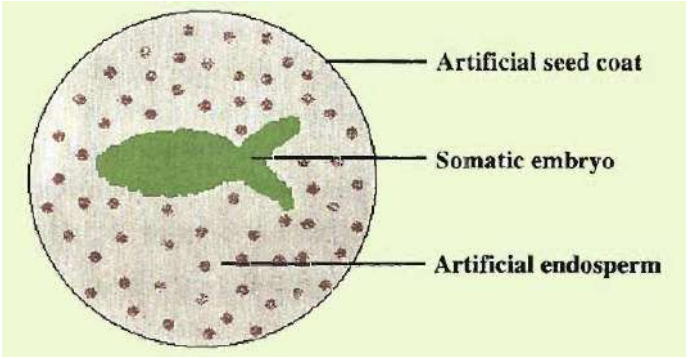


Figure 2. Parts of synthetic seed

Procedure for Synthetic Seed Production

The following are the different steps involved in artificial seeds production;

1. Establish somatic embryogenesis
2. Mature somatic embryos
3. Synchronize and singulate somatic embryos
4. Mass production of embryos
5. Encapsulation of matured somatic embryos
6. Desiccation
7. Field planting

Somatic Embryos

Somatic embryos are bipolar structure with both apical and basal meristematic regions which are capable of forming shoot and root, respectively. Somatic embryogenesis is the development of embryos form vegetative cells with in vitro systems. Specific tissues have a capacity for somatic embryogenesis in cultural systems.

Encapsulation of Matured Somatic Embryos

Somatic embryos produced naked embryos without storage materials and protective layer (seed coat). This is very difficult for handling so this demand the encapsulation and coating. The somatic embryos produced are encapsulated using gel agents like agar, alginate, polyco, carboxy methyl cellulose, guar gum, sodium pectate etc. Among these alginate encapsulation was found to be more suitable and practicable. Alginate hydrogel is frequently selected as a matrix for synthetic seed because of its moderate viscosity and low spinnability of solution, low toxicity for somatic embryos and quick gellation, low cost and bio-compatibility characteristics and protect somatic embryos against mechanical injury.

The propagules (embryos/ axillary buds/ shoot tips) are carefully isolated from aseptic *in vitro* cultures and blot dried on sterilized filter paper, and is then mixed in sodium alginate prepared in nutrient medium. The propagules are then picked up manually by forceps and dropped into a solution of calcium chloride for about 40 minutes. After the incubation period, the beads (synthetic seeds) are recovered by decanting the calcium chloride solution and washing them in sterile water for 3 to 4 times before culturing on nutrient medium or on different substrates such as filter paper, cotton or soil for their growth and conversion to plants.

TYPES OF ARTIFICIAL SEEDS

Two types of artificial seeds (encapsulated somatic embryos) are commonly produced: desiccated and hydrated.

Desiccated artificial seeds

Desiccated artificial seeds are achieved from somatic embryos either naked or encapsulated in polyoxyethylene glycol followed by their desiccation. Desiccation can be

applied either rapidly by leaving artificial seeds in unsealed petri dishes on the bench overnight to dry, or slowly over a more controlled period of reducing relative humidity. These types of artificial seeds can be only made in plants whose somatic embryos are desiccation-tolerant. The desiccation tolerance of somatic embryos can be induced using a high osmotic potential of the maturation medium.

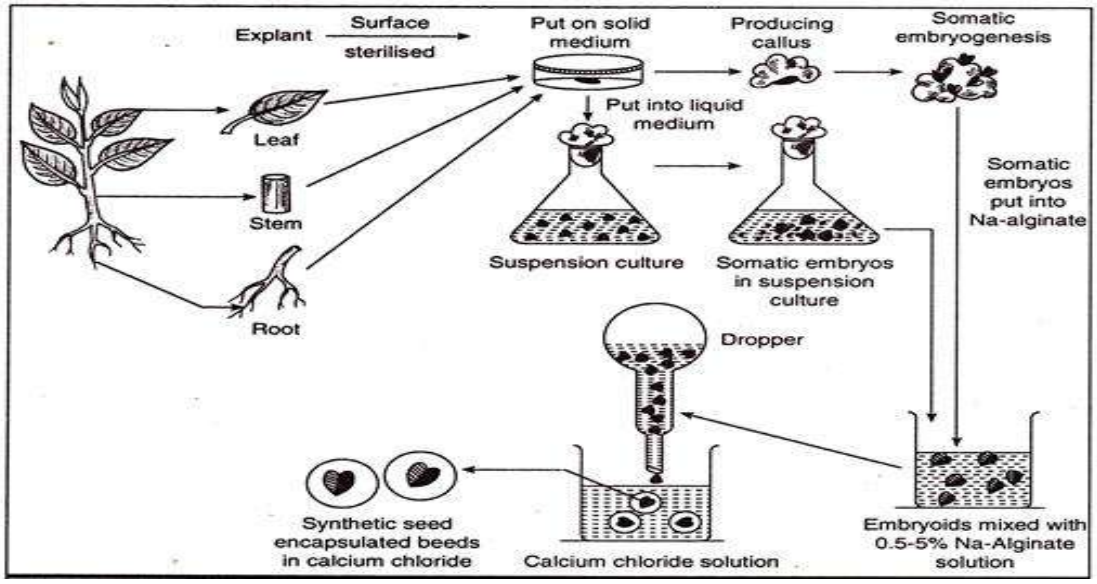


Figure 3. Steps in production of synthetic seeds

Hydrated artificial seeds

Hydrated artificial seeds can be produced by encapsulating somatic embryos in hydrogel capsules. They are produced in plant species which are recalcitrant and sensitive to desiccation. Encapsulation has been expected to be the best method to supply protection and to convert the in vitro micropropagules into artificial seeds or synseeds, and it is an important application of micropropagation to develop the success of in vitro-derived plant delivery to the field.

Advantages of Synthetic Seeds

1. Ease of handling while in storage
2. Easy to transport
3. Has potential for long term storage without losing viability
4. Maintains the clonal nature of the resulting plants
5. Multiplication of non-seed producing plants, ornamental hybrids or polyploids plant
6. Propagation of male or female sterile plants for hybrid seed production
7. Germplasm conservation of recalcitrant species
8. Multiplication of transgenic

REFERENCES

Kitto, S.l. and Janick, J. 1985. Production of synthetic seeds by encapsulating asexual embryos in carrot. Journal of American society of horticultural science. 110: 283.

Murashige, T. 1977. Plant cell and organ cultures as horticultural practices. In Proceedings of the symposium on tissue culture for horticultural purposes, Belgium.

Redenbaugh, K., Nichol, J., Kossler, M. E. and Paasch, B. 1984. Encapsulation of somatic embryos for artificial seed production. In vitro Cell Dev Biol. 20: 256-257.

https://www.agriquest.info/synthetic_seeds.php

https://www.biotecharticles.com/Agriculture-Article/Synthetic-Seed-Production-and-Application-104.html

Hydrogel absorbents in farming: Advanced way of conserving soil moisture

Rakesh S[1*], Ravinder J[2] and Sinha A K[1]

[1]*Department of Soil Science& Agricultural Chemistry, Uttar BangaKrishiViswavidyalaya, Cooch Behar, West Bengal*

[2]*Department of Soil Science & Agricultural Chemistry, Agricultural College, Aswaraopet, PJTSAU, Telangana State*

**Corresponding Author: rakisavan.940@gmail.com*

WHAT ARE HYDROGELS...??

Hydrogels are superabsorbent polymers, also called as water gels, is a synthetic water absorbing polymer material. These cross linked polymers have a great amount of capacity to absorb water without dissolving itself in water. The unique character of hydrophilic functional groups in it resist the dissolution. Hydrogels can absorb 400 times its weight of water, when the surrounding environment begins to dry out, it releases 95 % of water it stored earlier. Again, when it is exposed to water, starts rehydrate and repeats to absorb water. This is completely biodegradable, can work for 2 to 5 years.

Downsides of irrigation practices

Since traditional to modern agriculture, surface draining of irrigation is common. This is flawed system and it damages the crop stand, as the plant can utilize less than 50 % of what we applied, remained portion is lost through leaching/surface evaporation. However, modern technologies like drip irrigation and sprinkler irrigation efficiently utilize the water but the cost to install is exorbitant for the small land holders. Especially, in dry zones where distinct scarcity of water persists discourage the farmers from adopting advantageous technologies. It is already projected that by 2025 there will be a water scarcity in India require immediate redress. Irrigation practice in agriculture consuming 80 % of available water. Hence, there is a great need to conservesoil moisture.

Potential role of hydrogels in agriculture

Low water retention ability, surface loss and leaching are the three major soil conditions that slowdown the crop growth and yields. Hydrogels play significant role in farming that improves the soil quality, store enough water, and resist drought stress. It improves the seedling development ultimately increase the crop yields. The unique character of hydrogel of absorbing and releasing water can provide optimum moisture

to seedling germination and maturation reduces the seedling mortality in nurseries. Using hydrogels in freezing zones, allow gels to absorb excess moisture that kills plant by freezing the root tissues. So it regulates the seedling growth temperature and prevents death. Hydrogels helps save water and labour by reducing the irrigation frequency. Due to the absorption of soil nutrients along with moisture, it reduces the overuse of inorganic fertilizers and pesticides in farming. It helps in flocculation of soil matter that creates a congenial environment for the root growth by improving the soil aeration. Some important soil-physical benefits are illustrated in below figure. Hydrogels are extensively used in crop cultivation, municipal gardening, moisture conservation techniques, drought management, forestry plantations etc. to conserve soil, minimize chemicals application and achieve the maximum yields.

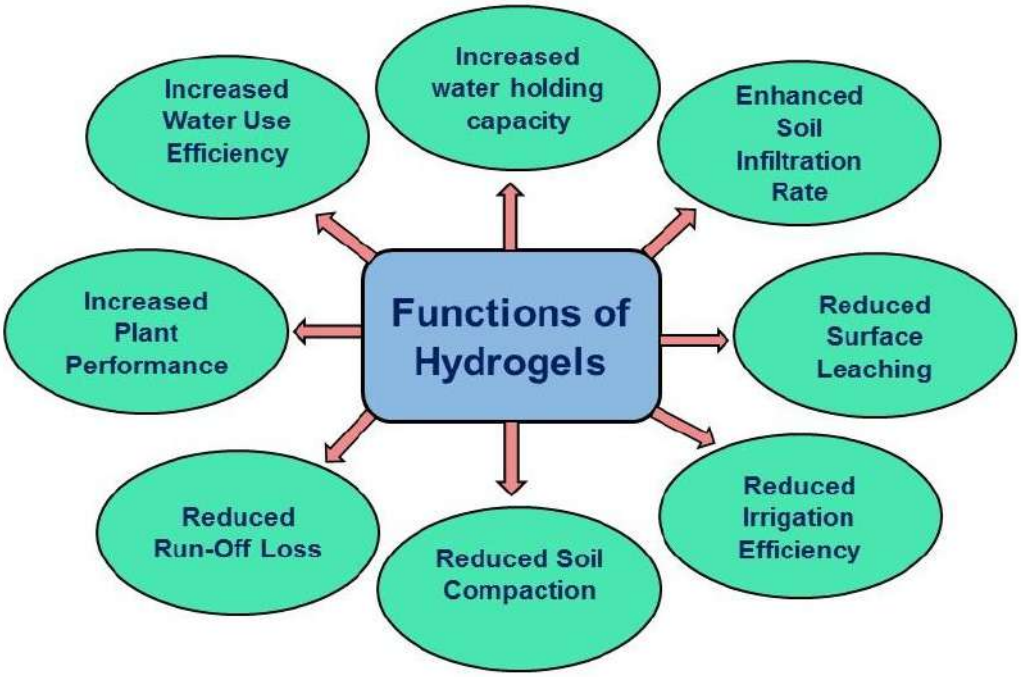


Fig: Important soil-physical benefits of hydrogels

How to apply…??

We can apply hydrogels in two methods

1. *Wet method to surface soil:*

The initially wetted topsoil is sprayed with polymer solution followed by drying creates a water stable aggregates that resist the soil erosion. This method is adopted to reduce higher water consumption in case of poor soils with low water retention capacity; immediately after sowing. Surfactants have positive effect on soil aggregate stability.

2. *Dry method to subsoil:*

The dry polymers (PAAm or PVA) are used in sandy soils; applied in subsoil (about 15-25 cm depth) by proper mixing. This benefits the soil structure, decreases the surface runoff. This method is highly suitable for long-term intentions but not recommended for immediate sowing as the polymer must absorb water otherwise not beneficial.

How much to apply…??

An optimum mixing ratio is important to maximize the efficacy of the hydrogels. Since the moisture holding capacity of the soil varies, the application rates of hydrogels also varies with soil types. The application rates to the specific soil types are illustrated in below table; however, proper soil testing is needed to determine the appropriate dose.

Soil type	Application rate
Sandy (to delay permanent wilting point)	0.2-0.4 g/kg soil
Arid & Semi-arid	4-6 g/kg soil
Loamy (to reduce irrigation water by 50%)	2-4 g/plant pit
To prevent drought stress totally	225-300 kg/ha
To reduce drought stress	0.2-0.4 % of soil
To decrease water stress	3% by weight

(*Source:*vikaspedia.in/agriculture/best-practices/sustainable-agriculture/crop-management/hydrogel-agriculture-technology)

CONCLUSION

Due to harsh temperature, unpredictable rainfall, freezing and several external factors soils losing its suitable physical statusnecessary for the plant growth. Nowadays, supplying irrigation at the critical crop growth stages specially in arid and semiarid environments has also became a challenge to the farmers. Sand predominated soils are unable to hold enough moisture for the root growth. Hydrogel polymers play a significant role in farming; a way to enhance soil moisture content and release the absorbed moisture during dry periods of crop growth. Adoption of this technique especially in the water crisis zones is effective to manipulate the soil physical condition that improve the water holding capacity of the soil and increases the crop yields at optimum levels.

Urban farming-emerging trends and scope

Maneesha S. R[1]., G. B. Sreekanth[2], S. Rajkumar[3] and E. B. Chakurkar[4]

[1]Scientist (Fruit Science), Horticulture Sciences section
[2]Scientist (Fisheries Resource Management), Animal Sciences section
[3]Scientist (Veterinary Pathology), Animal Sciences section
[4] Director (A)
ICAR-Central Coastal Agricultural Research Institute, Old Goa, Goa- 403 402
Corresponding Author: Maneesha.sr@icar.gov.in

Urban farming refers to cultivation of plants and rearing of animals and fishes within and around intra-urban and peri-urban/sub-urban areas. According to UN DESA (2018), 55% of 7.7 billion world population lives in the urban region and it will reach 68% by 2050.Urbanites completely depend on markets for food and their fast food habits and cozy life style affect their health and nutrition. Several urban kids suffer malnutrition though the purchasing power of their parents is high. Moreover, lifestyle diseases such as diabetes, obesity, depression, anxiety and stress are common in urban dwellers. Fresh fruits, vegetables, meat, milk and fish purchased from market contain varying amount of pesticides, weedicides, preservatives and adulterants. Urbanites are aware of the harmful effects of these chemicals and prefer safe organic agricultural produces. Market available organic produces often contain heavy metals and microorganisms. Growing our own food with the local resources in our surroundings is the best method to fight this issue.

Urban agriculture is being practiced in homestead or in micro level or on comparatively large scale on locations away from the residence. Community farming is practiced in private land (owned/ leased) or on public land (parks, roadsides, stream sides and railway sides), or semi-public land (school grounds, hospitals, public offices). The components of the farming system include food products from different types of crops (vegetables, fruits, flowers, spices, medicinal and aromatic plants and mushroom), livestock (poultry, rabbits, goats, sheep, cattle, and pigs), fishes (carps, catfishes, and cichlids) and honeybee.Approximately800 million people (10.38 % of total world population) in urban areas practice urban farming.

BENEFITS OF URBAN FARMING

Health and nutritional benefits

Urban farming assures food and nutritional security to the urban family and communities. Fresh, organic produces reach the plates of the consumers without

transportation and storage losses. ICMR recommends 150 g of vegetables, 50 g of green leafy vegetables, 100 g of tubers, and 100 g of fruits per person per day. But per capita consumption of fruits and vegetables is far below this recommended level in in India. Growing safe and fresh vegetables and fruits in our own households can cover this gap in per capita consumption. Moreover, the engagement of the people in agriculture activities would keep them active and healthy (physically and mentally).

Socio-economic benefits

Expenditure towards food and health could be considerably reduced by urban farming, which will substantially contribute to the family income. In community farming, the participatory approach will increase the bond between the residents or the members and this co-operation synergistically contribute to the wellbeing of the society. Community garden is a place where the members can spend leisure time and arrange community functions.

Environmental benefits

The urban farming can reduce the heat, dust and pollutants, supply oxygen and make the households livable. The pollinating insects and birds in the verdure help to balance the biodiversity. Moreover, the biodegradable wastes can be converted to manures and utilized in the farming.

TYPES OF URBAN FARMING

Urban framing is classified into various types based on the space where it is practiced. Micro farming or family farming is cultivation in small containers in a limited space mostly by a single family. It includes kitchen garden/ terrace garden/ window garden/balcony garden and backyard garden. In community farming, a group of people resides within a colony share the activities. This farming practice can be in a common barren land or on a public place. Farming in schools, colleges, hospitals or government or semi government institutes is called institutional farming. In schools, the produce from the garden can be used for the preparation 'midday meal'. It will help to attract the children towards farming and nature. In institutes, gardening can be a leisure time activity and physical exercise. In commercial farms, products are sold in nearby local markets or households. Mechanization, large-scale structures and advanced technologies may be present. In these farms, the produces are transported to different places inside or outside the city. The investment in commercial farms may be huge and the labour involved in this is high.

A model terrace farming unit with horticulture, animal husbandry and fisheries components

PRINCIPLES OF URBAN FARMING

In urban farming, the major components to be considered are layout, container type, plants suitable for the space, light and containers. The principles that ensures the success of the urban farming are,

- Do it by yourself -The complete benefit of urban farming can be achieved only when you are involved in the farming activities starting from planting to harvest.
- Grow local species- The local varieties of crops should be encouraged in the urban garden.
- Cultivate organically- In urban farming, especially in micro farms, organic cultivation is preferred since it uses eco-friendly inputs and create minimal impacts to the environment.
- Reuse and recycle- Plastic and metallic containers, buckets, bottles and boxes can be used to grow the plants and feed the birds and animals. Recycling of the resources in the garden itself will reduce the cost of inputs. Biodegradable materials can be composted and rainwater harvested can be used for irrigation.

- Practice crop rotation- Instead of growing similar type of plants always, crop rotation should be practiced based on season and requirements. This will also help to regulate the nutrients replenishment and pest and disease management.
- Keep records- Always keep a record of the input used and harvest details. This will help to work out the economics of the garden. Records on disease and pest outbreaks will help to take preventive measures.

Components of urban farming

Horticulture**:** Fruits, vegetables, flowers, spices and medicinal and aromatic plants are the horticulture components that can be included in the urban farming. These crops can be cultivated by different systems of cultivation.

1.1. Micro farming of horticulture components: Terrace farming, balcony gardens, window gardens, kitchen garden

1.2. Soilless cultivation of horticulture components: Hydroponics, Aquaponics, Aeroponics, Microgreens

1.3. Protected cultivation of horticultural components: Green house, shade net houses, poly houses and glass houses

2. Livestock and poultry: Rabbits, goats, poultry, ducks, quails

3. Aquaculture and fish farming: Cultivation of various species (Carps, catfishes and cichlids, ornamental fishes),

4. Mushroom cultivation: Button mushroom, milky mushroom, paddy straw mushrooms and oyster mushroom

5. Apiculture (Honeybee keeping): *Apis mellifera* and *Apis cerana*

1. Horticulture

Horticulture components for the domestic purpose can be cultivated by micro farming on terrace or balcony. Nutritious and safe vegetables can be produced by soilless cultivation. Highly nutritious sprouts are nutritious and easily produced pulses (e.g. Green grams), microgreens and baby greens are meant for the exclusive production of high quality leafy vegetables. In early stage of growth, they have high level of nutrients and low anti-nutritional or toxic factors.

Micro farming

The site selected for micro framing should receive 3-4 hours of sunshine a day. Empty tins, plastic crates, wooden boxes, HDPE bags, buckets, drums, PVC drainage pipes, packaging bags, bottles, thermacol boxes, bamboo baskets *etc* can be used for planting. Base layer of the pot should be with coconut fiber, dry grass or leaves. Potting mixture (Sand, soil and FYM in 1:1:1 ratio) is ideal as the growing media. Coirpith, vermiculite, perlite are some other media that can also be used for planting. Green leaf manure, oil cakes, wood ash, press mud, animal manures, poultry manure, fishmeal and blood meal are rich source of nutrients. Biofertilizers such as Rhizobium, Azotobacter, VAM and special organic nutrient sources like vermin compost. Vermin wash,

panchagavya, Amrit mitti, Amrit pani (Amrit jal) *etc* can also be used in the urban gardens. The vegetables, which need to be transplanted, have to be raised in protrays or beds before planting in the main field or pots. e.g. Tomato, brinjal. Bhindi, cluster beans and cow pea can be directly sown in plot or pot. Tomatoes, amaranthus and cucurbits are sown in portrays or raised beds and transplanted. The vegetables in the garden should be selected according to the season. Drip and sprinkler can be installed wherever possible. Hydrogels can help in water saving (90 %) and reduce the number of irrigations. Drainage holes should be provided in pots to avoid water stagnation and rotting of roots.

Growing plants need support to manage the weight of foliage and fruits. Bamboo, iron bars, sticks and PVC pipes can be used as support. Cucurbits like bitter gourd, snake guard, bottle gourd, pointed gourd, winged beans and cow pea can be trailed in pandals made with sticks, pipes, jute string, iron string or nylon string. Regular pruning exposes the plant to more sunshine, avoid extra load of leaves, and thus induce flowering. Clean; sharp equipment should be used for cutting the plants. Cuts should be treated with cow dung slurry mixed with fungicides to avoid infection. Avoid direct water contact to the injured portions. Prophylaxis is the best measure to avoid pest and disease management. Soil should be clean and free from pest and diseases spores. Soil solarizaton destroys the weed seeds, eggs of insects and sclerotia of fungi. Phyto-sanitary measures in the garden can avoid infections in the urban farming. Organic bio pesticides and yellow sticky traps can control the pests in the garden. Sucking pests like mealy bugs, thrips and mites can be controlled effectively by 3% neem oil spray. Dasagavya and other leaf decoctions are helpful to get rid of pests in the urban gardens. Hand weeding should be done at least once in a month. All the weeds need to be removed before flowering. Removed weeds can be composted or used for mulching after drying. Sparing a few fruits for seed collection will help to avoid market dependency for seeds for the next season. Seed should be collected from the well ripened fruits and after extraction; it should be dried and kept safe in moisture and insect proof bags.

Soil less cultivation of horticulture components

In soil less cultivation, the plants are grown in an inactive growing medium and the nutrients are delivered to the roots in an extremely soluble form. Chemically inert (no effect on pH balance), porous and clean growing media like vermiculite, saw dust, sand, peat moss, rock wool, perlite and clay pebbles are often used in the soil less cultures.

Hydroponics

In hydroponics, plants are grown in nutrient solution with physical support. Soluble fertilizers are mixed in water at required quantity. Green leafy vegetables and fruit vegetables can be grown very well in hydroponics systems.

Water culture: This is the simplest form of hydroponics in which plants are supported by thermocol sheets and air pump connected to the water system provides oxygen to the roots.

Wick system: It is a passive nutrient system with no moving parts. The plants can draw nutrient solution from the reservoir with the help of a wick.

Deep flow techniques (DFT)/ Nutrient Flow Technique (NFT): The plants are surrounded by an approximately four cm high nutrient solution and the system will recirculate the nutrients. The deep flow technique makes this type of hydroponic system safer, as the roots are still supplied in the event of a pump failure.

Nutrient Thin Film Techniques (NTFT): This system is characterized by a permanent flow of nutrients in a thin "film" around the roots. A pump transports the nutrient solution on an inclined plane (e.g. a tube), on which the plant roots lie. They are continuously watered and supplied with nutrients.

Ebb and flood system: Ebb and flood systems use a pump, which flood the plant level with nutrient solution. The plants sitting in net pots filled with substrate take up the required amount of nutrient solution. After switching off the pump, the excess nutrient solution is returned to the reservoir via an overflow. A residual amount remains to make the system less vulnerable if the pump should fail.

Hydroponic drip system: Via a drip line, the nutrient solution is dripped onto the substrate around the plants. The nutrient solution flows around the roots, so they are directly supplied. The excess fluid drains, drawing oxygen into the root area, which is important for plant growth.

Aquaponics

Aquaponics is a specific method of farming system that combines fish culture with soilless plant cultivation, is growing in popularity and gaining attention as an important and more sustainable method of food production in the urban areas. The aquaponics system represents a closed-loop recycling fresh water ecosystem between fish and plant species grown. The aquaponics system integrates both fish and plants into a recirculating agro system that utilizes natural nitrogen fixing microbes bacteria to convert fish wastes into plant nutrients. The nitrification process by the nitrogen-fixing bacteria reverts the fish wastes into nutrients for the plants. Therefore, the processes in the aquaponics systems helps to act as a biofilter before recirculating the waste water back to the fish tank. However, continuous monitoring of the water quality and the accessories is required for the efficient functioning of the aquaponics unit. The major units of the aquaponics system are fish tank system (for fish) and grow bed system (plants). The water pump system established in the fish tank system directs wastewater to the grow bed unit and the water is filtered in the latter unit using auto siphon system and the gravel bed. The grow bed can be prepared using plastic containers or tanks. Fish tanks are prepared from discarded barrels and discarded water tanks. There are two types of auto-siphon system used in the aquaponics unit and they are bell siphon and loop siphon. The feeding of fish is equally important in the aquaponics system. Fishmeal, soybean meal, groundnut oilcake, clam meal, prawn meal, wheat bran and oil can be

used for the preparation of the feed for fish. The rate of feeding should be 8-10% of the total weight of fish available in the aquaponics unit.

Aeroponics

In Aeroponics, the roots of the suspended plants are exposed to air and nutrient solution is sprayed to it. The plants absorb the nutrients from the misty atmosphere in a supported vase or holder. Water soluble fertilizers are used in the system and regular maintenance is required to avoid clogging of the system. Leafy vegetables, tomato, capsicum and ornamental plants are suitable for Aeroponics systems.

Sprouts/ microgreens/ babygreens

Microgreens are plants exclusively grown up to two leaf stage for sing it in salads and sandwiches. Micro greens are fresh and rich in nutrition that can be harvested within 14 days. It is used in salad, sand witches, pizzas, chutneys etc. Microgreens can be produced by a variety of vegetables and other crops. e.g. amaranths, radish, beetroot, paalak, wheat, fenugreek *etc*. They are dense source of nutrients than the mature plants and intake of these nutrients is easy. They are devoid of pest and diseases.

PROTECTED CULTIVATION OF HORTICULTURE COMPONENTS

Protected structures like shade net houses, poly-houses and glass houses can be constructed as part of the urban farming. The size of the structure and additional features can be incorporated as per the availability and necessity. Inside polyhouses, temperature and humidity can be controlled by fans and mist. Soil inside the polyhouses is usually solarized or fumigated to remove soil borne diseases. Since it is hi- tech system, high value crops like hybrid tomato, capsicum, cucumber, orchids, anthurims are cultivated inside the polyhouse.

2. Livestock and poultry

Small animals and birds can be included in urban farming without much effort. Rearing Rabbits, poultry and quail can be reared in small areas available in the terrace or balcony of urban houses. They can be fed with the locally available resources from the garden and their manure can be used to fertilize the plants.

Rabbits can be reared in small cages for meat purpose or for selling the breeding stocks. Breeds like Soviet chinchilla, Grey giant, New Zealand White etc will grow quickly. Male and female rabbits should be maintained in 3:7 ratios. Gestation period is 28 days and in the first litter it produces 5-6 bunnies and the litter size increase in the subsequent kindlings. The bunnies can be weaned at 30-40days and the female can be bred again. Bunnies will gain weight approximately 2kg at 3 months of age. The rabbit diet should include source of fibre from grass or vegetable wastes. A concentrate feed consisting of energy source like maize, rice/wheat bran, and protein source of soya bean meal or oil cakes (ground nut, gingelly, cottonseed) etc can be given @100g/animal /day.

Poultry birds like chicken and quail and can be reared in roofed cages with feeder and waterers. The floor space requirement in cage system is 450-525 sq.cm. (0.6-0.75 sq.feet) per bird. Single birds are kept in a single row or multi row cages. More

number of birds can be maintained in small areas by using battery cages with nipple drinking water provision, facility for egg collection and provision for removal of fecal matter. The birds can be fed with readymade layer feed or feed mixture prepared from ingredients like maize, rice husk, wheat bran, pearl millet, soybean meal, with vitamin and mineral supplements

3. Aquaculture and fish farming

It is a form of aquaculture in a limited space, like the rooftop or terrace. The technique can prove useful for urban farmers who want to cultivate fish for consumption or on a commercial scale but lack the space to do so. Food fish species such as tilapia, catla, rohu, common carp, pearlspot and Pangasius and even ornamental fish species can be grown in these systems. The size for the food fish species at stocking may range from 80-120 mm. The area of the tank or pond can be decided based on the available area on the rooftop. Similarly, the number of fish stocked would also depend on the area and depth available. Preferably, the depth should be 1 to 1.5 m and the stocking density of fish should be one fish per square meter. However, adequate strength for the roof and strong base for the bottom of the roof tank is necessary. Fishmeal, soybean meal, groundnut oilcake, clam meal, prawn meal, wheat bran and oil can be used for the preparation of the feed for fish. The rate of feeding should be 8-10% of the total weight of fish available in the system. Aquatic plants can also incorporate to facilitate the feeding for carp species and ornamental fish species. Exchange of the tank water (50%) is recommended fortnightly. Partial harvesting can be followed in these systems to cull the fast growing individuals. A marketable size of 700-900 g can be obtained in 8-10 months of culture period.

4. Mushroom cultivation

Commonly cultivated mushrooms are button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), paddy straw mushrooms (*Volvariella volvaceae*) and oyster mushroom (*Pleurotus* sp.). Milky and oyster mushrooms are most suited to tropical climatic conditions and the protein content varies between 18-20 % on dry weight basis and contain high amount of dietary fibers and less expertise in production. The seed material of mushroom production is spawn, which is a mass of fungal mycelium grown hygienically in artificial medium mostly on cereal paddy, wheat, bajra *etc*. Mushroom spawns can be purchased from authentic sources. Composts or pasteurized agricultural wastes like cereal straw, sugarcane bagasse, saw dust, jute and cotton waste; dehulled corn waste, peanut shells, dried grasses etc can be used as medium or substrate. It can be pasteurized with hot water or steam at 58-62 °C for 4-5 hours. Freshly prepared grain spawn is mixed or placed in layers with pasteurized substrate on wet weight basis @3-4 % in case of oyster mushroom and 4-5 % in milky mushroom in a prefumigated clean room. Spawned substrate is filled in bags (2-8 kg) in layers of spawn and substrate and pressed tightly and hanged with the help if nylon rope. Ten to fifteen holes should be made in each bag to ensure aeration and drainage. These bags can be hanged or kept in the incubation room for spawn run, where the

temperature is maintained at 25-30 ° C and 80 % relative humidity. In case of milky mushrooms, fully colonized bags are covered with pretreated soil to give physical support to the fruiting bodies (casing). From a household mushroom production unit, two to three harvests can be done within 25-30 days period.

5. Apiculture (Bee keeping)

Rearing of honey bee colonies in artificial bee hives is called apiculture. *Apis mellifera* and *Apis cerana* build multi comb nest with closed compartments and these are commonly used in bee hives. In a honey bee comb, a single queen, hundreds of drones and thousands of worker bees will be available. Bee hive should be kept in a manageable height in cool places away from houses, where good number of plants are available. During the rainy season, bee hives need protection from wind, rain and enemies. It should be exposed to sulphur or neem fumes and bees should be feed with 100 ml water with sugar syrup once in a week. One should wear net cap and gloves while handling bees. It is advisable to undergo training programmes on bee keeping before starting bee rearing.

CONCLUSION

Urban agriculture practices are gaining momentum due to the increased need and awareness among the consumers. The dimensions of urban farming range from micro level in households to high tech commercial farms in peri-urban areas. Horticulture crops, birds and small animals, fishes, mushrooms and honeybees can be a component of urban farming. Plants can be grown in micro farming, soil less culture or protected cultivation. The success of the urban farming depends on the organic production strategies and proper management approaches.

Acknowledgements

The authors acknowledge the staff of ICAR-CCARI for the necessary support and guidance in preparation of the article. The authors express their sincere gratitude towards Mr. Vishwajeet Prajapati, KVK, North Goa and Ms. Vidula Pitre, Young Professional for their timely assistance in preparation of the article.

REFERENCES

www.un.org/ development/ desa

http://theconversation.com/the-worlds-urban-population-is-growing-so-how-can-cities-plan-for-migrants-49931

www.tnauagriportal.com

Hayden, A., T. N. Yokelsen, G.A. Giacomelli and J.J. Hoffmann. 2004. Aeroponics: An alternative production system for high-value root crops. Acta Horticulturae. 629. 207- 213. 10.17660/ActaHortic.2004.629.27.

http://agritech.tnau.ac.in/org_farm/orgfarm_dasakavya.html

https://archive.indiaspend.com/cover-story/why-malnutrition-grows-in-rising-urban-india-77051

Electro-ejaculation: A method of semen collection in Livestock

Jyotimala Sahu[1], PrasannaPal[2], Aayush Yadav[3*] and Rajneesh[1]

[1]Department of Livestock Production and Management, [2]Department of Animal Physiology, ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India
[3]Department of Livestock Production and Management, College of Veterinary Science & A.H., CGKV, Anjora, Durg, Chhattisgarh, India
**Corresponding Author: ashyuga186@gmail.com*

ABSTRACT

Electro-ejaculation (EE)is a useful means for obtaining semen from livestock. By this method, collection of semen is carried out by inserting a probe or electrode in sire's rectum and stimulating nerves of the reproductive system by gradually increasing voltage in episodes for a short period of time. A successful electro-ejaculation requires skill, experience, patience and the knowledge of individual requirement of the stimulation.

Keywords: Electro-ejaculation, semen, livestock, probe, electrode

1. Introduction

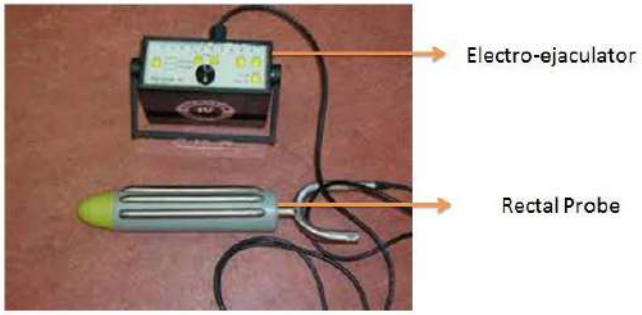
In livestock production, semen collection is a procedure used as part of breeding soundness examination and to a lesser extent fordiagnosis of reproductive diseases or research purposes in ruminants, including rams (Stafford, 1995).There are four methods of semen collection; vaginal aspiration, use of an artificial vagina (AV),trans-rectal massage and electro-ejaculation(EE)(Palmer, 2005). Electro-ejaculation is a useful alternative means for obtaining semen from ruminants that have not been trained to serve into an artificial vagina. The Electro-ejaculation technique was first described by Gunn in rams in 1936. He first made extensive use of electro-ejaculation as a means of collecting semen from rams. In 1952 this technique was first adopted by Batelli for collection of semen from guinea pigs.

2. Equipment'sfor electro-ejaculation method

The equipment used for the procedure includes rectal probes of variable sizes (Table 1), an electrical current generator, collection tube (attached to a latex rubber cone) and semen collection handle (Figure 1). At present there are a number of electro-ejaculators in the market of the world, which are either operated only on battery, or battery-cum-electric transistorized circuits. Modern models of electro-ejaculators consists of a single rectal probe equipped with bipolar electrodes capable of producing ejaculation by

electrical stimuli of the vesicular glands, ampulae of the vas deferentia, accessory sex glands, and the hypogastric plexus.

Figure 1. Equipment's for electro-ejaculation method



Semen Collection Handle

Table 1. Diameter of rectal probe using in electro-ejaculation in different species

Animals	Diameter
Bull	65mm-75mm
Older bulls	90mm
Ram	35 mm

3. Animals in which it is used

Electro-ejaculation is a very efficient procedure for obtaining semen from wild and domestic animals. Moreover, this procedure is easy, safe to apply, improves reliability in obtaining sample and requires minimal facilities (Palmer, 2005).Electro-ejaculation is anextensively and successive used method for semen collection in some species like bovine and ovine. Electro-ejaculation use in stallions is not advisable because of the risks for both the animal and operator (Stover *et al.*, 1981).

4. Management during semen collection:

Preparation of animals before semen collection: Before collection of semen, the bull is directed into a travis and left to rest for 2 to 3 min. Hairs around the prepuce is clipped and then cleaned with an antiseptic solution (no soaps or detergents should be added to the water as most are spermicidal) followed by wash with tap water and dried. The bull's accessory sex organs should be examined per rectum.

Collection Procedure: Restrain the animal and empty the rectum by using warm saline. The probe is slightly lubricated with some non-insulating material. Pass the probe into the rectum (Bull: 12 inches, Ram: 6-8 inches) and held in a position of rectal floor. Pass the required electrical current through electrical current generator (Table 2). Hold the penis with gauze and direct the urethral process into the collection vial to collect the semen.The current produced by the probes and electro-ejaculation is stimulated by starting with the probe set at the lowest voltage and gradually increasing the voltage until ejaculation occurs.

Table 2. Required electrical stimulus in different species

Animal	Bull	Ram
Voltage (volts)	10-15	10-15
Current (amp)	0.5 -1	-
Time (sec)	5-10	3-5
Intervals (sec)	15-20	5-15
Stimulus (times)	3-5	3-5

5. How does electro-ejaculation work?

Electro-ejaculation works on the principle of muscle contraction. When an electric probe is inserted into the rectum it gain contact with the intra-pelvic area. After passing of weak AC to sacral and pelvic nerves through electrodes stimulates the smooth muscles of the ampulla and vas deferens thus inducing the ejaculatory response.

6. Response during electro-ejaculation:

Electro-ejaculation (EE) is widely used method of semen collection in animals, which produces a stress response with negative effects on animal welfare. Response during EE can be observed through pain and stress hormone concentration. Understanding of pain in animals is very difficult (Palmer, 2005). However, it can be observed through their action i.e. struggling, muscle spasms and vocalization. In rare cases the animal may lie down or become recumbent. Various studies have been conducted to assess pain response during electro-ejaculation, with and without the use of anaesthesia and analgesia. Pain during electro-ejaculation may be subjective to operator technique hence operators must attempt to apply electrical stimulation as gently as possible. The concentration of cortisol increased and testosterone decreased after electro-ejaculation. It is noticed that heart and respiratory rate increased 10 min after electro-ejaculation (Damian and Ungerfeld, 2011). Vocalization is considered more useful in measuring pain response than either heart rate or cortisol.

7. Characteristics of semen

Characteristics of semenvary with the method of semen collection. According to the study of Malejane*et al*. (2014) on sheep, AV method yielded significantly better quality semen than EE and concluded EE to be the less reliable method than AV, however some researchers (Palmer *et al*., 2005) found EE as good method of semen collection than rectal massage.

Volume: Different method of collection influences volume of semen and sperm concentration (Austin,1962 and Jimenez-Rabadan, 2012). Marco-Jimenez (2008) found that sperm concentration was lower and volume was higher in the semen collected from EE method as compared to semen collected by AV method; however Matthews *et al*. (2003) found no difference in the volume of semen collected by AV and EE method.

Also, Palmer *et al*. (2005) found lower semen concentration inrectal massage method of semen collection than EE.

pH: The study of Malejane*et al*. (2014) showed that semen pH doesn't vary between the two method of collection i.e. AV and EE techniques.

Colour: The colour score between the AV and EE semen collection techniques varies andis due to the variation in the concentration of semen (Malejane*et al*., 2014).

Sperm motility: AV method showed higher sperm motility as compare to EE technique of semen collection (Malejane*et al*., 2014 and Austin, 1962). Sperm wave motion also varies between the two methods of semen collection (Malejane*et al*., 2014). Palmer *et al*. (2005) observed lower percentage of motile sperm in rectal massagemethod as compare to electro-ejaculation.

Abnormality of sperm: As per the study ofMalejane*et al.*(2014)sperm abnormalities do not vary between the different methods of semen collection.

Sperm viability or percentage live sperm: According to Jimenez-Rabadan (2012) semen collected from AV has more percentage of intact spermatozoa than electro-ejaculation method.However, Malejane*et al*. (2014) found no difference in the percentage of live spermatozoa between the AV and EE method of semen collection.

8. Advantages of electro-ejaculation:

1. Electro-ejaculation can be used satisfactorily for breeding soundness examination purposes.
2. No female or dummy is required.
3. It can be applied in the field using a battery powered unit.
4. It can be used to obtain semen from animals that are physically incapable of mounting due to musculo-skeletal disease or injury.
5. There are less chances of contamination.
6. In this method of semen collection no training of the male is required.
7. Semen is free of extraneous secretions.
8. A sterile condition of the apparatus ensures disease control.
9. The viability of the sperm is better.

9. Disadvantages of electro-ejaculation:

1. It is highly technical method, needs skill and practice.
2. Urine may be mixed with semen.
3. Avoid contamination of the semen from water, lubricating jelly or other harmful substances.
4. Animal may lie down due to paralysis of the leg, so harmful.
5. Semen volume is larger and concentration is lower of that collected by AV.
6. Some males resist too much and refuse collection.

10. CONCLUSION

Electro-ejaculation is more practical as it does not require previous training of the animals and can be used for breeding soundness examination however it requires skilled person to do so. Though quality is not up to the level as in artificial vaginal

collection method, electro-ejaculation method can be used as an alternative means of semen collection.

REFERENCES

Terrill C. 1940. Comparison of Ram Semen Collection Obtained by Three Different Methods for Artificial Insemination. ProcEerdAnnuMtg Am SocAnim Prod. Chicago, IL, pp. 201–207.

Foote R. H. 2002. The history of artificial insemination: selected notes and notables. *Journal of Animal Science*. 80(electronic suppl. 2).

Stover, J., Seager, S.W.J., Dolensk, E.P., Doherty, J.,Wildt, D.F., Platz, C.C. 1981. Electroejaculation and semen evaluation of the Przewalski horse (*Equusprzewalski*). *American Association of Zoo Veterinarians*.144–145.

Cary, J.A., Madill, S., Farnsworth, K., Hayna, J.T., Duoos, L., Fahning, M.L. 2004. A comparison of electroejaculation and epididymal sperm collection techniques in stallions. *Canadian Veterinary Journal*. 45:35–41.

Elmore, R.G. 1985. Evaluating bulls for breeding soundness: Sperm morphology. *Veterinary Medicine*. 80:90-95.

Palmer, C.W., 2005. Welfare aspects of theriogenology: investigating alternatives to electroejaculation of bulls. *Theriogenology*. 64: 469-479.

Stafford, K. J. 1995. Electro-ejaculation: a welfare issue. Surveillance. 22: 15-17.

Damian J.P., Ungerfield, R. 2011. The Stress response of frequently electroejaculated rams to electroejaculation: hormonal, physiological, biochemical, haematological and behavioural parameters. *Reproduction in Domestic Animals*. 46: 646-650.

Austin, J. W., E. W. Hupp and L. E. Murphree. 1961. Comparison of quality of bull semen collected in the artificial vagina and by electroejaculation. *Journal of Dairy Science*. 44:2292.

Jiménez-Rabadán, P., Ramón, M., García-Álvarez, O., Maroto-Morales, A., delOlmo, E., Pérez-Guzmán, M., Pérez-Guzmán, M., Perez-Guzman, M.D., Bisbal, A., Fernandez-Santos, M.R., Garde, J.J. and Soler, A., 2012. Effect of semen collection method (artificial vagina vs. electroejaculation), extender and centrifugation on post-thaw sperm quality of Blanca-Celtibérica buck ejaculates. *Animal Reproduction Science*. 132: 88-95.

Marco-Jiménez, F., Vicente, J. and Viudes de Castro, M. 2008. Seminal plasma composition from ejaculates collected by artificial vagina and electroejaculation in Guirra ram. *Reproduction in Domestic Animals*. 43: 403-408.

Matthews, N., Bester N., and Schwalbach L.M. J. A. 2003. Comparison of Ram Semen Collected By Artificial Vagina and Electro-Ejaculation. *South African Journal of Animal Science*. 4:28-30.

Malejane, C.M., Greyling J.P.C. and Raito M.B. 2014.Seasonal variation in semen quality of Dorper rams using different collection techniques.*South African Journal of Animal Science.* 44 (1):26-32.

C.W. Palmer, L.F.C. Brito, A.A. Arteaga, L. Sderquist, Y. Persson, A.D. Barth. 2005. Comparison of electroejaculation and transrectal massage for semen collection in range and yearling feedlot beef bulls. *Animal Reproduction Science*. 87:25–31.

Drudgery of Women in Agriculture

Jaya Sinha and Mohit Sharma

Assistant Professor, Dr. Rajendra Prasad Central Agricultural University, Pusa- Samastipur
**Corresponding Author: Jaya.sinha@rpcau.ac.in*

Agriculture is the backbone of our country and about 70% of population earns their livelihood from agriculture. Since beginning agricultural and allied activities were performed equally well by both men and women, unfortunately the contribution of women farmer has not been recognised. In Indian out of 30 million women work force 20 million live in rural areas. These women not only engaged in household activities but they also equally participate in agriculture, animal or allied activities. With the increase in migration of male from rural areas to urban areas women role in the field considerably increases. In addition to women day to day household activities women also execute most tedious activities of agriculture from land preparation, sowing and planting, weeding, harvesting, threshing and post-harvest activities. The nature and extent of women involvement in agriculture, varies greatly from region to region. But regardless of these variations, there is hardly any activity in agricultural, in which women are not actively involved. The average time spent by women on the agriculture and allied activies are equivalent or some time more than male farmers and most of these activities are drudgery prone and involve large women force. It means women in agriculture not only overworked, but their work is more gruelling than men. Some farm works such as weeding, transplanting, harvesting, cleaning, largely demands women force. These results various occupational health hazards due to improper posture and high exhaustive work. These activities are strenuous and the odd posture adopted while doing these jobs results in increased heart rate and leads to fatigue. Squatting and bending posture are the most preferred awkward posture while performing various farm activities and maintain it for long hours, which leads to different musculo-skeletal problems.

Since mechanisation in India is region specific and major agricultural activities are manually performed and with the usages of traditional tools, therefore the level of drudgery become more chronic. Further, women's work is basically supported by human energy it's thought of unskilled and therefore less productive. A long-time exposure to hazardous working condition which alters the physiological function of the individual and produces many types of acute or chronic physiological problems. The drudgery of women's worker in agriculture affects not only health but also their education, food security, productivity and indirectly economy of our country.

Women are also less acquainted to farm tools and machineries. In addition, the existing developed technology was designed considering male as user without taking different physical and physiological parameter for female though ergonomic characteristics of women are different than men workers. The design of tools and work spaces can have a profound effect on the exhaustion of the body. The size, design and dimensions of existing tools and implements have a great hurdle on operational difficulties because of mismatch of physical capabilities of women and men workers. As we know that anthropometry and physiology of women is different from that of men so, there is a need to modify the existing tools and to make them women friendly. If the tool geometry is evaluated based on the bio-mechanical analysis of women worker, the fatigue caused could reduce and efficiency can be improved. The only way to fulfil these objectives is to consider role of women equally in development and mechanisation of agriculture. Drudgery reducing tools and equipment can proved boon for farm women.

These tool and implements reduced grind of farm women further more as accrued their potency and work output. There is an urged to aware the farm women regarding the new tools and techniques, as it reduces the drudgery to a larger extent. The use of improved tools and equipment's can reduce the drudgery of women farmers in various farming activities.

The farm implements should be designed by taking ergonomics consideration of women as they play major role in farm production. Working in comfortable posture conjointly reduced the prevalence of musculo skeletal disorders among farm women. By considering the ergonomic characteristics such as the anthropometric and strength data of farm women, improved technologies need to be developed or the existing tools & equipment's need to be modified. The ergonomically designed farming tools and equipment's also help to enhance productivity, efficiency and work output. In addition, the women in the agricultural sectors are required to get awareness and trained properly for the use of ergonomically designed tools and techniques in farming, to reduce the drudgery involved, to increase productivity, and income, respectively. Apart from this more emphasis must also be given to design the implements gender friendly to make it economically viable. Different research institute and organization are working in these aspects to developed women friendly tools or implements or intervene the existing one. Various drudgery reducing tools and equipment namely hand ridger, improved sickle, groundnut decorticator and tubular maize sheller were developed and introduced among farm women which need to be popularized among farmers. Government and several institutes should take the responsibilities to make women aware that they are not deprived section of society, their role and participation are equally important as that of male. Several training should be organized by government organization to make women aware of their role in agriculture and how they are contributing to our society directly or indirectly. Several schemes or program should be organized by the government to increased their participation. There work should be acknowledged and their work need to be awarded. Women on their side should also understand their right and duties towards the society

and not depend on the male for their livelihood. They should also be cognizant of development and various technology available. They need to take voluntary participation in any activities which can improved their status in the society. They should know that with the migration of male from rural to urban area their role in agriculture largely increases. Its high time for the women to take the baton and improve the condition of herself and ultimately the society. They should be aware new developed techniques and technology developed in the agriculture and their usage.

Laboratory Animals Management: An Overview

Jyotimala Sahu[1], Aayush Yadav[2*], Anupam Soni[2], Ashutosh Dubey[2], PrasannaPal[3] and M.D. Bobade[2]

[1]Department of Livestock Production and Management, ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India
[2]Department of Livestock Production and Management, College of Veterinary Science & A.H., CGKV, Anjora, Durg, Chhattisgarh, India
[3]Department of Animal Physiology, ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India
**Corresponding Author: ashyuga186@gmail.com*

ABSTRACT

Laboratory animal science is a rapidly evolving field and remains a very important part of drug development and bio-medical researches. This literature covers nearly all the aspects of general management principles followed in the animal facility. It includes animal procurement of higher genetic merit from standard suppliers followed by identification of animals, either cage identification or individual identification.In addition, the literature describes 2 types of animal housing i.e. non-air conditioned with provision of clean and dirty corridors, and air-conditioned with central and window air-conditioning. The animals are housed in cages made of stainless steel or polypropylene or polycarbonate materials, or on floor with suitable bedding materials in controlled environmental conditions. Moreover, nutritionally adequate diets and appropriate breeding management, along with environmental enrichment reduces the pre and post weaning mortalities. The literature also focuses on proper handling and restraining methods of animals for various experimental purposes. Adding to it, veterinary care with appropriate anaesthesia and analgesia followed by euthanasia of animals for ethical reasons, cleaning and sanitation of cages, rooms and utensils and, disposal of animal carcasses has also been discussed in brief. Further, emphasis is paid on maintenance of records and transportation of lab animals with minimum stress.

INTRODUCTION

Laboratory animals in most countries are protected by the law "Prevention of Cruelty to Animals Act" founded in year 1960. One has to obtain licence from the "Committee for the Purpose of Control and Supervision of Experiment on Animals" (CPCSEA), founded in year 1998 for using them on experimental purposes. The health and well-being of the animals depend on the care and personnel's attitude of the animal facility. An animal

which grows and behaves normally and is free of disease is unremarkably deemed to be in a state of well-being. All the activities conducted by and at an institution have a direct impact on the well-being of animals and are directed towards the achievement and preservation of this state. This requires effective health monitoring, personnel management and oversight, occupational health and safety, follow up of Institutional Animal Ethics Committee (IAEC) functions, animal facility design, civil, electrical and refrigeration engineering within facility besides providing proper food and water and maintaining obligatory environmental conditions. Environmental requirements vary with the species and the experimental protocol. This literature reviews the basic managemental practices followed in animal facility for the proper care and use of laboratory animals in research, testing, teaching and production which requires scientific and professional judgment based on the animals needs and their intended use.

THE GENERAL MANAGEMENTAL PRINCIPLES ARE OUTLINED AS:

1. **Animal Reception/Procurement:** Animals of the appropriate species, genetic makeup, and quality must be procured for research purposes. Purchase of animals with ambiguous health and unknown genetic background represents inaccurate and invalid data or the necessity to repeat experiments. Each new shipment of laboratory animals should be received, examined and the name of supplier and time of arrival should be recorded, along with precise observations on the quality and condition of the animals he has supplied. Animals that appear sick should be euthanized without delay. Shipping containers should not enter the main facility and should be incinerated or disposed in dirty corridors. Wherever it is possible, species should be housed in separate rooms and if space does not permit, effort should be made to place compatible species together having similar environmental requirements.
2. **Animal Identification:** There may be limited information on identification cards to detailed computerized records for individual animals. Means of animal identification include room, rack, pen and cage cards with written, bar-coded or radio frequency identification (RFID) information. Identification cards should include the source of the animal, species, breed, the strain or stock, genotype information, age, name, contact information of the responsible investigator(s), pertinent dates (e.g., arrival date, birth date etc.), and protocol number when applicable. In addition, the animals may wear collars (generally cats, dogs, monkeys), bands (generally birds; made of aluminium, nickel), plates or be marked by coloured stains (picric acid: yellow colour; crystal violet: violet colour; carbol fuchsin: Red colour, for a period of 5-6 months), ear notches (pigs: V shaped notch, 3 mm away from the edge of ear) and tags (made of polyurethane material), tattoos, subcutaneous transponders and freeze brands. Besides, hair coat clipping is also practiced which requires re-clipping after every 4-5 months as hair re-grows. As a method of identification of small rodents, toe-clipping should be used only when no other individual identification method is

attainable. Natural body mark(s) is or are also considered as a method of identification.

3. **Animal Housing:**A suitable animal facility management ensures protection from the inclement weather, predators, mosquitoes, insects, extraneous factors (smoke, dust, dirt, noise, infections etc.) and comfort that permit the animals to grow, mature, reproduce and maintain in their good health. The author has come across 2 types of animal facility i.e. non-air conditioned and air conditioned. In earlier, the direction of air flow is taken into consideration while constructing the houses where, air flow should not directly enter the entrance of house rather have 2-3 pre-entry points before actual entry. There should be provision of clean and dirty corridors with the earlier been located at the front of animal room and focuses on bringing of sterilized feed, bedding materials, autoclaved cages and facilitates reduction of microbes infiltration in the house, with the doors opening outside and the later located at the backside of house and focuses on removal of dead animals, garbage, spoiled materials and have a washing room. Meanwhile, in air-conditioned houses, 2 sub-types are preferredi.e. centrally air-conditioning and window air-conditioning with the earlier blowing the conditioned air through centre of house which displaces the expired air in house and have an air flow rate of 8-10 times in an hour whereas the later utilizes exhaust fans for regulation of air current, maintaining an air flow rate of 6-8 times in an hour.

   The animal rooms should occupy about 50-60% of total constructed area while the remaining area may be judiciously used for stores, passages, quarantine, office, staff lounge and locker facilities.The animal room should be clean, quiet and orderly arranged. All procedures on animals may be performed in separate room as animals recognize the stress-induced sounds from cage mates. Research procedures which are permitted within the room include injections, blood collection, examinations and other non-invasive techniques while those which may not be permitted include surgery, euthanasia and necropsy i.e. there should be separate experimental animal room besides, washing and sterilization room and incineration room.

   The animals can be housed in cages (considered as micro-environment), made of stainless steel, galvanized iron sheet, synthetic polypropylene or polycarbonate materials or on floor (considered as macro-environment),which should be non-slippery, impervious, with corners rounded off, resistant to dilute acid and alkali, and rodent and termite proof,in groups or individually. In western countries and to some extent in India, cages are fabricated with wire netting and are installed in single, two or three tier (deck) pattern. Two or three tiercages even though expensive but are space saving and are utilized in commercial rabbitries. The wire mesh of 14 or 16 gauge is specifically used for bottom of cages. The floor space requirement mostly depends on body weight and size andcan be calculated bygiven formula:

$$\mathbf{A = } n\ \mathbf{(0.7}w\mathbf{ + 6}\sqrt{w}\mathbf{)\ in\ Sq.\ cms}$$

Where; A= Floor space; W= Weight of animal in grams and n= No. of animals

The floor spaces and cage specifications for different laboratory animals are provided below (Table 1):

Lab animals	Floor space/animal (cm^2)	Cage specification and housing capacity	
Mice	100-200	25 cm x 15 cm x 22.5 cm	4 adult mice/10-12 weaners
Rat	250-800	45 cm x 30 cm x 37.5 cm	1 male: 2 female
Hamster	120-650	45 cm x 30 cm x 37.5 cm	1 male: 2 female
Guinea pig	600-1200	91 cm x 45 cm x 45 cm	6-8 adult guinea pigs
Rabbit	2000-3000	61 cm x 48 cm x 46 cm	1 adult rabbit
Monkey	4000-7500	91.4 cm x 91.4 cm x 137 cm	1 adult monkey
Dog	7500-17500	45.72 cm x 61 cm	Under 14 kg dog
		76.2 cm x 91.4 cm	23-27 kg dog
		91.4 cm x 91.4 cm	27-36 kg dog

Animals should have adequate **bedding substrate** and/or structures for resting and sleeping, considering that it profoundly affects their micro-environment.Moreover, the longevity of animals tends to increase when maintained on bedding materials like paddy husk, wood savings, saw dust, hardwood chip, ground corncob, shredded paper and paper matting. However, aromatic bedding material is not advisable. The ideal bedding should be clean, dry, dust free, non-toxic, absorbent and preferably soft. It should absorb moisture from urine and faeces to facilitate cleaning and sanitation and provide warmth to animals. It also facilitates thermoregulation. The depth required is 2-3 cm.For many animals (e.g., rodents), contact bedding expands the opportunities for species-typical behaviour such as foraging, digging, burrowing, and nest building. Solid bottom caging with bedding is the preferred type of caging for all rodents, considering that unsterilized bedding is a possible source for the introduction of disease.

Besides, a constant and comfortable **environment** is required to ensure good health of the experimental animal for meaningful results. Many laboratory animals establish their own microenvironment within their cages. The nature of these will vary with the animals habits, the type of cage (as primary enclosure) and the climatic conditions prevailing within the room (as secondary enclosure) itself. It is noticed that changing animals environment too frequently is stressful. The environmental requirements of lab animals are as:

i. **Temperature:** For effective breeding and production performances, and minimum morbidities and mortalities, a temperature range of 24±2°c is considered standard for lab rodents and rabbits. Beyond this, growth curve, haematological, bio-physiological parameters and animals response to drugs will be affected, productive efficiency will be lowered due to reduced fertility

and temporary sterility in males, andinfluencing the animals susceptibility to infectious diseases. To maintain optimum temperature, thatch roofing and hanging of mats or gunnies or grass thatis on sides (30 cm away) with sprinkling of water on it is advisable. The fluctuation of temperature inside the house should not be more than 2-4°c irrespective of season.

ii. **Humidity:**Most animals prefer comfortable humidity range of 40-70% (average 50%) as long as it remains relatively constant. Fluctuations and extremes in relative humidity can precipitate illness, particularly respiratory distress caused by build-up of ammonia level which predisposes the animals to lowered immune response and infections by opportunistic pathogens. Dehumidifiers may need to be used where automatic watering and flushing systems are used in facilities that do not have a controlled environment. Humidity depends on frequency of bedding changes, stocking density, floor space, bedding type and ventilation.

iii. **Ventilation:**It is preferable to use a total air exchange system. If a recirculation system is to be used, it should be equipped with effective filters. An air exchange rate of 12-15 changes in an hour is recommended with strict emphases on frequency of cleaning, quality of incoming air, stocking density, species, weather and cage type (single or colony). Much of the odour in an animal facility results from bacterial decomposition of excreta, and can be controlled by maintaining the adequate ventilation.

iv. **Light:** To keep animals sexually active and fertile and to facilitate proper laboratory animal observation, record keeping and house-keeping, light intensity of 130-325 lux is recommended at 1.0 m above the floor. The light should provide good visibility and uniform, glare-free illumination. Ideal light: dark ratio of 12:12 hours should be maintained.

v. **Noise:** Noise is unavoidable in an animal care facility, but should be minimized and therefore the animal facility should not be constructed near industrial areas. A maximum background noise of 85 decibel has been recommended, beyond which reproductive problems, epileptic seizures, auditory lesions and increased blood pressure is recorded. Quiet species should not be housed with noisy species.

4. Animal Feeding: All experimental animals should receive palatable, uncontaminated and nutritionally adequate diet as per their requirement. Animal feed should be obtained from standard suppliers after sterilization by autoclaving or gamma-radiation, in packed and sealed bags that are stamped with manufacture and expiry dates. Perishable food products should be stored in cold rooms, refrigerators or freezers. There must be arrangements of inverted water bottlesof polypropylene material (for small animals) and suitable size bowls (for large animals), and feed trough or hoppers (L or J shaped with bottom mesh; called as self-cleaning feeders) on the floor or on the lid of cage. Water bottles should be clean, clear, transparent, to permit ready observation of cleanliness and water level. The feeder and waterer should be detachable for

easy cleaning and washing. Feeders and waterers attached on the sides are preferred which avoids turning down of these equipments by movement of animals. Further, hay racks may also be provided to animals to feed on bulky feeds (roughage) and reduce wastage. The feed trough or hoppers or hay racks should be attached from outside so that it can be accessed without opening the door of cage. Feed hoppers and utensils should be cleaned and sterilized regularly. Where animals are held in groups, care should be taken to ensure that subordinate animals have adequate access to food and water. Generally, pelleted feed should be given to the animals to minimize the wastage of feed and achieve better FCR. No added flavour is permitted. Deionized or sterilized tap water from a potable water source is adequate for the animals which should be made available at all times.Scheduled chemical and microbial analysis of drinking water is necessary.

5. **Animal Breeding:** The animals which are not available commercially may be bred and propagated through breeding methods viz. Monogamy (male: female=1:1) and Polygamy (1:>1). The breeding pairs should be procured from the organized animal resources and attention should be paid to maintain the genetic homogeneity (inbred animals) or heterogeneity (out bred animals). For breeding, **sexing** is necessary to pair male and female instead of pairing same sex animals. The correct method for sexing is to observe the sex organs of each animals. The length of perineal region i.e. distance between the anus and sex organ, in case of rat, mice and rabbit, is longer in males than females. Whereas, perineal region is not clearly visible in case of guinea pig and hamster and therefore, sex organs are pressed at a little distance from the anus. A 'Y' shaped slit (vulva) conjoined with anus is noted in female and protrusion of penis at a similar distance is noted in male. This is also observed in rabbits.

   In monogamous mating of **mice and rats**, female immediately comes to estrous after parturition. Therefore, to prevent immediate further pregnancy, the male should be removed in late gestation period. This also avoids disturbance in the growth of young ones by male. Mating may be allowed after the young ones are weaned at 3-4 weeks of age (similar in other lab animals). In polygamy method, the average male: female ratio should be 1:2-6.

   Hamsters are mated in the dark by keeping male and female together for short period till mating and immediately separated thereafter. The average male: female ratio should be 1:7.

   Guinea pigs are social animals and like community living i.e. in groups. They are active during day and light but get disturbed with strange visitors and even change of usual attendant makes them nervous. Sows nearing to farrowing are separated and rehoused with male after weaning of litter. The average male: female ratio should be 1:10.

   In case of **rabbits**, doe is taken to buck for mating but separated if mating doesn't takes place within few minutes. Coitus induces ovulation resulting into pregnancy of 75% does. Aftersatisfactory mating, male falls backward with

discharging scream.The average male: female ratio should be 1:6. On an average in 260 breeding females, 10 females can be replaced weekly, irrespective of species.

Breeding cages specifications for rabbit	
Size of rabbit	**Breeding cage (cm) for 1 pair**
Small (2.5-4.5 kg)	100 x 80 x 55
Medium (4.5-5.5 kg)	125 x 80 x 60
Large (>5.5 kg)	145 x 80 x 65

6. **Pregnancy, Parturition and After care:** As soon as pregnancy is confirmed (after 12-14 days of mating in rabbit,15th and 30th day in guinea pig and 2 to 3 weeks in hamster), closed nest box is attached to the cagefrom outside having an ideal size of 25 cm x 45 cm x 30 cm (rabbit), to minimize the pre-weaning mortality losses. The nest box may be fabricated with G.I. sheets, plywood or plastic and should maintain temperature of 30-35°c. In absence of nest box, clean piece of cloth with fresh bedding material may be provided on the bottom of cage. The pregnant animal should be kept in kindling cage(105 cm x 95 cm x 75 cm; for rabbit) from 3rd week onwards to adopt new house for parturition. During last 10-15 days of pregnancy, extra allowances (rabbit: 20-25g) should be given to fulfil the growth of foetus and development of mammary glands.

   The animal exhibits restlessness, to and fro movement, jumping, squatting and licking of genitalia prior to giving birth to the young ones, mostly during night. The new borns of small lab animals are altricial and totally depend on dam for their survival except guinea pig, where the new borns are pre-cocial. In most of the species, frequent disturbance to freshly littered female, frequent breeding, inferior bedding materials and inadequate nutrition results in the destruction of young ones which should be prevented. Provide extra allowances to dam, to facilitate nourishment of new borns. The new borns depend on mothers milk for initial 3 weeks of age and are thereafter weaned. From 2 weeks of age, young ones may start chewing grass and eat concentrate along with suckling. Provide ample fresh water to dam and young ones. In case the dam dies or is unable to lactate or if litter size is more, the young ones may be subjected to "fostering" i.e. taking to another dam for rearing. In addition to it, young ones may also be hand reared on cow's milk by increasing the protein content in milk by 10% (by addition of calcium caseinate). In case of rabbit, cow's milk is offered at the rate of 5ml/day/bunny during 1st week followed by 15 ml and 25 ml during 2nd and 3rd week, respectively. Total quantity should be fed divided into 2 times daily.
7. **Environmental enrichment:** As a part of animal welfare programme, enrichment enhances the breeding performances of animals and lowers the pre and post-weaning losses. It includes group housing of social animals which are compatible and non-aggressive and there should be visual, tactile and olfactory contact with the fellow animals. Further, human interaction, exercise opportunities, nesting material, digging substrates, wooden piece, branches etc.

can be used for enrichment purposes. The most labour-efficient devices should be incorporated. For example, if tunnels and other similar devices are used in rodent cages, they should be colorless, nonopaque materials that allow easy visualization of all the animals in the cage to eliminate the need for additional time and effort to manipulate the previously used devices.

8. **Animal Handling:** Laboratory animals should be properly handled and restrained when put into new cages or removed for various experimental purposes. The methods of handling are:
    a. **Mice:** Take the help of an assistant who holds the tail of the animal with the left hand and gently raises the hind limbs from floor of the cage. The mouse placed in such position cannot turn round and bite. By the help of right finger and thumb a fold of skin close to the head is held.
    b. **Rat:** One hand is placed across the back of the animal with the thumb behind the shoulders and the other fingers well forward on the opposite side. The animal is lifted gently supporting its weight with other hand placing the palm uppermost under the hind quarters.
    c. **Guinea pig:** Similar to rat.
    d. **Hamster:** It should be grasped with large pinch on the scruff of neck and then turn over to support with palm and other fingers to hold.
    e. **Rabbit:**The **rabbit** is picked up from cage with the ears by one hand in a firm grip and another hand is placed under the hind-quarters to support the weight and then lifted gently. After removing from cage, the animal is placed in a non-slippery place as it otherwise feels insecure and becomes frightened.
    f. **Monkey:** The operator is advised to wear protective cap, apron, mask, gloves and gumboots before handling monkeys as they harbour lot of infection. Further, monkeys must be sedated before handling. Sedated monkey can be held by holding the upper arms behind shoulders in horizontal position.
9. **Veterinary Care and Disease Control:**A routine tour of inspection of the animals should be made by a veterinarian at least once a day with attention to the general condition of animals, amounts of food and water consumed and the nature of faeces. To see nose movements of the animals and to see any animal remaining quiet and still. Such animals may be separated and investigated for the cause of disease. The veterinarian should ensure that the animals are fasted overnight and the painless procedures are conducted under appropriate anaesthesia (Ketamine HCl, IM: 22 mg/kg BW; Pentobarbitone Na, IV: 30 mg/kg BW; Thoiopentone Na, IV: 20 mg/kg BW; Urethane, IP: 0.75 mg/kg BW). Later, on termination of an experiment, animal should be sacrificed for ethical reasons by cervical dislocation (mice, rat, guinea pig, rabbit), decapitation (mice, rat, rabbit) and inhalation of CO or CO2 or CO2 with chloroform (mice, rat, guinea pig, rabbit).

10. **Cleaning and Sanitation:** The entry of clean and edible supplies should be restricted through clean corridors, while dirty materials, dead animals and other wastes through dirty corridors. All cages, pens, racks etc. must be cleaned and disinfected weekly or more often if required. Animal cages are most efficiently cleaned and sanitized with mechanical washing equipment operating at 83°c (180°F) or higher, for a minimum of ten minutes. Cages may be hand washed with detergent, rinsed in hot water (180°c) and allowed to dry prior to autoclaving. As a general rule, the animal house should be cleaned every day or alternative day. Bedding in cages or pens should be changed as often as necessary to keep the animals clean, dry, and relatively odour free. Smaller lab animals require 1-3 changes/week and depend on the stocking densityof animals.
11. **Disposal of Animal Carcass:** The dead animals, excreta, bedding, unused dietetc. should be packed in polythene bags before sending for disposal and are either buried deep in the ground covered with lime and disinfectants or burnt in an incinerator.
12. **Animal Transportation:**Transportation of lab animals from one room to another room, from place to place should be done with minimum stress. Mice loose around 5-8% of the body weight during 28 hours journey as a result of stress, induced by new social groupings, new box and lack of food and water etc. The stress order is higher in primates> carnivores> rodents. Transportation is advocated in cool hours to avoid heat stress however, too cold environment in winter is also deleterious for transport. At least 20 air changes per hour should be provided having air inlets at roof level of vehicle to prevent entry of direct drafts or other fumes in the truck. Also, exhaust fans in truck facilitate air exchange during stoppage period of vehicle. Transportation by railway is preferred with loading of animals shortly before departure of train and collection of animals immediately after arrival of train to destination. Air transportation is most suitable for long distance shipping. As far as possible, direct flight should be preferred.

    If the duration of transportation is upto six hours, feed or water is not necessary. For 12 hours; water can be given partly,however if duration is upto 24 hours, full water is required by guinea pigs and rabbits. Mice and rat can sustain without water for 48-72 hours, however they must be watered immediately on arrival. During long journey, succulent vegetables, fruits like apple and watermelon, and adequate water prevent loss of weight. Usual housing cage with sufficient absorbable bedding material can be very well used for transportation, which should totally secure the animal, be easy to handle, disposable, sterilizable and preferably rectangular. The container should be labelled with appropriate details and picture of animals for easy identification. Special care should be taken for germ-free animals transportation in air-filter cages with labelled instructions of not to open cages. It is advisable to cage same age and sex group animals

together to reduce fighting. Adults other than breeding pair should be caged individually. If temperature exceeds 27°c, the ventilation area should be doubled.

13. **Animal Facility Records:** To evaluate the progress of experiments and welfare status on and of animals, maintenance of records is crucial. Only required documents should be maintained as unnecessary record keeping is unauthentic. Following records should be maintained: population status, birth, death and weaning date, supplies, breeding and experiment records, no. of projects, animals issued and rehabilitated, disease diagnosis and treatments, log books, and visitor and transportation records.
14. **Miscellaneous:**The **droppings** mixed with bedding material are removed daily in cages, however removed weekly when reared on floor, andis replaced with fresh bedding material. Lack of cleanliness increases the risk of coccidiosis and other infections along with reduction of life of cages due to rotting from urine. The manure, particularly of rabbit is used directly as fertilizer, for biogas production or as fish and cattle feed ingredient after drying, as it contains 1 % nitrogen, 0.5% phosphorus and 1.5% potash. The manure can be preserved in form of compost, liquid and dry manure.

    Animal colonies should be sampled preferably at 1-3 months interval to allow for rapid detection and elimination of disease. Alternatively, sentinel rodents (weaner or adult from SPF stock) may be utilized. Immunization of staff especially for tetanus and rabies should be carried as per institution policy. All bites and scratches should be immediately and thoroughly scrubbed and cleansed with soap and running water for atleast 15 minutes followed by antiseptic bandaging.

    The firms capable of **managing repairs** of equipments and machines should be in contact for immediate repairs. Periodical servicing and changing of the valves, cartridges and other parts of water purification system should be ensured effectively.

    Protective clothing such as gloves, face masks, bonnets, booties, and eye-protective devices, should be purchased in quantity and provided to staff members as needed. The cost of these disposable items can be large to meet **occupational health and safety guidelines**. In some cases, these items can be repeatedly autoclaved and recycled for reuse to reduce the overall cost. Further, in-service training of employees on use of protective equipments, periodical medical evaluation and practice of preventive medicine should be carried.A properly constructed building should be **vermin proof**, but may not be free from vermin. It is important that pesticides should be applied as a last resort and only under supervision.

15. CONCLUSION

Animal experimentation has become a vital component of current drug development programmes and biomedical researches and therefore, it is pertinent that the animal resources from where the experimental stocks are drawn, are managed and supervised skillfully with a view to produce defined

animals. It is considered that,a well-planned, well-designed, well-constructed, properly maintained and managed animal facility is an important element of humane animal care and use, as it facilitates efficient, economical, and safe operation. Moreover, the records should be effectively maintained in a relational database system whenever possible to monitor the production performances, quality and health status of animals and to take appropriate remedial actions to improve the health status of animals and the personnel.

16. REFERENCES:

Anonymous. (2019). Laboratory animals: Care, management and diseases. https://bit.ly/2GI5kWL. Accessed on 25 February, 2019.

ICAR. (2015). Handbook of animal husbandry. Indian Council of Agricultural Research, New Delhi, India.

Jadhav, N.V., Baig, M.I. and Devangere, A.A. (2004). Handbook of wild animals and livestock management. Academa publishers, Delhi, India.

NRC. (2000). Strategies that influence cost containment in animal research facilities. The national academies press, Washington, D.C., U.S.A.

NRC. (2011). Guide for the care and use of laboratory animals. The national academies press, Washington, D.C., U.S.A.

Rajenderen, M., Aravindan, U., Pugazhenthen, T., Bhagat, V.M., Giri, V.C. and Ali, M.K.S. (2019). Manuals of laboratory animals basic facilities, handling and care.Central Leprosy Teaching & Research Institute, Tirumani, T.N., India.

Goat kid pneumonia: Causes and risk factors in tropical climate in West Bengal

D. Mondal

Eastern Regional Station, ICAR-Indian Veterinary Research Institute
37, Belgachia Road, Kolkata-700037
**Corresponding Author : dayamoy21@gmail.com*

ABSTRACT

Goat kid pneumonia is very prevalent disease in wet and hot climate in West Bengal. There are several causes of pneumonia including viral, bacterial, parasitic, fungal infection as well as noninfectious causes like drenching pneumonia and allergic origin. Clinically, the pneumonia can be identified with increased body temperature, panting, dyspnoea, coughing, abnormal lungs sound, nasal discharges of various kinds. Laboratory diagnosis can be made by isolation and identification of causative microbial organisms, worm infection and radiological investigation. Therapeutic intervention of pneumonia can be made accoding to aetiology of pneumonia. Bacterial, fungal, healminthic and drenching pneumonia are most common in kid and management of the diseases may be done with proper medication as per causes of pnemonia.

Key words: Goat Kid, Pneumonia, Risk factors,

Pneumonia is the inflammatory changes in air sacs and bronchioles either one or both lungs. The air sacs may be filled with exudates or pus (purulent), showing cough, phlegm or pus, fever, chills, and difficulty breathing. A wide varieties of microorganisms as well as macroorganism, including viruses, bacteria, fungi, parasites cause pneumonia. Non living aetiologies are those can cause pneumonia are physical and chemical articles. In isolated small flocks incidence of pneumonia is comparatively lower but in community goat flocks (Fig-1) the transmission of disease occurs easily.

Figure 1: Black bengal Flocks

There are several predisposing factors for kid pneumonia, they are sudden change in weather particularly sudden exposure to cold and wet weather, poor nutrition, transport stress, feeding stress, poor ventilation, over crowded and dirty farm,immunocompromised goat, late feeding of colostrum etc. Normally some microorgamism reside in lungs of goat and kid, solid antibodies can protect them from lung inection. New born kid lacks circulatory antibodies while some bacteria remain in their lungs. Newborn kids can be prone to pneumonia because they are still developing immunity and colostrum provides some antibodies to protect infection. Thus, feeding of colstrum is essential immediate after birth till 12 hours post birth. Tropical climate in West Bengal consists of high environmental temperatuture, rainfal, and humidity enhance the chance of occurance of pneumonia.

CAUSES OF PNEUMONIA IN GOAT KID

The causes of pneumonia in animals varies in different species. In goats and kids various microorganisms causes pneumonia. Of the aetiologies several microbial infections show pneumonia along with other clinical signs.

Viral pneumonia : Retrovirus infection, caprine arthritis encephalitis virus, viral parainfluenza-3., Adenovirus, PPR, Bluetongue and reoviruses

Bacteria pneumonia: Pasteurella multocida, Mannheimia haemolytica, Mycoplasma mycoides subsp. Mycoides, M. mycoides capri, M. capricolum, Bordetella bronchoseptica, Chlamydial infections. Mycobacterium bovis, Porphyromonas katsikii,Corynaebacterium pseudotuberculosis.

Mycotic Pneumonia: Cryptococcus neoformans, Emmonsia crescens, Histoplasma capsulatum, Candida albicans, Rhodotorula rubra, Coccidioides immitis, Blastomyces dermatitidis, Paracoccidioides, Sporothrix schenckii etc.,

Parasitic pneumonia: *Dictyocaulus filariae, Muellerius capillaris*, *Protostrongylous rufescens, P. commintatus.*

Drenching/Aspiratory pneumonia: Careless drenching of drugs and liquid, improper insertion of stomach tube during medication, paralysis of phrynx and larynx, dusty moundy environment, irritating gas, engulfment of liquid

Allergic pneumonia: Eosinophilic bronchopneumopathy with pulmonary eosinophilia. The causes of the condition are due to migrating parasites, reaction to microfilariae of heartworms, lungworms, chronic bacterial or fungal infections (histoplasmosis, aspergillosis), external antigens, toxic gasses, change of season and unknown precipitating factors.

RISK FACTORS FOR KID PNEUMONIA

There are several risk factors like age, sexes, planes of nutrition, general health status, housing, climatic factors like temperature, humidity and raifall largely alters susceptibility. Goat kid pneumonia is very common in individual house hold and in farm condition. Several factors are responsible for prnumonia by either single or multiple factors. The common predisposing factors for production of pneumonia are lower age.

In human medicine, the infants upto 2 years and aged person above 65 years are more vulnerable due to this diseases. Goat upto six months are very susceptible than aduld ones. Of the two sex group males are more prone to pneumonia than female. It has been found in human medicine that estrogen secretion in females enhances the macrophase activity for clearing the bacterial load. General health status and body score play role in the incidence of pneumonia in kids. Low birth weight remains highly susceptible to various diseases. Housing and movement of air circulation also play very important role for the occurance of pneumonia. Any animal shed needs wide appart window and ventillators for expulsion of carbon di-oxide and other gasses produce in the byre. During winter season, norther side of the room should be closed to prevent winter air flow while east and southern side should be much open to enter fresh air in summer and rainy seasons. Again, the floor of the shed should be concreted, slide sloppy and dry. Most of the inhouse goats i.e stall feeder show scanty pneumonia than grazing animals. Individual goat in isolated house show scanty pneumonia while community based goat kids show much for pneumonia through contamnation with the infected ones. Environment factors like humidity, environment tempertaure and frequent rainfall invites more pneumonic cases than dry chilly season.

Classification of Pneumonia : Depnding upon the extent of invasion and pathogenic status of involvement of lung tissues several sorts of pneumonia are described. The types of pneumonia in different individuals and surrounding environments depend on nature of organisms and duration of pneumonia persists.

Suppurative bronchopneumonia: Although this type of pneumonia in kids is not common but in adults the condition is not uncommon. Abscess formation in lungs with bacterial infections may be Corynaebacterium pseudotuberculosis,Pasteurella multocida and other pus forming bacteria. Affected goat shows poor cachectic condition, dull and depressed condition. Affected goat show faster abdominal breathing.

Fibrinous bronchopneumonia: It is an acute fulminating pneumonia characterized by accumulation of fibrinous exudates in lungs.The condition clinically showing increased respiration rate and depth of repiration. Breath sound could be audible on auscultation.

Inertstitial pneumonia: This type of pneumonia where there is diffuse patchy damage of alveolar septa and are widely distributed in lungs.An intra alveolar exudate phase may be there followed by proliferative enlargement of interstitial tissue. The condition may be due to infection of viral, bacterial, fungal or even with chemical injury.

Granulomatous pneumonia : Granulomatous pneumonia is the formation of granulomas in the lungs tissues, The granuloma are collection of inflammatory cells at sites of tissue infection and includes activated macrophages (epithelioid cells), Langhans' giant cells, lymphocytes and tissue reaction. The pathogenicity may be a slower condition characterized by formation of granulomas in lungs. This types of pneumonia may be due to Mycobacterium tuberculosis and systemic fungal infections like coccidioidomycosis.

CLINICAL SIGNS OF PNEUMONIA

The clinical signs of pneumonia varies due to aetiologies causing pneumonia.In viral pneumonia there will be more body temperature reaction than bacterial infection (Fig-2).. The body temperature varioes 104°-107°F Nasal discharges or "runny nose" from nostril, this may vary depending upon the aetilogy. The kids feel lazy why they laydown, depressed. Difficult breathing even open mouth breathing is seen and on auscultation different types of lung sounds are auduble depending on the causes.

Figure 2: Pneumonic goat with nasal discharge

Coughing is the cardinal reflex in pneumonia.The cough may be moist painful rales to dry husky type.The clinical signs of aspiratory pneumonia are coughing, rales,frothy nasal discharge,protrussion of tongue and fever.

Diagnosis of pneumonia

In Veterinary practice, diagnosis of goat pneumonia can be made by clinical findings. However, general examination of lungs by ausculation of lung sound by stethoscopic examination may be confirmed. In pneumonic condition lungs provide characteristic sound like crackling, bubbling, whisting and rumbling sounds during inhalation. In heavily lung involvent there may be no untoward sound in lungs on suface auscultation.However, there are several other ways to confirm the pneumonia as follows.

Blood Analysis : Complete differential count of WBC may reflect to reveal pnemonia. In pneumonic cases the Neutrophil Lymphocyte ratio may be higher side in acute pneumonic cases than chronic pneumonia (tuberculosis). In acute pneumonic cases the immune system goats actively fighting an infection to leminate the bacterial antigen.

Cultivation of nasal discharge and plural fluid to find out any bacterial involvenet for showing clinical signs of pneumonia. For isolation of bacterial infections several cultural media and biochemical tests to be accomlished. Nasal swab can be collected by inserting sterile swab into the nasal opening while flural fluid may be collected inserting needle into the plural space, the technique called **thoracentesis.**

Chest X-Ray : The X ray of cheast cavity (PA. AP and Lateral) show the lung, heart and blood vessels. When a chest plate in examined under illuminated box, a radiologist will look for white spots in the lungs (called infiltrates) that identify an infection. But the chest plate contains not only white and dark spot.There may ve sevral other approaches to determine several factors influencing the x ray plate. There are nine factors those influence the interpretational aspect of x ray plate. They are ABCDEFGHI approaches and shadows. A for airways, B for bone and soft tissue,C for cadia shadow,D for

diaphragm, E for effusion,F for fatty tissues and field of lungs, G for gastric bubbles, H for Hila and mediastinum and I for impression.

Chest computed tomography (CT): When an X ray cannot reveal clear idea for details pathology of lung tissues, a CT scan can provide details of complication of lung tissues. Lung involvement may be with formation of absess in lungs, plural effusion and even metastatic growth can be revealed by CT scan detail than a chest x ray.

Bronchoscopic examination: Bronchoscope is medical tools with tube like structure containing a light source and a camera. The bronchoscope is inserted through mouth or nose to the windpipe and airways to take pictures and collection of samples and biopsies form nasal passagage and pneumonic field. With this tools pneumonia and other pathological condition in lungs and air passages can be determined.

Economics of kid pneumonia

Economic significance due to kid pneumonia varies with the atiologies. Some pneumonia secondary to deadly disease like PPR and Bluetongue disease may be very high with morbidity and mortality. However, some common infections with kid pneumonia may be not so deadly. The economic aspects of pneumonia deals with that multiple determinants. The number of cases affected with any diseases at a defined time is also a risk factor. Whatever may be the cause of pneumonia, the economic losses enumerated considering therapeutic cost, morbidity, mortality, reproductive disorders/delay, loss of body weight, loss due to improper skin development,disease management etc. Therapeutic cost including medicine, labour, clinical nutrition, isolation of patients, vaccination, disinfection and patient management. Morbidity causes loss of body weight, unfit for muscle develoment, reproductive and productive delays. This is again depends on the severity and duration of disease. Prolong illness drastically reduce body wieght which is very essential for animal production. Pneumonia due to diseases like PPR, bluetongue etc severely hampers reproductive and productive functions and the survived animal become less productive. Generally, pneumonia may prolonged puberty process for effective development of genital system. Sometime the fallout of pneumonia particularly suppurative pneumonia may lead to prolong convulescence period, cachecia and those animals have no use for production except culling. The prevalence rate of pneumonia in goat kids varies from 12-15% which is highest amongst all the diseases. The mortality trends veries with pneumonia in kid. It may reach as high as 50% of the total death.

THERAPEUTIC INTERVENTION OF PNEUMONIA

Use of antibiotics: For viral infcetion there is scanty cost effective veterinary medicine for treatment.Pneumonia of viral infection can be checked through vaccination and preventive treatment. Bacterial infection can be checked using susceptible antibacterial drugs. Antibiotics of Betalactam derivaties and macrolids are drugs of choice for goat pneumonia. Ceftiofur (cephalosporin) 1-2 mg/kg body weight may be useful. Fluoroquinolone, moxifloxacin, gatifloxacin, gentamicin, carbenicillin may also be used.

Mucolytic agent: In goat kid pneumonia nasal congestion and glogging of nostril may be decongested using mucolytic agents like ambroxol (10mg) erdostein (50mg) may be used as expectorant.

Nebulization: Corticosteroid like prednisolon (3-5mg), budesonide (0.25mg)) may be used to reduce inflammatory reaction against respiratory tract inflammation. Corticosteroid along with antibiotics may be given through nebulization for quick action.The nebulization is new concept in veterinary practice and ealry response. Through nebulization other drugs like bronchodilators (theophyline) may also be administered.

For Parasitic pneumonia

Several antiparasitic drugs can be used effectively to treat the respiratory helminthic infection. After confirmatory diagnosis the following drugs can be used against respiratory helminthiosis

Ivermectin (0.2 mg/kg) through subcutaneous route, the drugs may be repeated after 15-20 days.

Fenbendazole (5 mg/kg orally, every day for 7 days). Levamisole can be used @2.5mg/kg for 1-2 days.

Fungal and granulomatic pneumonia: Granulation of lungs caused by Mycobacterium bovis and fungal infections. Fluconazole at the rate of 2.5–10 mg /kg/day are considered the treatments of choice. Other antifungal drugs amphotericin B can be injected IV (0.5–0.8 mg/kg) diluted in 0.45% saline containing 2.5% dextrose; 250-400 mL 2–3 times per week. Tubercular pneumonia is something incurable as it takes more time for proper healing.

Preservation and Shelf Life Enhancement of Fruits and Vegetables

Sheshrao Kautkar[1]and Rehana Raj[2]

[1]Scientist, FM&PHT Division,
ICAR-Indian Grassland and Forage Research Institute, Jhansi (Uttar Pradesh)
[2]Scientist, B&N Division, ICAR-Central Institute of Fisheries Technology, Cochin (Kerala)
[1]Corresponding author: sskautkar15@gmail.com

ABSTRACT

India stands at second position in the production of fruits and vegetables in the world and is the leader in producing several horticultural produce like mango, banana, papaya, potato, okra, areca nut etc. The major chunk of this huge production of fruits and vegetables is going as a waste mainly because of unawareness of on farm processing methods. Post-harvest losses of fruits and vegetables in India are in the tune of 5.8 to 18%. To reduce these huge amounts of losses and to increase the nutritional securitypreservationis the important aspect which needs to consider seriously.

Keywords: Value addition, Fruits and vegetables, Preservation, Food processing

INTRODUCTION

On farm preservation and processing of fruits and vegetables can certainly reduce these losses. Preserve means is to keep safe, maintain quality and avoid decomposition. Food preservation in a simple way can be defined as a process by which certain foods are prevented from getting spoiled for a long period of time. The nutritional value of the food is also preserved. Fresh fruits and vegetables are highly perishable because they contain high amount moisture and they are biologically active. These commodities can be preserved either in fresh form or by converting them in to different processed products.

Need for Preservation of Fruits and Vegetables: Preservation of fruits and vegetables is necessary;

- To utilise themduring the periods when theyareunavailable or when their demand is high with higher price
- To save and preserve excess food production
- To add variety to our meals in the form ofChatni, Papad or Pickleetc
- To make them available in the areas wherethey are not grown

- To makes transportation and storage of foods easier by reducing their bulk. For example, drying of vegetables such as methi, green peas and coriander reduce their weight and volume thus making their storage and transport easier.

Principles of Preservation of Fruits and Vegetables

Fruits and vegetables are high moisture content commodities therefore they spoil rapidly unless special care has not been taken. The general principle of preservingfood is to have an effective control over the growth orspoilage causing microorganisms, keeping water activity at safe level, thereby, prolonging the shelf life and maintaining the quality of the products. The three main principles of preservation fresh fruits and vegetables;

1. Removal of micro-organisms or inactivating them: Microorganisms are main cause of spoilage and deterioration of foods therefore their becomes very important. This is done by removing water, air, lowering down or increasing the temperature, increasing the concentration of salt or sugar or acid in foods.
2. Inactivation of enzymes: Enzymatic browning is one of the important reasons of spoilage which results in brown pigments in fruits and vegetables. Enzymes can be inactivated by application temperature or by maintaining moisture level.
3. Removal of insects, worms and rats: This can be done by storing foods in safe, dry, air tight containers, packages or storage rooms.

TYPES OF FOOD PRESERVATION TECHNIQUES

Fresh and processed fruits and vegetables can be safely preserved for long time by adapting following simple and basic techniques.

1. **Preservation by application of heat:**
   - The spoilage causing microorganism and bacteria's can be destroyed or chemically inactivated and their numbers can be reduced by rising the temperature of foods and keeping them at elevated temperature for required time,
   - Enzymatic activity can also be reduced at a temperature around 80-90^{0}C so as to avoid enzymatic browning of sliced fruits and vegetables.
   - Blanching, pasteurization, sterilization, canning are some of the methods of preservation of foods by application of heat
2. **Preservation at low temperature:**
   - Growth and multiplication of bacteria can also be controlled or practically stopped by lowering down the temperature surrounding food
   - Enzymatic and chemical reactions, particularly those responsible for destruction of vitamins, alteration in color and flavors, are also progressively retarded as the temperature is brought down.
   - The physiological activities responsible for rapid maturity of fruits and vegetables such as transpiration, respiration and ripening can also be considerably slow down by applying low temperature atmosphere.

- Chilling, freezing, cold storage are some of the methods of preservation of foods by preserving at low temperature

3. **Preservation by removal of moisture:**
   - Microbes cannot grow and multiply in absence of sufficient water
   - Many of the enzymatic reactions are hydrolytic in nature and require water as one of the reactant
   - Chemical reaction in food materials can slow down when itis in solid state
   - Therefore removal of the moisture to safe level from the foods can effectively reduce spoilage and enhance the post harvest life of fruits and vegetables.
   - Drying and dehydration are the examples of preservation by removal of moisture.
4. **Preservation by addition of chemical**
   - Preservation and storage of foods with the help of chemicals has been practiced since early days of food handling. Chemicals preserve the foods by checking the growth of microorganisms.
   - The chemicals must be carefully chosen and their application dose is correctly selected to avoid unwanted chemical reaction with foods and side effect of the persons who is going to consume it.
   - Only few chemicals, of known biological effects are allowed to be added and that too for a very limited number of food stuffs with their safe applicable limit.

Methods of Preservation of Fruits and Vegetables

On the basis of above principles and techniques of preservation, following are the different methods which can effectively preserve and enhance the shelf life of fruits and vegetables.

1. **Canning:**
   - It is the process of hermetically sealing and sterilizing the product in a container for long term storage.
   - The temperature and time of heat processing depends on the pH value of the food. In general fruits are classified as high acid foods, while most of the vegetables fall in the category of low to medium acid group.
   - Fruits with pH values greater than 4.5 require relatively severe heat treatments. Most of the fruits are processed in boiling water (~100˚C) while vegetables are processed in steam under pressure (115-121˚C)
2. **Drying:**
   - Drying means removal of water from food products at predetermined level.
   - It is one of the oldest methods of food preservation
   - Moisture may be removed from foods by any of methods like sun drying, hot air drying, vacuum drying, freeze drying etc.
   - Proper packaging and storage conditions play a vital role in dried products.
3. **Freezing:**
   - Exposing foods to very low temperature (less than -18˚C) resulting in converting the water molecules of food into ice crystals so as to lower down the water

activity and to deactivate spoilage causing microorganisms is called freezing.

- Microbial growth is inhibited and chemical reactions are slower down.
- Air freezing, plate freezing, liquid immersion freezing and cryogenic freezing are different types of freezing methods

4. Addition of sugar and salt:

- Sugar and salt also plays a vital role in preserving some food products.
- Preservative effect by both sugar and salt is caused by osmosis.
- Sugar or salt, whether in solid or in the form of solution, attempts to reach equilibrium with sugar or salt content of the food.
- This removes available water from the food and inserting salt or sugar molecules into the food interior which result in reduction of product water activity which is a measure of unbound, free water molecules present in the food that is necessary for microbial survival and growth.
- Fruit products like jam, jelly, marmalade, candy etc are preserved by adding sugar whereas salt as a preservative can be utilized in pickles, chutneys etc

5. Addition of acids:

- Acids increase the acidic content or hydrogen ion concentration of food items, thus preventing the activity and growth of micro-organisms.
- Sour food items like lemon juice, vinegar, citric acid are used as preservatives.
- Vinegar is used to preserve onions, tomato ketchup; lemon juice is used in pickles; citric acid is used in squashes.

6. Addition of chemical:

- These are the substances capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food.
- Sodium benzoate, potassium meta-bisulphite, sulphur dioxide, potassium sorbate are some of the examples of chemical preservatives used in food industries.

7. Fermentation:

- It is the process of converting carbohydrates in to alcohol and carbon dioxide or organic acids using yeast, bacteria or their combination under anaerobic conditions.
- Microorganisms are used to ferment sugar by complete oxidation, partial oxidation, alcoholic fermentation, lactic acid fermentation and other minor fermentative actions.
- Pickles and yogurtare the best examples of preservation by fermentation.

		
Dried	**Frozen**	**Canned**

Sugar Preserved

Salt and Acid Preserved

Fermented

Fig.Fruits and Vegetables Preserved by VariousPrinciples and methods of Preservation

CONCLUSION

The correct knowledge of principles behind preservatation of fruits and vegetables along with suitable method of processing can not only important to reduce post harvest losses of these commodities but it also adds a variety of delicious products in our daily meal. Round the year the consumer will be able to see these preserved products in their dish, in the form of taste as well as nutrition.

REFERENCES

Horticultural Statistics at a Glance.(2017). Horticulture Statics Division.Department of Agriculture, Cooperation and Farmers Welfare.Ministry of Agriculture and Farmers Welfare, Government of India.

Jha SN, Vishwakarma RK, Ahmad T, Rai A, Dixit AK. (2015). Report on assessment of quantitative harvest and post-harvest losses of major Crops and Commodities in India. ICAR-All India Coordinated Research Project on Post-Harvest Technology, ICAR-CIPHET, Ludhiana.

Lal G, Siddappa MA, Tondon GL. (1960). Preservation of fruits and vegetables.Indian Council Agricultural Research, New Delhi.

Rahman MS. (2007). Handbook of food preservation. CRC Press, Taylor and Francis Group, New York

Agroforestry as an option for mitigating the impact of climate change

Nikhil Raghuvanshi[1] and Vikash Kumar[2]

Research Scholars
[1]Department of Agronomy, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya- 224229
[2]Department of Agronomy, Banaras Hindu University, Varanasi- 221005
Corresponding author: vikasagronomy@gmail.com

ABSTRACT
Global warming is continuous without any doubt and since 1950's many of the observed changes in the climate are unprecedented over decades to the millennium. Anthropogenic greenhouse gas emissions will cause further changes and warming in the climate system. In the 21st century, climate change and its effect are fast becoming one of the prime events. Climate change effects coupled with overpopulation and weather crises, climate disruptions may have a major influence on resilient and sustainable development.

Keywords: Climate change, mitigation, sustainability

Two maps show averaged projections for three general circulation models, two greenhouse gas emission scenarios for the 2050's (top map) and the 2080's (bottom map). Safe winter chill amount of winter chill that is exceeded with 90 percent probability for a given scenario year.

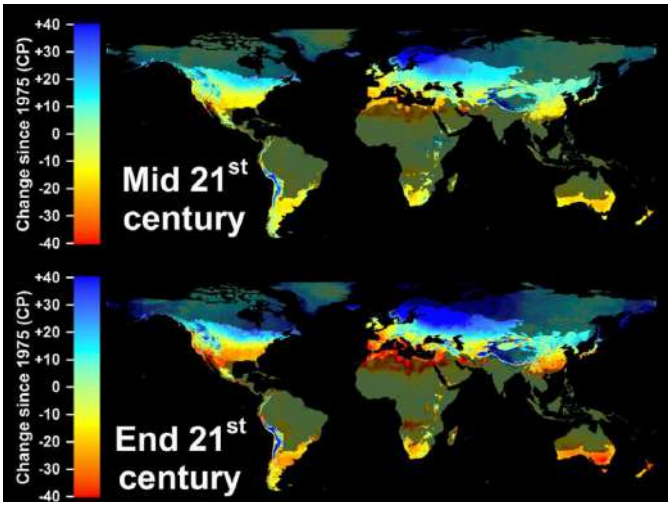


Figure 1:Projected losses in safe winter chill around the world compared to baseline scenari. (Luedelinget al., 2009)

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE

Climate change and agriculture are interrelated processes, both of which take place on a global scale. The consequences of climate change are being realized across the world and it is expected that agricultural crop production might be significantly affected by the predicted change in climate and atmospheric carbon

dioxide concentration. The probable effect of higher CO2 concentration increase plant photosynthesis and result in higher crop production in the tropical forest ecosystem. However, a rise in temperature may reduce crop yield by hastening plant development by modifying water and nutrient budget and by increasing plant stress. The net effect of increased CO2 and climate change on crop yield, thus depend on local condition. While warmer summer temperature might be beneficial to crop production in the temperature latitudes, where the length of the growing season and the frost-free period would increase, warmer temperature exerts negative effects on crop maturity in those regions where temperature and water stress limit crop production.

Figure 2: Agroforestry system (Alley cropping)

Therefore, the vast area of the arid and semi-arid region of India, where agriculture is mostly rain-fed will have probably, a strong adverse effect on global warming. it is projected that there will be 5 to 25% decline in winter rainfall and 10 to 155 % increase in monsoon rainfall over India by the 2080s, which is significant and may lead to droughts during the dry month and more intense rainfall spell during the wet season. If global surface temperature increased 0.14 to 0.58 degrees centigrade per decade, the yield of tropical grain crops could increase by 5 to 11% by the year 2020 and 11 to 46 % by 2050. In this situation, climate change mitigation and adaptation will playout locally but have global consequences. Both adaptation and mitigation strategies can complement each other and together can significantly reduce the risk of climate change.

CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGIES THROUGH AGROFORESTRY

Agroforestry can contribute to climate change mitigation by sequestering carbon in their biomass, in the soil, and in a wood products. Although agroforestry system usually storeless carbon per unit area then do forests, they have the advantage to allowing the land to remain in use for the production of food or other crops.Additional, a large total land area is suitable for agroforestry practices,implying a potential for large-scale carbon sequestration.Agroforestry can also play a role in climate adaptation.Trees can moderate local microclimate, protecting crops by lowering temperature and reducing soil evaporation.They can ameliorate draught by improving soil water holding capacity.They can reduce damage from extreme floods and wind storms.They are able to access deep supplies of water and nutrients.They mature trees are generally less susceptible to climate fluctuation then annual crops and can provide alternative source to food and income under adverse climate.

Agroforestry play a significant role in mitigating the atmospheric accumulation of greenhouse gases.There are three major paths by which agroforestry can help reduce the atmospheric carbon they are: conservation of exciting carbon pools through practices such as afforestation and alternate to slash and burn;sequestration through improved fallows and integration with trees and substitution through biofuel and bioenergy plantation to replace fossil fuel use.Agroforestry also play a vital role in helping smallholder farmers adapt to climate change, if it is supported by appropriate and marketing methods, agroforestry products can make a major contribution to the economic development of the millions of poor farmers by meeting their needs for food fuel and income.Combined yield of tree, crop and livestock products from well front and well planned and well managed agroforestry system tend to be higher than those from sole system due to increased and efficient use of scarce resources especially moisture.Recognizing the ability of agroforestry system to address multiple problem and deliver multiple benefits, it has been started that agroforestry can both sequester carbon and produce a range of economic and environmental and socioeconomic benefits.Now it is believed that agroforestry interventions provide the best adaptation and mitigation measure in making communities resistant to the impact of climate change.

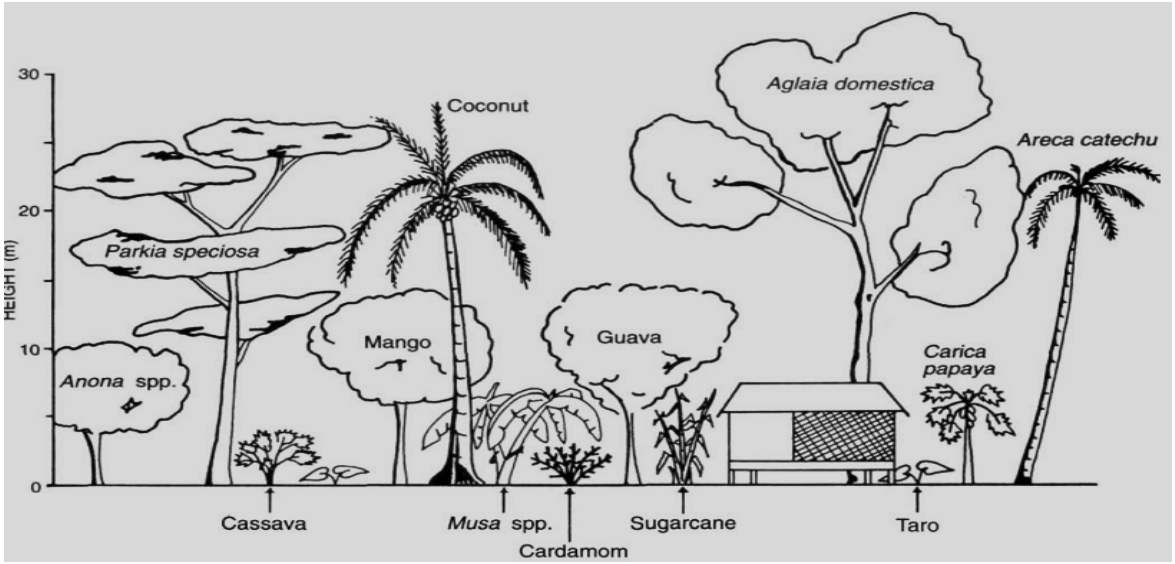


Figure 3:components structures of agroforestry system (Source. Gebre. 2016)

AGROFORESTRY FOR SOIL IMPROVEMENT AND CARBONSEQUESTRATION

The nitrogen, organic carbon and potassium levels were 42, 31 and 25% respectively higher under the canopies of *Faidherbiaalbida* than outside which is found in Zambia (Umar, 2013). Planting of trees in agroforestry system is thus an option for the households that will have secure tenure to their land use type.Reduction rates of agroforestry systems, integrated land-use systems combining trees and shrubs with crops and livestock, are fairly high. This is due to the moderatelygreat time-averaged biomass of trees compared to crops. The normal abatement rates in tonesCO_2per ha

per year are 7.6 for alley farming (the growing of crops simultaneously in alleys of perennial, preferably leguminous trees or shrubs), 7.5 for tree-crop farming, 8.7 for improved fallow (involving the use of fast-growing trees to accelerate soil rehabilitation), 4.6 to 6.3 for intercropping (the growing of crops near existing trees), and 4.3 to 6.7 for croplands where trees are introduce (World Bank,2012).

The integration of leguminous trees into the farming systems is highly efficient and the trees have multiple functions (Hadgu*et.al*, 2011). Some farmers in Asia maintain naturally regenerated sangwan, sweet neem, and other leguminous spp.in their farms for one or more benefits: soil fertility improvement, soil moisture retention, rain water infiltration, feed for livestock and income from sale of products.

CONCLUSION

As the danger of climate change looms large on the environment, following agroforestry practices is one way to mitigate the negative effects of climate change. Agroforestry helps in sequestering carbon in their biomass, in the soil, and wood products. Although less carbon is stored per unit area in agroforestry system, but it allows the land to remain inuse for the production of food or other crops. Since a large total land area is suitable for agroforestry practices, there is potential for large-scale carbon sequestration.Therefore, decision makers should have to be encourage climate smart agroforestry practices to mitigate the globally facing climate change challenges that affect the amount and quality of living thing.

REFERENCES

Altieri, M.A. and Nicholas, C.L. (2017) the adaptation and mitigation potential of tradition agriculture in a changing climate. Climate change. 140(1). 33-45.

Gebre, A.B. (2016) Potential effects of agroforestry practices on climate change mitigation and adaptation strategies: a review. Journal of natural science research. 6(15) 83-89

Hadgu, K.M., Mowo, J. Garrity, D.P. and Sileshi, G. (2011) current extent of evergreen agriculture and prospects for improving food security and environmental resilience in Ethiopia, International Journal of Agricultural Sciences ISSN: 2167-0447 Vol. 1(1), pp. 006-016

Luedeling, E., Zhang, M.,Luedeling V andGirvetz, E.H. (2009) sensitivity of winter chill models for fruitand nut trees to climate change expected in California' Central Valley. Agriculture, Ecosystemsand Environment, 133(1-2) 23-31

Spencer, J., Lawer, J., Lowie, C., Thompson, L., Hinckley, T., Kim, S. H., Bolton, S., Meschke, S., Olden, J.D., and Voss, J. (2017) Case studies in co-benefits approaches to climate change mitigation and adaptation. Journal of Environmental Planning and management. 60(4). 647-667.

Umar, 2013. Effects of Faidherbiaalbida on the fertility of soil in smallholder conservation agriculture systems in eastern and southern Zambia; African Journal ofAgricultural World Bank, 2012. Carbon Sequestration in Agricultural Soils; report No. 67395-GLB www.worldbank.org/ard.

Beehive Briquette for maintaining desired microclimate in Goat Shelters

Arvind Kumar[1*], Mohd. Arif[2], Ravindra Kumar[3], and N Ramachandran[4]

ICAR- Central Institute for Research on Goats, Makhdoom, Mathura (UP) 281122
[1,4]Sr. Scientist, [2]Scientist, [3]Principal Scientist, [1,2,3]Division of Animal Nutrition, Management and Products Technology, [4]Division of Animal Physiology and Reproduction
[*]Corresponding author's email: arvindkr30@yahoo.com

ABSTRACT

In the absence of proper protection measures goat kids are likely to suffer from pneumonia and other respiratory problems during winter when temperature falls below 10°C. This retards the growth of young goats and mortality rate is increased. Use of gunny bags and thatch panels for covering the goat sheds during winter has not resulted full protection, especially in newborn kids. Use of artificial heat using electricity or heavy concrete structure may protect the animals from extreme cold but increases the cost of rearing. Direct burning of biomass emits substantial amount of pollutants including respirable particles and harmful gases, which may cause health hazards to the animals. Beehive briquettes are low cost solution to these problems. These briquettes are made by mixing charcoal powder and mud in the ratio of 70:30 by volume using briquette mould. Mud (clay) is used as binding agent for giving the required shape and also used to elongate the burning period. Each dried briquette having 145 mm diameter and 85 mm height can be burnt in briquette stove with smokeless blue flame having an average burning time of 2 to 2.5 hours. Experiments on shed heating with beehive briquettes were conducted at the goat shelters of ICAR- CIRG, Makhdoom during winter months of 2018. Three briquettes were burnt at equal spacing in the central gallery of goat shelter having 10 m length and 7 m width. The maximum rise of temperature was observed to be 4°C at the middle of the shed one hour after burning the briquette.

Key words: goat shelter, beehive briquette, winter protection, microclimate

Extremely cold weather condition adversely affects the growth performance of goats especially the young ones. Normally recommended minimum temperature inside shed for 3 months old kids is above 10°C. Accordingly, the climatic zones where the minimum temperature falls below 10°C needs extra care by means of side wall protection of shelters using gunny bags and thatch panels. The gunny bags are stitched and hanged on long side of the shed during mild winters (Fig. 1a). Thatch panels of about 10 cm thick (Fig. 1b) are also used to maintain microclimate above 10°C. During day time, the

gunny bags and thatch panels are removed to have proper ventilation inside shed with proper drying of floors before sunset (Fig. 1c).

Fig. 1 Winter protection measures in goat shelters (a) Gunny bags, (b) Thatch panels, (c) Opening of protection in day time

Even after the gunny bags and thatch panels, the occurrence of pneumonia and other respiratory problems are being observed in newborn kids and kids of lower birth weight particularly in highly prolific and small sized goat breeds like Black Bengal where the birth weight of kids is even less than 1kg in few multiple birth cases. For such conditions, use of artificial heat using electricity is needed to have warmer microclimate inside kid's enclosure which increases the cost of kid rearing. In rural areas, goat keepers are burning grasses, wood materials etc which causes animals to suffocate, if provisions are not present in shelters for escape of smoke. Heavy concrete structures may protect the animals from extreme cold but high cost involvement makes it economically unsuitable for goat shelters. Direct burning of biomass emits substantial amount of pollutants including respirable particles and harmful gases such as carbon monoxide, nitrogen and sulphur oxide, which may cause health hazards to the animals.

Beehive charcoal briquette has been found to be a solution to above mentioned environmental problems. Briquetting has been practiced for many years in several countries. These briquettes can provide an alternative source of solid fuel, especially in rural areas for warming up houses and animal shelters. These can be burnt clean and therefore are eco-friendly and possesses the advantages associated with the direct use of biomass burning. These briquettes are made cylindrical in shape with number of parallel holes which make it look like beehive. Beehive briquettes are made by mixing charcoal powder and mud in a certain proportion. Charcoal can be obtained by controlled burning of locally available biomass. Mud (clay) is used as binding agent for giving the required shape and also used to elongate the burning period. Beehive briquettes are produced by densifying loose charcoal mixed with clay mud in briquetting equipment known as briquette mould (Fig 2a). In general, the ratio of charcoal and mud used for making briquettes is 70:30 by volume. For making the briquette charcoal powder and mud (clay) are mixed together and a little water is added to make the paste soft enough to hold the structure. A standardized beehive briquette mould with overall dimension of 400 mm × 100 mm is used to make the briquettes. It consists of three parts i) cylinder, ii) base plate with 21 rods and iii) cover plate. Cylinder dimension is 145mm diameter × 85mm height. Base plate has total 21 rods of 12 mm diameter and 95 mm height welded on it. Cover plate has same number of holes of slightly larger diameter so that it can move through the rods on base plate

freely. After putting cover plate and cylinder on base plate, the charcoal mixture is put into the cylinder and the whole unit is beaten on ground to increase the compaction of the material. Then the cylinder along with cover plate is pulled out of the base plate along with the formed briquette. It is placed upside down on ground and pressed to release the briquette. Thus the dimension of each briquette formed is 145 mm in diameter and 85mm in height which perfectly fits in the briquette stove (Fig 2c) available in the market. Raw briquettes are allowed to dry in open air as well as in sun light. These briquettes are easy to store because they are of uniform shape and size. Dried beehive briquettes produce smokeless blue flame with an average burning time of 2 to 2.5 hours.

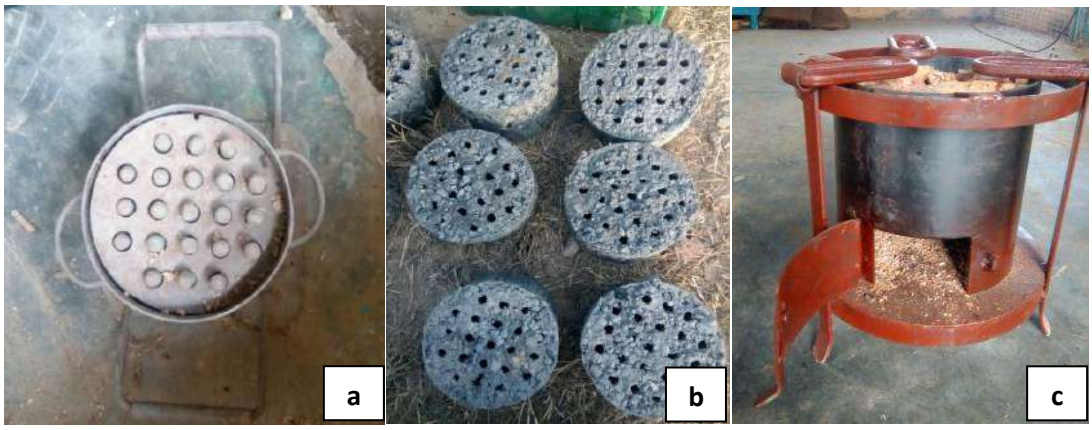


Fig. 2 (a) Briquette mould, (b) Beehive briquettes, (c) Briquette stove

The fuel density, moisture content, size and geometry as well as the material properties, all these factors have significant effect on burning rates of biomass. The exact ratio of the raw materials, number of holes and shape and size of the briquette has been standardized by ICAR Research Complex for NEH Region, Meghalaya. These briquettes are commonly used for space heating in NEH region during winter season. The technology has been recognised by NRDC, Ministry of Science and Technology, Government of India and awarded with NRDC National Societal Innovation Award of the Year 2018.

Trials on heating of goat shed by combustion of beehive briquettes were conducted at ICAR-Central Institute for Research on Goats, Makhdoom, Mathura (UP) during winter months of 2018. Three briquettes were burnt at equal spacing in the central gallery of goat shed having 10 m length and 7 m width (Fig 3). The rise in temperature at the middle of the shed and at the boundary with burning time is shown in Table 1. The data revealed that the maximum rise of temperature was observed to be 4 ^{0}C at the middle of the shed 1 hour after burning the briquette. The burning of briquette has lasted for maximum of 2.5 h.

Fig. 3 Heating of goat shelter by combustion of beehive briquette.

Table 1 Rise in temperature of the goat shed due to briquette combustion

Time duration	Temperature inside the shed (without briquette combustion) (^{0}C)	Temperature inside the shed (with briquette combustion) (^{0}C)	
		Temp at middle of the shed	Temp at boundary of the shed
11.00 AM (start of briquette burning)	12	12	12
12.00 Noon	12	16	13.6
1.00 PM	13	15.5	14.5
2.00 PM	16	18	17.7

SUMMARY

Extremely cold weather condition adversely affects the growth performance of goats especially the young ones. The climatic zones where the minimum temperature falls below 10°C needs additional protection by use of gunny bags, thatch panels etc. During day time, the gunny bags and thatch panels are lifted up to have proper ventilation and drying of floor. Even after the gunny bags and thatch panels, the occurrence of pneumonia and other respiratory problems are being observed in newborn kids and kids having lower birth weight particularly in highly prolific and small sized goats. For such conditions, beehive briquette can easily be used for maintaining goat sheds with required microclimate in rural areas at low cost as the biomass is available locally and does not require any costly equipment. Therefore, the goat keepers in rural areas shall use these briquettes to have warmer microclimate for rearing young kids during inclement cold weather conditions.

An Overview on Nutritional Deficiencies in Swine Production

Jyotimala Sahu[1] and Aayush Yadav[2]*

[1]Department of Livestock Production and Management, ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India
[2]Department of Livestock Production and Management, College of Veterinary Science & A.H., CGKV, Anjora, Durg, Chhattisgarh, India
**Corresponding author: ashyuga186@gmail.com*

ABSTRACT

Swine industry ensures lower costs of production with higher income due to the ability of swine to convert a larger proportion of feed into edible meat and fat. Error in diet results slow growth rate and deficiency diseases. Diet may be deficient in vitamins,minerals and nutrients (energy, protein and fatty acid). The deficienciesmay lead to higher losses in swine production; however the problems can be overcome by addition of required nutrient in theappropriateamount.

Keywords: Swine, Vitamins, Minerals, Nutrients, Deficiencies

INTRODUCTION

The control of deficiency diseases among swine is one of the first essentials in successful pork production. The importance of adequate nutrition is further emphasized by the fact that the cost of feed alone, including pasture, is estimated as 70 - 75 percent of the total cost of pig rearing (ICAR, 2011). Swine are able to convert a larger proportion of their feed into edible meat and fat than any other farm animal, but errors in diet which slow their growth or lead to poor utilization of feed or the development of deficiency diseases can result in heavy death losses and otherwise seriously interfere with the economical production of pork. Many deficiency diseases of swine can be readily controlled if feed requirements are understood and the required nutrients are provided. Early recognition of deficiency symptoms and prompt application of curative or preventive measures will frequently prevent heavy losses. Swine are raised under a wide variety of conditions and are fed many kinds of feed. Concentrated feeds make up the bulk of most ordinary rations, but some bulky feeds, such as good pasture plants or a limited amount of well-cured roughage (particularly alfa-alfa), have proved to be a source of essential nutrients. Pigs fed in the dry lot and especially in floored pens depend entirely on their daily allowance of feed to meet their requirements. Such animals are particularly likely to suffer from deficiency diseases unless their ration is carefully selected (Madsen, 1942). The mineral, vitamin and nutrient deficiencies that

affect swine often with serious consequences for the producerare discussed in this literature.

1. Mineral deficiencies (Reddy, 2009)

Mineral	Signs of deficiency	Description/ Consequences
Calcium & Phosphorus	▪ Rickets ▪ Osteomalacia ▪ Agalactia ▪ Depressed milk yield ▪ Fractures ▪ Osteoporosis ▪ Parturient paresis	▪ Disturbance in interrelationship between Vit D, Ca& P. ▪ Mostly in spring and winter season and lack of sun exposure ▪ Lack of vitamin D leads to reduced absorption of Ca& P ▪ Causes delayed growth, bowed legs, weak legs and vertebrae
Iron	▪ Nutritional anaemia ▪ Thumps ▪ Poor growth ▪ Pale skin	▪ Reduced haemoglobin in piglets (below 8 g/100 ml) by 10-14 days of age ▪ Fatty degeneration of liver ▪ Difficult spasmodic respiration ▪ Daily requirement by piglet-7-16 mg/day ▪ Drench piglet with saturated ferrous sulphate solution ▪ I/m administration of iron dextran (200mg) on 4th and 14th day of birth
Iodine	▪ Goitre ▪ Hairless piglets ▪ Reproductive failure	▪ Enlargement of thyroid gland
Salt	▪ Poor growth ▪ Low water intake ▪ Poor feed efficiency ▪ Unthriftiness	▪ Sodium content of plant feedstuffs is low and potassium is more which adversely affects the sodium retention. Therefore animal diet is supplemented with salt @ 1% of concentrate mixture.
Selenium	▪ Mulberry heart disease	▪ Mottled appearance of heart muscle ▪ Necrosis and haemorrhage in myocardium
Copper	▪ Loose faeces ▪ Nutritional anaemia	▪ Microcytic hypochromic anaemia ▪ Decreased osteoblastic activity ▪ Depressed growth ▪ Depigmentation of hairs ▪ Diarrhoea
Zinc	▪ Parakeratosis	▪ Skin gives severe mange like appearance ▪ Diarrhoea and anorexia observed
Manganese	▪ Infertility ▪ Lameness	▪ Bone abnormality
Magnesium	▪ Infertility	--

2. Vitamin deficiencies

Vitamin	Signs of deficiency	Description/ Consequences
B1 (Thiamine)	▪ Poor appetite & growth rate	--
B2 (Riboflavin)	▪ Crooked and stiff legs ▪ Corneal opacities	▪ Diarrhoea ▪ Dermatitis ▪ Nerve degeneration
B3 (Niacin)	▪ Pellagra	▪ Rough, scaly and de-pigmented skin ▪ Mouth ulcers, dermatitis, diarrhoea, hind leg paralysis ▪ Predominantly in maize based diet and Tryptophan deficient diet
B5 (Pantothenic acid)	▪ Goose stepping gait ▪ Scurvy skin ▪ Thin hair	▪ High stepping gait particularly hind legs ▪ Incoordination and posterior paralysis
Biotin	▪ Poor hoof quality ▪ Lameness	--
B12 (Cyanocobalamin)	▪ Anaemia ▪ Wobbley gait	▪ Unsteady gait due to injury to the legs and feet or to the nervous system
A (Retinol)	▪ Night blindness ▪ Incoordination ▪ Congenital defects & infertility ▪ Poor bone growth	▪ Keratinization of epithelium which interferes with normal secretion and elimination of urine and forms a foci which leads to kidney and bladder stones ▪ Reduced no. and motility of spermatozoa ▪ Abnormal spermatozoa
K (K_1: Phylloquinone; K_2: Menaquinone)	▪ Poor blood clotting	▪ Haemorrhage in tissues ▪ Delays prothrombin synthesis
E (Tocopherol)	▪ Porcine stress syndrome (PSS) ▪ Hepatitis dietica (HD) ▪ Exudative diathesis (ED)	▪ Diffused and severe degeneration of skeletal muscles with excess of pericardial fluid and fatal hyperthermia occurs during halothane anaesthesia to test pigs for PSE and PSS. ▪ Necrosis & congestion of liver in HD ▪ Oedema of subcutaneous region is ED
Folic acid	▪ Anaemia	▪ Macrocytic hyperchromic anaemia

	▪ Poor litter size	
Choline	▪ Poor litter size	--
		(Madsen, 1942 and Prasad, 2014)

3. Nutrient deficiencies

Nutrient	Sign of deficiency	Description/ Consequences
Energy	▪ Ketosis ▪ Negative energy condition	▪ Energy intake becomes insufficient to meet the energy requirement of early lactating sow leading to utilization of fat reserves from body thereby converting fatty acids in ketones and leading to ketosis.
Fat and fatty acids (Linoleic acid)	▪ Dry skin	--
Protein	▪ Lean tissue gain reduced	--

CONCLUSION

It is concluded that during formulation of diet one has to take account of stage of life and production of swine.Swine needs minerals, vitamins and nutrients for proper growth and reproduction thus producers almost always feed a balance diet which contain right amount of required nutrients to avoid the loss in production.

REFERENCES

ICAR. (2011). Handbook of animal husbandry. Indian Council of Agriculture Research. New Delhi, India.

Madsen, L.L. (1942). Nutritional diseases of swine. Yearbook of Agriculture, 810-828.

Prasad, J. (2014). Goat, sheep and pig production and management. Kalyani Publishers, New Delhi, India.

Reddy, D.V. (2009). Principles of animal nutrition and feed technology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.

Nutritional Practices of Laboratory Animals

Aayush Yadav, Ashutosh Dubey, Rajkumar Gadpayle,AnupamSoni*, SudheerBhagat, UpasanaVerma, SandhyaKashyap and Kiran Kashyap

Department of Livestock Production and Management,
College of Veterinary Science & A.H., CGKV, Anjora, Durg (C.G.), India
**Corresponding Author: vetanupam456@gmail.com*

ABSTRACT

A laboratory animal's nutritional status reflects its ability to grow, reproduce and perform and a well-balanced diet therefore ensures good welfare and unbiased experimental results for which the animals are reared. The diet may be natural, semisynthetic or synthetic and be presented to the animals in form of dry powder, wet mesh, pellets, extruded, crumbled or liquid diets. The paper gives a brief knowledge on the nutritional practices of laboratory animals to ensure normal growth in immature animals and maintenance of normal body weight, reproduction, and lactation in adults.

Keywords: Laboratory animals,welfare, nutrition

INTRODUCTION

The nutritional management of laboratory animals is one of the important managemental aspects of the laboratory animals care. Since, the inadequate quantity and quality of food, changes the various normal physiochemical, biological and behavioural responses of the laboratory animals, thus, altering the aforesaid parameters and ultimately the research/diagnosis findings, for which these animals are reared. A nutritionally balanced diet is important both for the welfare of laboratory animals and to ensure that experimental results are not biased by unintended nutritional factors.

Factors affecting nutrient requirements:-Various factors affecting nutrient requirements of laboratory animals are given below.

1. **Genetics:-**

Genetic differences among species, breeds, strains, stocks, sexes, and individuals may affect nutrient requirements. For example, the lack of L-gulonolactone oxidase (a key enzyme required for the synthesis of ascorbic acid) in some species is apparently the consequence of genetic mutation. There is evidence that mouse strains may differ in

requirements for riboflavin, pantothenic acid, and other nutrients. Genetic differences in growth potential among species, strains, and sexes may influence the daily requirements for amino acids and other nutrients that are incorporated into tissues.

2. Stage of life:-

Nutrient requirements change during stages of the life cycle, especially in response to growth, pregnancy, or lactation. Synthesis of tissues or products requires amino acids, fatty acids, minerals, glucose, or other substrates as well as increased amounts of vitamins and associated cofactors.The physiological state of the animal also plays an essential role in food intake. Several reports show increased intake with the onset of pregnancy, but other reports suggest few changes, if any.

3. Environmental impacts:-

The laboratory animals are usually studied under controlled conditions with minimal diurnal or seasonal variation in temperature, light cycle, or other environmental conditions. Marked modification in these conditions may alter nutrient requirements. High temperature, disturbing stimuli, social conflict, or other environmental factors that reduce food intake may necessitate diets higher in nutrient concentrations to maintain adequate nutrient intakes. Housing types can also affect the amounts of nutrients needed in diets. For example, laboratory rodents maintained in either galvanized cages or cages with solid bottoms may have a lower dietary requirement for zinc because of the availability of zinc from the feces and cage materials. Solubilized minerals in drinking water (such as copper from copper water lines) may affect the amounts of these minerals that must be supplied by the diet. If laboratory animals ingest bedding or other "nonfood" materials, these may provide an unintended source of some nutrients or toxins. In studies of the requirements of laboratory animals for constituents that might be needed at extremely low concentrations, even the air supply may be a significant source of contamination.

4. Microbiological status:-

Under normal rearing conditions, laboratory animals harbours populations of microorganisms in the digestive tract. These microorganisms generate various organic constituents as products or by-products of metabolism, including various water-soluble vitamins and amino acids. The extent to which these nutrients contribute to the nutrition of the host may be substantial but varies according to species, diet composition, and rearing conditions. In the rat and mouse, most of the microbial activity is in the colon, and many of the microbially produced nutrients are not available to the host unless faeces are consumed, as is common for rats and other rodents.

5. Research conditions:-

Experimental procedures may produce stress or otherwise alter food intake. For example, surgical procedures or test substances in diets may lead to anorexia, necessitating the provision of more palatable diets or diets with elevated nutrient concentrations. Experimental protocols that require restriction of the amount of food offered alter the intakes of all nutrients unless dietary concentrations are altered to account for changes in food consumption.

6. **Nutrient interactions:-**

Alterations in dietary energy density usually cause a change in feed intake. If high-energy diets are used, it may be necessary to increase nutrient concentrations in the diet to compensate for decreased food consumption. Other interactions occur between nutrients, such as competition for absorption sites among certain minerals that share common active transport systems. Thus in formulating diets containing unusual nutrient concentrations, the potential effects on other nutrients must be considered and adjustments made in nutrient concentrations, if appropriate.

TYPES OF DIET FOR LABORATORY ANIMALS:-

1. **Natural diet:-** These diet contains all the natural ingredients like raw cereals, legumes, grains, vegetables and fruits.
2. **Semisynthetic diet:-** It is a combination of natural and partially pure substances like starch, sugar and milk products. It also has certain amount of minerals and vitamins.
3. **Synthetic diet:-** These includes highly purified diet like protein, carbohydrate, fat, minerals and vitamins. It is highly expensive and is used generally as an experimental diet.

Presentation of diet for laboratory animals:-

1. **Dry powder:-**It is in the form of dry powder. Some medicines can also be mixed with it.
2. **Wet mesh:-** It is a powdered form mixed with little quantity of water. It will be like gruel. The feeding trough should be cleaned everyday otherwise there will be more chances for growth of fungus and microbes.
3. **Pellets feed:-** It is typically formed by adding water to the mixture of ground ingredients and then forcing it through a die. The size and shape of the holes in the die determine pellet shape and rotating blades control the length; the diet is then dried to firmness. Binders are sometimes used to improve pellet quality. Pelleted diets are easy to handle, store, and use; reduce dust in animal facilities; prevent animals from selecting choice ingredients; and tend to minimize wastage. It is not easy, however, to add test compounds or otherwise alter pelleted diets after manufacture. The size of the pellet varies from 4-6 mm (In Rabbits) to 8-10 mm (In Rat & Mice).
4. **Extruded diets:-** Extruded diets are similar to pelleted diets except the meal is forced through a die under pressure and at high temperature after steam has been injected, so the product expands as it emerges from the die. Extruded diets are less dense than pelleted diets and are preferred by some animals (e.g., dogs, cats, and nonhuman primates).
5. **Crumbled diets:-** They are prepared by crushing pelleted or extruded diets and screening particles to the most appropriate size for a particular age or size of laboratory animal, including fish and birds. Crumbled diets offer a method of presenting small particles of diet that, theoretically, contain all dietary ingredients present in pelleted diets.
6. **Liquid diets:-** These diets have been developed to accommodate specific requirements such as filter sterilization. Liquid diets are often used in studies of the

effects of alcohol on nutrient utilization and requirements. In some cases purified diets will take the form of a stable emulsion when blended with water. Neonatal animals are also fed liquid diets that are derived primarily from milk products. As with gel diets, care must be taken to store liquid diets properly to avoid microbial growth.

Average feed intake (g/day) of different species of laboratory animals:- The average feed intake (g/day) of different species of laboratory animals are given in Table 1.

Table 1: Average feed intake (g/day) of different species of laboratory animals

Species	Growing	Adult	Pregnant	Lactating
Mouse	3–5	5–7	6–8	7–15
Rat	8–25	25–30	25–35	35–65
Hamster	6-12	10-12	12-15	20-25
Guinea pig	35-45	45-70	70-80	100-130
Rabbit	120-200	200-300	300	300-400

Laboratory rodents are usually fed ad libitum.

Basic nutrients required for different species of laboratory animals:- The basic nutrients required for different species of laboratory animals are given in table 2.

Table 2: Basic nutrients required for different species of laboratory animals

Nutrients	Mice	Rat	Monkey	Guinea pig	Rabbit
Crude protein(% min)	20.0	20.0	20.0	24.0	20.0
Ether extract(% min)	4.0	4.0	6.0	3.5	3.5
Crude fiber (% max)	4.0	4.0	4.0	12.0	12.0
Ash (% maximum)	8.0	8.0	8.0	8.0	8.0
Calcium (% minimum)	1.0	1.0	1.0	1.2	1.2
Phosphorus (% min)	0.6	0.6	0.6	0.6	0.6
Nitrogen free extract (%)	55.0	53.0	53.0	43.0	47.0
Metabolisable energy (Kcal/Kg)	3600	3600	4000	3000	3000

Dietary feed composition for different species of laboratory animals:-The dietary feed composition for different species of laboratory animals are given in table 3.

Table 3: Dietary feed composition for different species of laboratory animals

S.No.	Ingredients	Composition	
		Rat, Mice, Hamster	Monkey, Rabbit, G. pig
1.	Wheat flour	22%	61%
2.	Roaster Bengal gram flour	60%	28%
3.	Ground nut flour	10%	-
4.	Casein	4%	1%
5.	Refined oil	4%	5%
6.	Salt mixture with starch	4.8%	4.8%
7.	Vitamins & choline mixture with starch	0.2%	0.2%
8.	Vitamin C (For Guinea pig)	-	50 mg/100 g diet

Extra diet for some laboratory animals				
S.No.	**Ingredients**	**Monkey**	**Rabbit**	**Guinea pig**
1.	Roaster Bengal gram flour	20g	20g	25g
2.	Ground nut flour	15g	-	-
3.	Plantain	1g	-	-
4.	Lucerne grass	-	100g	50g

IMPORTANT POINTS TO BE CONSIDER WHILE FEEDING LABORATORY ANIMALS:-

1. Animals should be fed palatable, non-contaminated, and nutritionally adequate food daily unless the experimental protocol requires otherwise.
2. Feeders should allow easy access to food, while avoiding contamination by urine and feces.
3. Food should be available in a mounts sufficient to ensure normal growth in immature animals and maintenance of normal body weight, reproduction, and lactation in adults.
4. Food should contain adequate nutrition, including formulation and preparation; freedom from chemical and microbial contaminants; bio-availability of nutrients should be at par with the nutritional requirement of the animal.
5. Laboratory animal diets should not be manufactured or stored in facilities used for farm feeds or any products containing additives such as rodenticides, insecticides, hormones, antibiotics, fumigants, or other potential toxicants.
6. Areas in which diets are processed or stored should be kept clean and enclosed to prevent entry of insects or other animals. Precautions should be taken if perishable items such as meats, fruits, and vegetables are fed, because these are potential sources of biological and chemical contamination and can also lead to variation in the amount of nutrients consumed.
7. Diet should be free from heavy metals (e.g., lead, arsenic, cadmium, nickel, mercury), naturally occurring toxins and other contaminants.
8. Exposure to extremes in relative humidity, unsanitary conditions, light, oxygen, and insects hasten the deterioration of food. Meats, fruits, vegetables, and other perishable items should be refrigerated if required to be stored. Unused, open food should be stored in vermin – proof condition to minimize contamination and to avoid potential spread of disease agents. Food hoppers should not be transferred from room to room unless cleaned and sanitized. The animal feed should contain moisture, crude fibre, crude protein, essential vitamins, minerals crude fat and carbohydrate for providing appropriate nutrition.

REFERENCES

CLTRI. (1987). Manual of laboratory animals, basic facilities, handling and care. Central leprosy Training and Research Institute, Ministry of Health and Family Welfare, Chengalpattu,Tamil Nadu, India.

CPCSEA. (2003) Guidelines for laboratory animals facility (2003). Indian Journal of Pharmacology,35: 257-274.

Luecke, R.W. and Fraker, P.J. (1979). The effect of varying zinc levels on growth and antibody mediated response in two strains of mice. *J. Nutr*., **109**:1373–1376.

NRC. (1995). Nutrient requirements of laboratory animals, 4thRevised Edition. Subcommittee on Laboratory Animal Nutrition, Committee on Animal Nutrition. National Academies Press.

Stevens, C.E. (1988). Comparative physiology of the vertebrate digestive system. Cambridge University Press, New York.

Biofortified wheat: food security along with nutritional quality

Suresh[1*], Antim[2]and Ashish[3]

[1]*Department of Genetics and Plant Breeding, CCSHaryana Agricultural University, Hisar (Haryana)*
[2]*ICAR-Indian Institute of Wheat and Barley Research, Karnal (Haryana) – 132 001*
[3]*ICAR-Central Soil Salinity Research Institute, Karnal (Haryana) – 132 001*
[*]*Corresponding Author: suresh.nyol@gmail.com*

ABSTRACT

Wheat is an important staple food for almost every country of the world. But most of wheat varieties are lacking or have deficient micronutrients which are required by our body to protect us against severe disease. This deficiency can be overcome by wheat biofortification. Wheat biofortification can be achieved by various approaches such as agronomic, genetic and transgenic approach. Agronomic approach is based on use of various chemical fertilizers which is not environmental friendly. Genetic approach is most acceptable and eco-friendly. A few biofortified varieties are also developed by breeder under the program HarvestPlus.

Keywords: Wheat, Biofortification, HarvestPlus

INTRODUCTION

Bread wheat (*Triticum aestivum*) is one of the most important cereals grown all over the world and used as a primary input for various food industries. The importance of this crop can be felt by the fact that in the year 2018-19 wheat production has reached 766 million tonnes (FAO, 2019). Wheat is a rich source of carbohydrate and protein. But for proper growth and development of our body, we require some essential micronutrients. Iron (Fe), zinc (Zn), iodine (I), selenium (Se) are some of the most important micronutrients. But most of the vegetarian people lack these micronutrients in their diet which may lead to severe malnutrition problems. Even our modern wheat cultivars are lacking these essential micronutrients. The problem of malnutrition and hidden hunger is common in pregnant women and children below five year age group of developing countries. This problem can be resolved by increasing the nutritional status of any crop with global importance. Enhancement of micronutrient contentsby different methods in crop plants is called biofortification. As wheat is consumed globally as a staple food, release of varieties rich in micronutrients can fulfil this purpose. Biofortification of wheat with higher Fe and Zn contents and essential amino acids such as lysine and tryptophan is the need of the present time. This is most effective and simplest solution to battle with micronutrient deficiencies.

CONVENTIONAL METHOD OF BIOFORTIFICATION

As plants absorb nutrients from soil, application of fertilizer in soil can increase their uptake. In conventional or agronomic biofortification approach, we use micronutrient fertilizer. These fertilizers can be applied in soil or can be sprayed on foliage. Although application of fertilizers in soil by broadcasting is easy but better results are gained with foliar sprays at the time of anthesis in wheat. In case of wheat, $ZnSO_4$ is most commonly used micronutrient fertilizer. When these fertilizers are applied, more micronutrients can be accumulated in stem and reproductive parts of plant (Cakmak, 2008). The main advantage of fertilizer based approach is that we can apply these micronutrients easily. But it increase cost of production and use of fertilizer may cause problem of environmental pollution.

Biofortification through plant breeding

Genetic manipulation in wheat for biofortification is a better choice over agronomic approach. In this approach, various germplasm lines are screened and potential genotypes with higher nutrients are selected, evaluated and released as a variety. Evaluation of germplasm for genetic variability is the first step in this regard. Emmer wheat and durum wheat are two good source of genetic variability for micronutrients especially Fe and Zn. In wheat, biofortification based breeding started in CIMMYT, Mexico with the imitation of programme 'HarvestPlus' in 2003. A number of varieties are now available with increase Zn and Fe content Zincol 2016, Zinc Shakti (Chitra), WB02 and HPBW-01 is some successful varieties (HarvestPlus, 2017). These varieties are not only high-yielder but also have some important agronomic traits like earliness and rust resistance. This breeding based approach is most effective, environmental and farmer friendly. But the main limitations of this method include lower genetic variability for micronutrients, time-consuming and linkage of micronutrients with undesirable traits.

Biotechnological or transgenic based biofortification

In transgenic based approach, we can insert any genes which increase nutritional status in wheat from any unrelated organism. When wheat plants are transformed with *ferritin* gene of soybean and wheat, the resulting genotypes have higher Fe content in their grains (Xiaoyan *et al*., 2012). This is just one example to show the beauty of this method. This method breaks the barriers of cross-ability. For the development of transgenic wheat, there is need to identify and incorporate genes associated with improvement in nutritional status from different organism. This method requires advance laboratory facility and skilled person. Further in developing countries, release of transgenic varieties faces many problems.

CONCLUSION

The problem of hidden hunger is a boon to most of countries. Use of different methods for biofortification of wheat can increase the micronutrient content in diet of vegetarian population. Genetic manipulation of wheat biofortification is most useful method of

present time. But to strengthen wheat breeding in this regard, there is need to use biotechnological tools like genetic markers and recombinant technology. If important genes related to higher micronutrients are tagged, the process of varietal development can be accelerated.

REFERENCES

Cakmak I. (2008). Enrichment of cereal grains with zinc: Agronomic or genetic biofortification? *Plant Soil***302**: 1-17.

FAO (2019). http://www.fao.org/worldfoodsituation/csdb/en/

HarvestPlus. 2017. https://www.harvestplus.org/

Xiaoyan S, Yan Z and Shubin W. (2012). Improvement Fe content of wheat (*Triticum aestivum*) grain by soybean ferritin expression cassette without vector backbone sequence. *J Agric Biotechnol***20**: 766-773.

Farmer field school on improved animal husbandry practices: a report

Dr. S. Senthilkumar

Associate Professor
Department of Veterinary and Animal Husbandry Extension Education
Veterinary College and Research Institute
Ramayanpatti, Tirunelvlei – 627 358
Corresponding Author: usveteng@gmail.com

Farmer Filed School (FFS) is a group based adult learning approach that teaches farmers how to experiment and solve problems independently. Sometimes called "schools without wall", in FFS, groups of farmers meet regularly with a facilitator, observe talk, ask questions and learn together. FarmerField School is one of the viable options for transfer of idea, skill and knowledge from research System to Farming System.

Farmer Field School is successful in teaching, emphasising and popularising some of the important techniques/ skill /knowledge that can be of benefit to livestock farmers to adopt ataffordable cost in maximising profit.Farmer Filed School is a six week programme wherein classes are conducted through demonstration mode only once in a week preferably in the early hours of the day with maximum of five hours duration considering the working pattern of the farmers in the village identified.

Accordingly, a Farmer Field School on "Improved Animal Husbandry Practices" was conducted by the Department of Veterinary and Animal Husbandry Extension Education, Veterinary College and Research Institute, Tirunelveli with the financial support of AgriculturalTechnology and Management Agency (ATMA), Tirunelveli district.

METHODOLOGY

A package of Improved Animal Husbandry Practices were framed in demonstration mode of training for six weeks period. The practices identified are

- Preparation of Concentrate feed
- Conservation of Fodder – Silage making
- Cultivation of Co-4 grass
- Demonstration of milking machine
- Deworming and deticking for sheep and goat
- Oral Pellet Vaccination against Ranikhet disease in Native Chicken birds.

Twenty five progressive livestock farmers were selected randomly in the Manur block of Tirunelveli District and the programme was conducted at Kalakudi village.

ACTIVITIES

❖ Preparation of Concentrate feed

The training class on "Preparation of concentrate feed" was conducted wherein the livestock farmers were taught on the importance of feeding concentrate feed to the livestock. The list of feed ingredients with choices was briefed to the beneficiaries. Thefeeding rations for milch animals at various stages were explained to the farmers. Similarly, the ration to be given for sheep and goats were specified. Importance on feeding animal as per the stages of growth and their impact on the animals' health, productivity and overall performance were explained. Later importance of quality feed and preparation of such feed equivalent to purchased feed was explained to them and how it reduces the feed cost involved in cattle rearing was also emphasised.

After that, a demonstration was performed for the beneficiaries as they could take note on all the ingredients used for the ration preparation and also how to prepare ration and store it for maximum utility. During this demonstration class, a total of 25 kg of dairy cattle feed ration was prepared with cereals, oil seed cakes, deoiled rice bran, mineral mixture and salt. Participants were also made to be involved in the feed ration preparation process. After which one kilogram of cattle feed prepared during the session were distributed to the participants.

❖ Conservation of Fodder – Silage making

The second demonstrative class on "Conservation of Fodder - Silage making" was conducted. During this programme, types of green fodders available, green fodders suitable for irrigated land and rainfed regions for proper nutritive requirement of the animals are taught. The quantities of each type of green fodder that need to be fed to the animals were also explained. The concept of silage making – an ideal option for conservation of excess fodder or a solution to solve the problem of fodder scarcity during summer were explained in detail as this is a new technology that has been extended to meet famers problems and demands. To reiterate this concept, a demonstration on silage making was organised on a small scale for better understanding and retention which included the involvement of the participant. After the end of the programme, the silage prepared was distributed to the participants at the end of the Farm Field School programme.

❖ Cultivation of Co-4 Grass

The third class was on "Cultivation of Co 4grass. Co 4grass is cultivable, multicut fodder crop that can be cultivated in irrigated land. The advantages of cultivating this fodder crop both yield wise and nutrition wise was explained. Besides this, the quantity of this fodder that has to be fed to cattle, sheep and goat were also taught to them.

For better understanding, a plot was identified. Land was prepared for planting of the Co4 grass slips with proper spacing and was demonstrated to the farmers. They were also given hands on practice on planting the slips. Later management schedule that included life irrigation, successive irrigation, time of first harvest and the next consecutive

harvests, yield expected and application of manure/ fertilizers after harvest were explained in detail to the farmers.

❖ **Demonstration of milking machine**

The fourth class was on "Demonstration of Milking Machine". Initially, the class on clean milk production, its health benefits for farmers, consumers and animals and on the keeping quality of milk were explained. This was followed by demonstration of different models of Milking machine and its "how to use" aspect was demonstrated to the farmers. The advantages of using it on animals were listed out. The farmers were also encouraged to try on animals – Hands on Practise. The information regarding its details for purchase of the equipment was also provided to farmers.

❖ **Deworming and Deticking for sheep and goat**

The consecutive class was on "deworming and deticking of sheep and goats".Here lectures on Ectoparasiteand endoparasites affecting sheep, goat and poultry, its illhealth on animals' performance, milkyield and / or weightgain of theanimals were delivered.Schedule to be followed for deworming of cattle, sheep and goat was informed.Per osdrenching of deworming solution/ medicine was demonstrated. The procedure to be adopted for wetting the animals with deticking medicine and preparation of wetting solution in water at proper concentration was explained and simultaneously demonstrated, followed by application of the solution on the body of the animal, how much time to retain the medicine to act on the coat of the animal and ticks and washing of animal after the waiting period were also explained and demonstrated.

❖ **Oral Pellet Vaccination against Ranikhet disease in Native Chicken birds**

The final demonstrative class was on"Oral pellet vaccinationagainst New Castle disease for Native Chicken". The merits of vaccination and its economic significance in poultry were explained to the farmers. One of the Technical innovations of TANUVAS was Oral Pellet Vaccine prepared to combat against Ranikhet disease in Poultry. The stability of the vaccine, its user friendly nature and its low cost input were briefed to the farmers and its oral administration to the bird was demonstrated and the schedule to be followed was also given.**An effort for popularisation of TANUVAS Innovations was also a theme in this class.**

CONCLUSION

The farmers are now in a situation wherein they can prepare their own ration for the livestock species they rear and feed according to the stage of growth. Some of the farmers have even prepared their own feed for the animals they own and happy to adopt it.With regards to cultivation of Co4, the farmers have found it as an answerable solution to fodder scarcity. Awareness on use of milking machine has been created among the farmers and farmers understood to a great deal on its types, usage and economic benefit to the farm and animals when used in large farms.With the demonstration of drenching, the right method of drenching and right time for deworming was taught to the farmers. Participants

are satisfied with the oral pellet vaccine administered against Ranikhet Disease in Country Chicken.

IMPACT

- ❖ Knowledge and Skill on"Improved Animal Husbandry Practices" have been impartedamong the beneficiaries of Farmer Field School.
- ❖ Beneficiaries are preparing their animal feed and thereby feed cost has been reduced in the study area.
- ❖ Fodder Scarcity has been reduced due to adoption of two techniques i.e Silage making and Green fodder cultivation (Co4) by farmers.
- ❖ The farmers have purchased fodder seeds and slips from Veterinary College and Research Institute, Tirunelveli.
- ❖ Beneficiaries are adopting scientific method of milking after knowing the importance of clean milk production and its effect of keeping quality.
- ❖ Popularised Oral Pellet Vaccine against New Castle Disease among the Farmers which is a TANUVAS Innovation.
- ❖ Mortality percentage of birds has reduced due to adoption of TANUVAS Oral Pellet Vaccine,i.e vaccination of desi birds with Oral Pellet Vaccine.

Demo on "Preparation of Concentrate feed"

Conservation of Fodder – Silage making

Cultivation of Co-4 Grass

Demonstration of Milking Machine

	
Deworming &Deticking for sheep and goat	**Oral Pellet Vaccination Programme**

Seaweed – An Alternative Source of Plants Nutrients in Agriculture

Ankita Begam[1*] and Dulal Chandra Roy[2]

[1]Ph.D scholar, Deptt of Agronomy, B.C.K.V, Mohanpur, Nadia, W.B. 741252, India
[2]Assistant professor, Deptt of LFC, WBUAFS, Mohanpur, Nadia, W.B. 741252, India
[*]Corresponding author: b.ankita01995@gmail.com

For any kind of improvement in agricultural system that results in higher production and it should reduce the negative environmental impact and enhance the sustainability of that system. For enhancing the effectiveness of conventional mineral fertilizers use of Bio-stimulants is such type of approach. Indiscriminate use of chemical fertilizer for the long time it beckon the crucial problem of soil health disorder vis-à-vis reduced input use efficiency, more accurately and fertilizer use efficiency. Behind this reason farmers are turn towards various options like organic manures, INM, growth regulator, biozymes and bio-stimulants. Use of seaweed extracts is one such option as it is a plant bearing fertilizer. Sea weed extracts it can be used as foliar spray or directly applied as granule form as an organic nutrient source. Fertilizer derived from sea weeds are more superior than chemical fertilizer due to high level of organic matter, vitamins, fatty acids, macro and micro elements, amino acids, auxin, cytokinin, betaines, gibberelins and abscisic acid like growth promoting substances and stimulate the growth and yield of plants, develop tolerance to environment stress (Zhang *et al*., 2003). In recent years sea weed extracts become popularity due to its potential use in organic and sustainable agriculture (Russo abd Beryln, 1990) and it helps to reduce excessive fertilizer application and to improve mineral absorption. Sea weeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds (Dhargalkar and Pereira, 2005). Sea weeds are several groups of multicellular marine algae *viz*. Chlorophyta (green), Phaeophyta (brown) and Rhodophyta (red), saltwater dwelling and simple organism. Sea weed grow in the shallow water and it is a primitive type of plants lack of roots, stems and leaves. In nature 900 species of green seaweed, 4000 red species and 1500 brown species are found. In tropical and sub-tropical waters red sea weed is found while brown seaweeds are more common in cooler, temperate waters. Liquid extracts which obtained from seaweed and recently gained importance as foliar sprays for many crops like various cereals, pulses and different vegetable species. Central Salt Marine Chemical Research Institute and Central Marine Fisheries Research Institute have developed some culture techniques for commercially important seaweed species in India. As a result of this effort, at coastal

poor people a lot of Self Help Groups, Village Youth Groups and NGOs have come forward to promote seaweed cultivation as an alternate livelihood option. Considering the great demand for these resources in the international market and availability of adequate manpower and interest in the country, seaweed cultivation has a very good prospect and it can be developed as a successful cottage or co-operative sector industry. As of 2018 the top 10 countries produced 96% of the global total of 2,165,675 metric tons and the production of this 10 countries are China (699 thousands metric tons per year), France (617 thousands metric tons per year), United kingdom (205 thousands metric tons per year), Japan (123 thousands metric tons per year), Chile (109 thousands metric tons per year), Philippines (96 thousands metric tons per year), North Korea (71 thousands metric tons per year), South Korea (67 thousands metric tons per year), Indonesia (47 thousands metric tons per year), Norway (41 thousands metric tons per year) respectively (Anonymous, 2019).

TYPES OF SEAWEED

Mainly three types of seaweed- brown seaweed, green seaweed and red seaweed.

- **Brown seaweed (Phaeophyceae):** The brown colour of these algae due to the presence of xanthophyll pigment fucoxanthin. Brown algae is the only algae known to have internal tissue differentiation into conducting tissue and in higher plant no true xylem tissue was found. Examples of some brown algae - *Laminaria and Saccharina, Fucus, Sargassum muticum.* Brown seaweeds.
- **Green seaweed (Chlorophyta) :** Green colour of this algae due to the presence same proportion of chlorophyll a and b in the higher plants. In Australia organic beta carotene is produced from hypersaline green algae *Dunaliella salina* grown in huge ponds. Examples of green algae: *Chlorella*, *Chlamydomonas*, *Spirogyra*, *Ulva*. Green seaweeds.
- **Red seaweed (Rhodophyta) :** The red colour of this algae due to the presence of phycoerythrin and phycocyanin pigment. *Kappaphycus* and *Betaphycus* this two red algae now the most important sources of carrageenan, and commonly used ingredient in food, particularly yoghurts, chocolate milk and repared puddings. Other red algae like *Gracilaria*, *Gelidium*, *Pterocladia* are used in the manufacture of the all-important agar, used widely as a growth medium for microorganisms, and for food and biotechnological applications. Some examples of red algae are *Palmaria, Delesseria, Chondrus,* Coralline algae.

ROLE OF SEAWEED IN CROP GROWTH AND YIELD

Sea weed contains plant hormones (Auxins, Cytokynins, Gibberellins), macro nutrients (Mg, S & minimum N P K), micro nutrients (B, Fe, Mn, Zn) and other compounds like carbohydrates, amino acids, algenic acid, vitamins, vitamin precursors, organic smolites (Betaines), hydrolysed proteins and enzymes. Plant growth regulators (stimulant) improve the effective partitioning and translocation of accumulates from

source to sink in the field crops and it also plays an important role in enhancement of cell size and cell division which ultimately complement each other as
cytokinins are effective in shoot generation and auxins in root development, while micro-nutrients improve soil health (Liu and Lijun, 2011). Seaweed extract not only influences the growth of the crops but also the production or the yield of the crops. Yield increases due to increased mobilization of reserve food materials to developing sink through increase in hydrolyzing and oxidizing enzyme activities. A field experiment showed that treatment of seaweed extract increased the length (31.7%), diameter (18.2%) and yield (37.4%) of *Ablemoschus esculentus* than the control (Zodape *et al.,* 2008).

OTHER USES OF SEAWEED

Food : Edible sea weed or sea vegetables that can be eaten and used as preparation of food. This edible sea weed contain high amount of fiber. Edible sea weeds are harvested or cultivated for the extraction of polysaccharides such as agar, gelatinous substances. Usually, marine algae sea weeds are edible and most of the fresh water algae is toxic. Sea weeds contain high level of iodine relative to other foods. Some common edible sea weed like red algae (Rhodophyta)- Carola (*Callophyllis spp.*), Carrageen moss (*Mastocarpus stellatus*), Dulse (*Palmaria palmata*) and brown algae (Phaeophyceae) - Arame (*Eisenia bicyclis*), Badderlocks (*Alaria esculenta*), Cochayuyo (*Durvillaea antarctica*), Green algae - Chlorella (*Chlorella* sp.), Gutweed (*Ulva intestinalis*),Sea grapes or *green caviar* (*Caulerpa lentillifera*),Sea lettuce (*Ulva spp.*).

Medicine and herbs

Sea weed extract is used in some diet pills and some red and green algae (sulfated saccharides) inhibit some DNA and RNA envelop viruses. Agar is used as a culture medium in microbiology.

Bioremediation

Algae had the large affinity for nutrients due to it's strong potential photosynthesis and this allow the sea weed to be used to remove remove undesired nutrients from water. In hypoxic (= oxygen- poor) dead zones, sea weed is very important because it also generates oxygen and growing sea weed rapidly consumed nutrients such as ammonium, ammonium nitrate, nitrite, phosphate, iron, copper as well as CO2. Sea weed (macro algae) as opposed to phytoplankton (micro algae), is used universally for filtration purpose because of the need to be able to easily remove (harvest) the algae from the water, which then removes the nutrients. Microalgae require more processing to separate from the water than macro-algae does; macro-algae is simply pulled out.

Climate change

"Ocean afforestation" is a main proposal for farming seaweed for carbon removal. After harvesting the seaweed it decomposes into biogas, (60% methane and 40% carbon dioxide) in an anaerobic digester. The methane can be used as a biofuel, while the carbon dioxide can be stored to keep it from the atmosphere. Seaweed grows quickly

and takes no space on land. Afforesting 9% of the ocean could sequester 53 billion tons of carbon dioxide annually (annual emissions are about 40 billion tons).

Liquid seaweed fertilizer

Liquid sea weed fertilizer is one of the best fertilizer which is not only organic but it also comes from a suatainable source and can be harvested without damaging the environment. Sea weed has more than 70 minerals, vitamins and enzymes. If liquid sea weed fertilizer is applied when the plants are beginning to bud the solution helps to promote additional budding and it can also be used as rooting solution. In case of pasture crop the algae increases the nutrient uptake, protein content and overall quality of the crop. Liquid seaweed fertilizers act as soil conditioners (especially the alginates in the seaweed). The alginates react with metals in the soil and form long, cross-linked polymers in the soil. These polymers improve the crumbling in the soil and swell up when they get wet and it also helps to retain moisture for a long time.

BENEFITS OF SEAWEED EXTRACT FERTILIZER

- It promotes more buds when applied as the plants are beginning to bud.
- Extends the shelf life of fruits and vegetables if applied 10 days before harvesting.
- Lengthens the life of cut flowers if they are sprayed with Liquid Seaweed a day or two before cutting.
- Treating seeds or seed pieces with Liquid Seaweed before planting will improve seed germination, root growth, and early seedling vigor.
- It acts as a rooting solution also. Place cuttings in a solution of Liquid Seaweed and water until roots develop, then plant. When planting, water in with Liquid Seaweed solution.
- We can use it as a soil treatment to grow healthier, stronger, and more disease-resistant plants.
- It promotes vigorous growth of plant and helps to prevent pests and diseases on fruit, flowers, vegetables, lawns etc.
- Eco-friendly.
- Odorless.
- Feeds all indoor and outdoor plants.

DOSE : As we applied for foliar application the dose will be 2ml/L and for soil application 5ml/L.

REASON FOR SEAWEED FARMING

Non-availability of required quantity of seaweeds for various uses.
Provide occupation / source of income for the coastal people and also provide continues supply of raw material for seaweed based industry.
For industrial purpose uniform seaweeds are provide.
Concerned seaweeds conserve natural populations.
Seaweed farming is a ecofriendly activity and a major tool to treat coastal pollution in the sea and reduce CO2 in global warming.

METHODS OF SEAWEED FARMING: Mainly three types of seaweed farming viz.-

1. Single Rope Floating Raft method (Coir Rope & Nylon Rope).
2. Fixed Bottom long line method (Coir Rope & Nylon Rope).
3. Integrated Multi Trophic Aquaculture (IMTA) method.

CONCLUSION

Seaweed extract are rich in micro-nutrients, hormones, enzymes, vitamins etc. and plays an important role in enhancing crop growth and yield. In present day agriculture, sustainable food production is a great challenge as it has to face various biotic and abiotic stresses like degradation of soil fertility, price increase of agricultural inputs etc. Under these circumstances, seaweeds are the good inducer for production enhancement and restoring soil fertility. But being a rich source of vitamins, minerals and growth promoters, seaweeds can be of immense help to the farming community of our country for their use as a source of organic fertilizer. Seaweeds are also being used for preparation of various health and nutritious human food globally as it contains high amount of minerals, vitamins, enzymes etc. Hence there is a need for popularizing the use of seaweed as a source of organic fertilizer and health food through mass scale field trials and awareness programmes.

REFERENCES

Anonymous, (2019). Volume of seaweed production ranked by country. www.*surialink.seaplant.net*. Retrieved on 28.04.2019.

Liu, Z. and Lijun, L. (2011). Effects of Plant growth regulators and saccharide on in vitro plant and tuberous root regeneration of Cassava. *J. Plant Growth Reg.* **1** (30): 11-19.

Russo, R. O., and G. P. Berlyn. (1990). The use of organic bio-stimulants to help low-input sustainable agriculture. *Journal of sustainable agriculture*. **1** (2):19–42.

Zodape, S. T., Kawarhe, V. J., Patolia, J. S. and Warade, A. D. (2008). Effect of liquid seaweed fertilizer on yield and quality of okra *Abelmoschus esculentus* L. *Seaweed Res. Utiln*. **67**: 1115-1117.

Zhang, X., and E. H. Ervin. (2004). Cytokinin-containing seaweed and humic acid extracts associated with creeping bentgrass leaf cytokinins and drought resistance. *Crop Science* **44**:1737–1745

Nabothian cyst in animals and humans-a review

***[1]Thangamani A, [2]B. Chandra Prasad and [3]Manda Srinivas**

[1]Ph.D Scholar, [2]Assistant Professor, [3]Professor
Department of Veterinary Gynaecology and Obstetrics
NTR College of Veterinary Science, Gannavaram
Sri Venkateswara Veterinary University
**Corresponding author: thangamtamil19@gmail.com*

ABSTRACT

The present analysis addresses nabothian cyst in both animals and human beings. The condition is a minor impediment in the reproduction in animals and humans.Factor responsible for nabothian cyst was analyzed and according the degree of involvement of this condition treatment protocols are suggested. Relevant to nabothian cyst the case records are scanty inboth animals and humans.The present analysis is placed on record as reports regarding nabothian cyst in both animals and human beings.

Key words: Animal;Human; Nabothian cyst;Infertility.

INTRODUCTION

The female reproductive system consist of gametogenic organ(ovary) and tubular portion,that consist of oviduct,uterus,cervix and cranial(anterior)portion of the vagina originated from paramesonephric duct,i.e. Mullerian duct, whereas the caudal portion of the vagina,vulva and vestibules emerged from urogenital sinus(Roberts,2004). Persistent mullerian duct might be involved in the formation of nabothian cyst.Portio-vaginalis portion of cervix made up of stratified squamous epithelium. In that area specialized secretory mucus glands (Nabothian gland) are present. Whenever the portio-vaginalis occluded the secretory mucus glands may lead to cystic condition called nabothian cyst.Cystic condition encountered in the reproductive tract was tabulated (Tab.1)

Tab.1 Cystic Condition of the Reproductive tract.

Cystic Condition	Location
Cystic ovarian degeneration	Ovary
Endometrial cyst	Uterus
Gartner's cyst	Vagina
Bartholin cyst	Vestibule
Nabothian cyst	Cervix

Among the above cystic condition regarding nabothian cyst cases are rare.The present review gives on detailed information regarding nabothian cyst in animals and humans.

Incidence: The nabothian cyst (or) follicle defined as a mucus filled cystic appearance found on surface of cervix(Laing et al.,1988).The German anatomist Martin Naboth(1707),who termed the cyst name was Nabothian cyst.Some reports in 1650-1735,the nabothian cyst was described by French surgeon Gillaume Desnoues.The synonyms for this condition was retention cyst of cervix,cervical epithelial cyst,cervical cyst.Incidence data collected from previous abattoir studies (Tab.2).

Tab.2 Data Collected From Previous Abattoir Studies

Name /place of abattoir/slaughter house/research station	Species	Reports	References
Konya abattoir(Turkey)	Cow	0.09%	Hatipoglu et al.,(2002)
Abattoir in Mymensingh	Goat	3.9%	Rahman et al., (2008)
Slaughter house in Mirpurkhas	Cow	3%(overall cervical abnormality_)	Kunbhar et al., (2003)
Data from Kentucky research station	Cow,heifer	0.2%	Perkins et al., (1954)
Hazaribagh slaughterhouse Dacca, Bangladesh	Cow	1%	Alam and Abdur Rahman, (1979)

CAUSES:

Nabothian cyst may be occur due to unpredictable causes.Scientist reported some possible causes to the nabothian cyst.

1.*Secondary trauma to the cervix:*

Physically excessive trauma to the cervix(Rama Rao, 1983; Jubb et al., 1985),however faulty artificial insemination (AI) trauma in previous estrus (Honparkhe et al., 2002)

2.*Chronic cervicitis:*

Animal recovered from chronic cervicitis (Kier et al., 1992)also responsible for formation of cervical cyst.

3.*Overgrown epithelium of cervix:*

During child birth (or) delivery time,the excessive skin cell(stratified squamous epithelium)can grow over the mucus producing endo-cervical gland(Sosnovski et al., 2009) results in cyst formation due to blockade of passage of secretion

4.*Developmental defect:*

Roberts,(2004) opined that developmental defect in the Mullerian duct (or) hereditary defect.

5.*Estrogen level:*

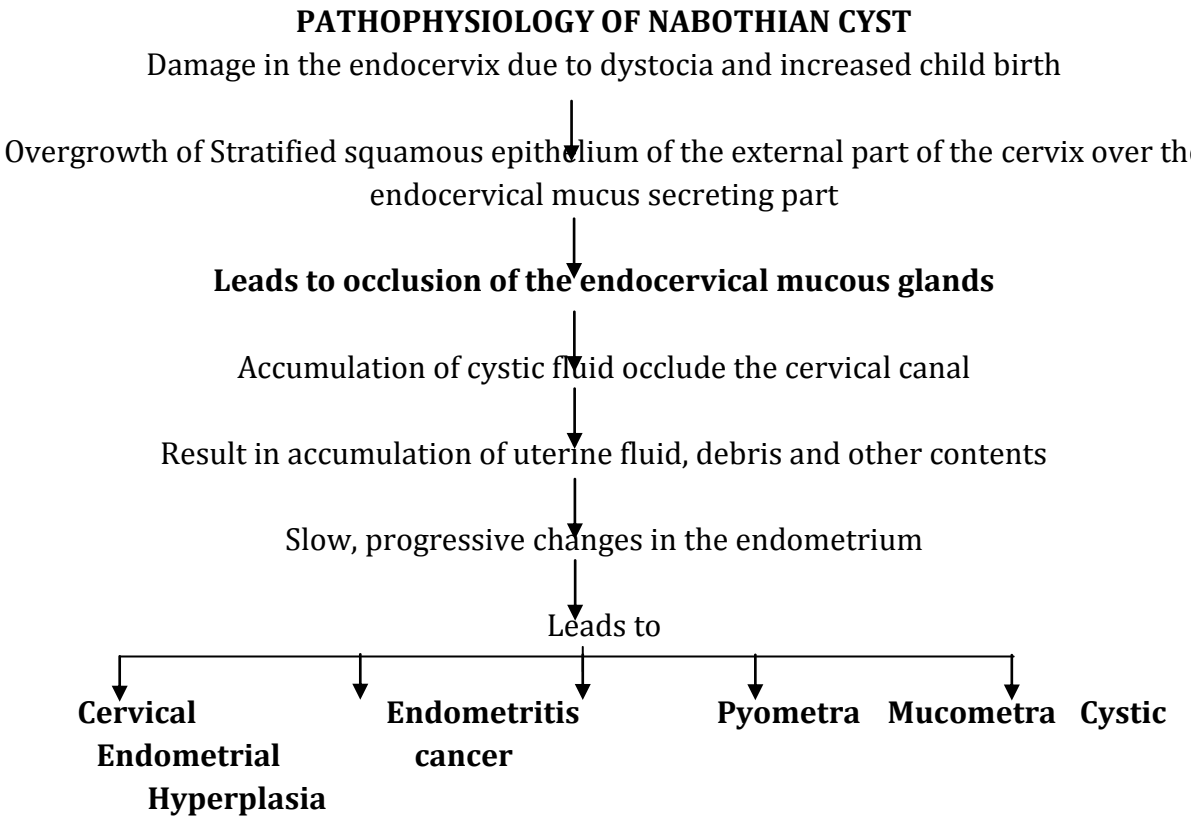
Excessive estrogen hormone level promote the cystic growth and increase the secretion of cyst(McEntee,1990).

6.*Metaplastic changes:*

Metaplastic changes in the cervical gland may predisposes to cystic cervix (Hotipoglu et al., 2002)

7.*Assisted delivery:*

Improper assisted delivery in previous calving cause's traumatic injury to the cervix leads to formation of cystic cervix condition.



CLINICAL SIGNS:

Clinical sign of the patient varies according to the size of the cyst (Tab.3)

Tab.3 Characteristic Clinical sign according to the Size of the cyst	
Subject and Size of the cyst	**Characteristic Clinical sign**
Animal A)*Small Size Cyst* B) *Large Size Cyst*	• Cervical mucus discharge clear and oozed out without any impedance. • No external abnormal discharge appears. • May impede the normal passage of cervical mucus discharge. • Impede the artificial insemination and natural service.

	• Uterine discharges are get accumulated lead to endometrial cyst, persistent CL contributed to anestrus. • Increased chances of repeat breeding followed by infertility.
Human	• Abnormal vaginal discharge with no changes in the cyclicity. • Feels discomfort. • Giant size cyst cause pelvic pain. • Pain evinced while sexual intercourse.

DIAGNOSIS:

In veterinary practice especially in large animals advanced diagnostic modalities are not feasible in field level.The most important diagnostic tool used in the field was recto-vaginal method of examination,but in human side well advanced diagnostic modalities utilized for diagnosis of nabothian cyst condition.Diagnostic method and its findings are presented in the table (Tab.4)

Tab.4 Diagnostic method and its findings

Subject	Method	Findings	References
Animals	Per rectal method	Cauliflower like growths with fluctuation on palpation	Honparkha et al., 2002 Venkata Naidu et al., 2009 Manokeran et al., 2012
	Per vaginal examination	Cyst found on external os (2-3 cm in diameter)	Devanathan et al., 2000
Humans	Per speculum examination	Continuous watery discharges observed.	Yelikar KA et al ., 2015
	Trans vaginal USG(Colposcopy)	Multiple tiny heterogeneoushypo echoic cyst.	Caglar et al., 2009
	MRI(Magnetic Resonance Imaging)	Multiple cysts in the cervix.	Caglar et al., 2009 Temur et al., 2011 Yelikar KA et al., 2015

Differential Diagnosis:

1.Cervical adenoma
2.Abscess
3.Hematoma
4.Cervical polyps
5.Cystic dilatation (Roberts, 2004) associated with sacculation and diverticulum of the cervical canal

Treatment

Nabothian cyst are clinically non-significant.Rarely found in per rectal examination when animal in estrus,whereas in human it can be addressed when pelvic pain and abnormal vaginal discharge observed while intercourse happen.If the condition observed by the clinician,it should be addressed immediately,because most of the cystic affections of genital tract contribute to infertility in animal (Pande et al., 2011).Cyst should treated before pregnancy itself because cyst may impede the proper closure of cervix (Rao, 1991) leads to pregnancy losses

1.*Recto-vaginal method of rupture of cyst:*

In large animals cervix can be fixed by non-dominant hand per rectally followed by per-vaginal introduction of stylet of AI gun(or) 5 inch 16 gauge needle (Honparkhe et al., 2002) used alone to rupture the cyst. But in this method recurrence of cyst possible in the next estrus

2.*Rupture of cyst followed by painting with 5% Lugol's Iodine:*

Epidural analgesia with 2% lignocaine hydrochloride,for reducing the straining of animal.Vaginal speculum was fixed in the vagina followed by rupture of the cyst,resulted in content of the cyst were squeezing out from the cervix.After drainage,the ruptured cystwas painted with 5% of Lugol's iodine solution (Venkata Naidu et al., 2009).

Roberts(2004) opined that cervicitis mixture had good responses achieved to this condition.The mixture includes ,(a)Phenol one part, Tincture iodine one part and Glycerin two parts, (b)Menthol crystals one gram, Tincture iodine four ounces and glycerin four ounces.

3.*Cryotherapy andElectro-cautery:*

Cryotherapy and Electro cautery therapy not indicated in non-symptomatic cases.If required go ahead with cryotherapy and electro cautery (Yelikar KA et al., 2015).Cryotherapy done with help of liquid Nitrogen.

4.*Hysterectomy:*

It is followed in humans when unbearable pain evinced from by giant nabothian cyst gives pressure over the rectum(Temur et al., 2011)

Caglar et al., (2009) opined that hysterectomy was necessary when chronic pain suspected due to nabothian cyst compression on pelvic organ.In large animal the pain reflex arises from nabothian cyst observed only during natural mating.

Prognosis:

Prognosis was good,if cyst was not interrupted with and artificial insemination (AI) and normal intercourse in animals and humans respectively.In human point of view early treatment intervention with medical and surgical therapy may lead to good prognosis without any complication like cervical cancer.In animal point of view could think about the origin of cyst either hereditary (or) secondary to the trauma.This condition in heifer with hereditary origin the prognosis was guarded to be poor(Roberts,2004;Noakes et al., 2009),because leads to poor conception rate and secondary endometrial changes

like endometrial cyst (Pande et al., 2011). Secondary to trauma casesthe prognosis wasfavorable after treatment.

CONCLUSION:

Nabothian cyst condition not shows any external signs,at the same time diagnosis also difficult unless through per rectal and per vaginal examination in animals.But in human they express the pain feeling while intercourse at the same time diagnostic modalities are well developed in human side that favorable for the diagnosis of the condition periodically.Cystic condition of the female genital organ finally may end in infertility in animals and humans.In veterinary practice especially in field level,cystic condition of animals always gives challenges to the veterinarians due to lack of diagnostic modalities and skills.

REFERENCES:

Abattoir study of reproductive diseases in goats-Short Communication. The Bangladesh Veterinarian 25(2): 88 – 91

Alam and Abdur Rahman. 1979. Diseases of the genital tract of indigenous cows in Bangladesh .*Trop. Anita.Hlth Prod*. 11, 179-180

Caglar Y, Asker ZO, Selda B, Dincer S, Ali C. 2009.Multiple & large nabothian cysts: a case report. *Cumhuriyet Med J*.31:456-9.

Devanathan,T.G., Asokan, S.A., Rajasundaram, R.C and Pattabiraham, S.R.2000. A Case report of Nabothian cyst in a cross bred cow.*Indian J AnimReprod*. 21:79

Hatipoglu, F., Ortatatli, M., Kiran,M., Erer,H., ciftçi,M.K.2002.Ciftçian abattoir study of genital pathology in cows.*Revue Med. Vet*. 153, 2,93-100.

Honparkhe, M., Ajeet Kumar and Pangaonkar, G.R.2002.Infertility due to cervical cyst in a buffalo-a case report.*Indian Vet.Med.Jour*. 26:286.

Jubb K.V.., Kennedy P.C. and Palmer N. 1985. The Female Genital System In: K. V. F. Jubb, P. C. Kennedy and N. Palmer (ed.) *Pathology of Domestic Animals*. Vol. 3, 3rd Ed., Academic Press, New York, pp.305-377

Kier R. 1992. Non ovarian gynecologic cysts: MR imaging findings. *AJR Am J Roentgenol*.158:1265-9.

Kunbhar, H.K., Samo, M.U., Rind, R., Kaka, I., Channa, A.D.2003. Gross pathological studies on female reproductive organs of Thari Cow (*BosIndicus*).*Journal of Animal and Veterinary Advances*, 2(2) :58-63.

Laing, J.A., Brinley Morgan, W.J and Wagner, W.C.1988.Fertility and infertility in veterinary practice, 4thedn.Macmillon Publishing Co.Inc. NewYork .

Manokaran,S., Palanisamy,M., Selvaraju,M and EzakialNapolean, R.E.2012.Nabothian cyst in a Jersey crossbred cow- A case report. *North-East Veterinarian*. Vol.12.No.2.pp 29.

McEntee K .1990: Reproductive Pathology of Domestic Mammals. Academic Press, Inc. San Diego, California 92101, USA.

Noakes, D.E., Parkinson, T.J., England, G.C.W. 2009. 9thEdn, *veterinary reproduction and obstetrics*. London, Saunders.

Pande, M., Khan, F.A., Das, G.K., Prasad, J.K., and Ghosh, S.K.2011.Nabothian and endometrial cysts in a buffalo- A case report. *Buffalo bulletin* .Vol.30 No.4. 219-221

Perkins, J.R., Durward Olds and D.M. Seath. 1954. A study of 1000 bovine genitalia. *J. Dairy Sci.,* **37:** 1158 - 1163.

Rama Rao, P. 1983. The Reproductive System, p. 447. *In* Ganti, A. Sastry (ed.) *Veterinary Pathology*, 6th ed, , CBS Publications and Distrubutors, Delhi, India.

Rao, A.R. 1991. Reproductive disorders in Indian Livestock, 1st ed. Everest Press, New Delhi, India. p. 30-31.

Roberts, S.J. 1982. Infertility in the Cow, p. 490 - 491. In Roberts, S.J. (ed.) *Veterinary Obstetrics and Genital Diseases*, 2nd ed, Indian Reprint, CBS Publishers & Distributors, Delhi, India.

Sosnovski V, Barenboim R, Cohen HI, Bornstein J. 2009. Complex nabothian cysts: a diagnostic dilemma. *Arch Gynecol Obstet*.279:759-61.

Temur I, Ulker K, Karaca M, Aydin A, Gurcu B. 2011.A giant cervical nabothian cyst compressing the rectum, differential diagnosis & literature review. *ClinExpObstet Gynecol*.38:276-9.

Venkata Naidu, G., M. Murugan, M. Srinivas and S. Adlak. 2009. Management of a cervical cyst in a graded Murrah buffalo. *Buffalo Bull*., 28: 214.

Yelikar Kannan A., Deshpande Sonali S., Deshmukh Shubhangi F., Pagare Sanjay B. 2015. An unusual presentation of nabothian cyst: a case report. *Int J ReprodContraceptObstet Gynecol*. 4(5):1589-1591.

Toxicity of Common Toxic Plants and Poisoning in Farm Animals

I. Subhedar[1] and S. Umap[2]

[1]M.V.Sc Scholar, [2]Assistant Professor,
Dept. of Pharmacology and Toxicology, Mumbai Veterinary College, Parel, Mumbai.

Corresponding author: subhedar28irfan@gmail.com

ABSTRACT

Poisonous plants are a major cause of economic loss to the livestock industry. Each year these plants adversely affect the cattle, sheep, and horses that graze. These losses result from death of livestock, abortions, photosensitization, decreased production, emaciation, and birth defects. In addition to these losses are those of increased management costs associated with such things as fencing, altered grazing programs, and loss of forage.This article describes principal poisonous plants growing on Indian soil, their characteristics, clinical signs, treatment of poisoning in livestock which well be very helpful for farmers, for early diagnosis, treatment and further management to avoid major losses.

INTRODUCTION

- India is agrarian country, many farmers have ruminants as they can easily maintained along farming and no special care is required.
- Farmer should have sound knowledge about some common poisonous plants, signs of toxicity and primary treatment for same.
- Many poisonings by toxic plants have no cure or very costly treatment hence prevention is better in this case.
- As known prevention is better than cure, it is better to prevent the poisoning by ingestion of toxic plants in farm animals.

1. Datura (*Datura stramonium*)

- **Common name:-***Datura stramonium* (DS) also known as Jimson Weed, Locoweed, Angel's Trumpet, Thorn Apple, Devil's Trumpet.
    - **Hindi:-**Dhatura
    - **Marathi:**-Dhutura
    - **Telgu:**- Ummatta
    - **Kannada:**-Unmatta

- Datura stramonium is one of the most poisonous plant found in India and also used in many cultures as a poison.
- All parts of the datura plant are poisonous.
    - **Active principle:-**Daturine

Clinical signs:-

- Signs usually occur 30-60 minutes after ingestion.
- Signs includedryness of mouth and throat, difficulty in swallowing.
- Dry and hot skin and increased body temperature.
- Dilated pupils, increased respiration, bloat.
- Retention of urine.
- Animal becomes restless, excitation, change in behaviour.
- Very high amount of ingestion lead to muscular paralysis, nervous signs and may lead to coma.

✓ **Treatment:-**

- No specific antidote is available.
- Only symptomatic treatment is given.
- Drugs like physostigmine and pilocarpine are beneficial.
- Sedatives may be used to avoid excitation.

2. Lantana *(Lantana camara)*

- **Common name:-**Also known as big-sage, wild-sage, and tickberry.
    - **Hindi:-**Raimuniya
    - **Marathi:**-Tantani
    - **Telgu:**-Pulikampa
    - **Kannada:**- Kakke, Natahu
    - **Active principle:-**Lantadene A, LantadeneB

Clinical signs:-

- Signs of lantana poisoning depend on the amount and type of lantana consumed and the intensity of sunlight to which the animals have been exposed.
- Signs can appear after one feed and, in acute cases, within 24 hours.

- Cattle may become sun sensitive and their skin may blister. (Photosensitization)
- Yellow discolouration (jaundice) of the whites of the eyes and gums, and skin of the nose and mouth.

✓ **Treatment:-**

- No specific antidote is available.
- Only symptomatic treatment is given.
- Stop further exposure of animal to plant.
- Avoid exposure to sunlight.
- Give purgatives to remove toxins.

3. Castor Bean *(Ricinus Communis)*

- **Common name:-**Commonly known as castor oil plant, castor bean and Palma Christi.
  - **Hindi:-**Arandi
  - **Marathi:**-Arandi
  - **Telgu:**-Amanakku
  - **Kannada:**-Oudla

- The seeds contain Ricin, an extremely toxic and water-soluble ribosome-inactivating protein; it is also present in lower concentrations in other parts of the plant.
- Also present are ricinine, an alkaloid, and an irritant oil.
- Castor oil, long used as a laxative, muscle rub, and in cosmetics, is made from the seeds, but the ricin protein is denatured during processing.
- Ricin irreversibly inhibits the ribosome, the molecular machine responsible for producing proteins in cells.
- Poisoning occurs when animals ingest broken seeds or break the seed by chewing; intact seeds may pass through the digestive tract without releasing the toxin.
  - **Active principle:-**Ricin, abrin

Clinical signs:-

- Mainly include nausea, vomition, diarrhoea (often bloody), abdominal pain, bloat, loss of appetite, excessive thirst and muscular twitching.
- Rapid loss of water due to diarrhoea lead to dehydration and hypovolaemic shock.
- Lateron there is difficulty in breathing, incoordination, increased body temperature.

- Nervous signs like convulsions, opisthotonos, paralysis and coma may seen.

✓ **Treatment:-**

- Best treatment is the anti-ricin serum from a previously hyperimmunised animal, if available. (Easily not available in India.)
- Remove toxic material from stomach by gastric lavage, purgatives, vomition.
- Give adequate intravenous fluid to avoid dehydration.

4. Ipomoea*(Ipomoea Convolvulaceae)*

- **Common name:-**The most widespread common name is morning glories.
  - **Hindi:-**Jharmaric, Kaladana
  - **Marathi:**-Kaladana, Neelpushpi
  - **Telgu:**-Kollivittulu, Jiriki, kolli
  - **Kannada:**-Gowri beeja, Kollibeeja
  - **Active principle:-**Scammonin**(**Jalapin)

Clinical signs:-

- Depends on amount of plant ingested.
- In lower doses there is diarrhoea and in higher doses there is drastic purgation.
- In very toxic doses it leads to Nausea, salivation, dilation of pupils, incoordination, ataxia,
- altered gate, hallucination, decreased response to stimuli, paralysis of limb.

✓ **Treatment:-**

- No specific antidote is available.
- Only symptomatic treatment is given.
- Remove the source of poisoning.
- Liver tonics are given to affected animals.

5. Strychnine *(StrychnosNuxvomica)*

- **Common name:-**Commonly known as the strychnine tree.
  - **Hindi:-**Bailewa, Chibbinge, jahar, kajra, Kucchla
  - **Marathi:**-Kajra, Kuchala, Jharkhatchura
  - **Telgu:**-mucidi, mushidi, mushti
  - **Kannada:**-Hemmushti, Hemmusti, Ittangi
  -

- Strychnosnux-vomica, the strychnine tree, also known as nux vomica, poison nut, semen strychnos, and quaker buttons.
- It is a deciduous tree native to India and to southeast Asia.
- It is a medium-sized tree in the family Loganiaceae that grows in open habitats. Its leaves are ovate and 2–3.5 inches in size.
    - **Active principle:-**Strychnine, brucine

Clinical signs:-

- Initial sign appear within 0.5-2 hours of ingestion.
  Signs include restlessness,anxiety, muscular twitchingand neck stiffness.
- Later on convulsions occur with intervening periods of relaxation.
- External stimulus like noise, touch or light induces convulsions.
- Breathing becomes laboured and irregular.

✓ **Treatment:-**

- No specific treatment is available.
- Results are good if animals treated early.
- Animal should be maintained undisturbed in worm and quit environment away from external stimuli.
- Artificial breathing may be given to avoid respiratory failure.

6. Oleander *(Neriunolender)*

- **Common name:-**Oleander in Marathi it is called as kaner.
    - **Hindi:-** Kaner,ganer
    - **Marathi:**- Kaner, kaneri
    - **Telgu:**-erragannaeru
    - **Kannada:**-ashvamaaraka

- Widely cultivated as ornamental plant.
- Most poisoning in livestock occur in drought when animal ingest leaves of plant, or when cuttings of plant get mixed with fodder.
- It grows in subtropical and tropical climate.
- The plant is highly poisonous and the milky juice which exudates from all parts of the plant contain high concentration of toxic principles.
    - **Active principle:-**Oleandrin, nerin

Clinical signs:-

- Toxicity depend on the amount of plant ingested.
- If high amount ingested animals may found dead without showing any signs.
- If less amount ingested signs take few hours after ingestion of toxic plant,
- The affected animal shows signs of weakness with rapid pulse.
- Nausea, vomiting, loss of appetite, abdominal pain, sweating may observed.
- These signs followed by spasms, drowsiness, unconsciousness, coma and death.

✓ **Treatment:-**

- Generally, treatment is not possible as the animals are often found dead.
- No specific treatment is available.
- Administer sedative and tranquilizer.
- Atropine with propranolol is effective.

7. Abrus*(precatoriusAbrus)*

- **Common name:-**Rathi, Jequirity bean, Prayer bean plant. In Marathi it is known as gunja.
  - **Hindi:-** Ratti,Gunchi
  - **Marathi:**-Gunja
  - **Telgu:**-Guruvindaginja
  - **Kannada:**-Gulugunji

- It is found throughout the tropical zone.
- It is trailing, twining perennial vine with yellow or red flowers and pod like fruits containing oval, shiny red and black seeds.
- Seeds are used as beads in jewellery and necklaces.
- Seeds of *Abrusprecatorius* possess a powerful phytoxin known as abrin.
  - **Active principle:-**Abrin

Clinical signs:-

- Salivation, nasal discharge, nausea, vomition, profuse haemorrhagic

diarrhoea, watery faeces, dehydration and occasionally ulcerative lesions in mouth.

- Stiffness of muscle, incoordination, ataxia, muscular spasms, trembling, convulsions, paralysis, coma and death.

Treatment:-

- No specific antidote is available.
- Give only the symptomatic and supportive treatments.
- Immediate removal of the poison from the stomach by emesis or gastric lavage, followed by activated charcoal, demulcents and saline purgatives.

8. Parthenium*(Parthenium hysterophorus)*

- **Common name:-**Carrot Grass, Congress grass, Wild carrot weed
  - **Hindi:-** gajarghas,ChatakChandani
  - **Marathi:**-Gajargavat
  - **Telgu:**-congresspoolu, pitchigenjayi, pitchimaachipathre
  - **Kannada:**-congress gida, congress hullu, congress kale
- Parthenium hysterophorus L., a native weed of South and Central America, accidentally introduced into India.
- This plant is a threat to agriculture in southern parts of the country where it has invaded food and fodder crops fields.
- Cattle and buffaloes graze occasionally, while goats graze more freely on the weed in areas where waste lands and pasture fields are heavily infested with Parthenium.
- Parthenium has been found to be responsible for allergic contact dermatitis in humans.
  - **Active principle:-**Parthenin,Tanetin

Clinical signs:-

- Parthenium weed is toxic to animals Primarycausing photosensitization, liver pathology and skin reactionscausing dermatitis with pronounced skin lesions on various animals including horse and cattle.
- If eaten, it is responsible for mouth ulcers with excessive salivation.
- Significant amount (10–50%) of this weed in the diet can kill cattle.
- It causes anorexia, pruritus, alopecia, diarrhoea, and eye irritation.
- Toxicity in cattle and buffaloes develops following ingestion of the weed over a period of seven or more days.

Treatment:-

- Fluid therapy to eliminate toxins.

- Topical anti-pruritics and antiseptics for treating skin lessions.
- General liver tonics to support liver function.

CONCLUSION

Farm animals not generally graze on above mentioned plants due to strong repulsive smell and bitter test, but in case of scarcity and fine chopping with palatable fodder it tends to consume and result in toxicity. Knowledge regarding characteristics of plant, signs of toxicity is essential for farmer to initiate primary treatment and other veterinary aid and to take further precaution to avoid toxicity and economic losses.

REFERENCES

Agriculture Information Bulletin Number 415 (2011). Plants Poisonous to Livestock in the Western States. United States Department of Agriculture, Agricultural Research Service.

Garg, S.K. (2010). Veterinary toxicology. CBS publisher and distributers pvt. Ltd. New Delhi.

Kaur, M., Aggarwal, N. K., Kumar, V., & Dhiman, R. (2014). Effects and management of Parthenium hysterophorus: A weed of global significance. *International scholarly research notices*, *2014*.

Lewis S. Nelson, M.D. Richard D. Shih, M.D. Michael J. Balick, Ph.D. (2007). Handbook of Poisonous and Injurious Plants. (Springer Science+ Business Media, LLC, 233 Spring Street, New York, NY 10013, USA).

Narasimhan, T. R., Ananth, M., Swamy, M. N., Babu, M. R., Mangala, A., & Rao, P. S. (1977). Toxicity of Parthenium hysterophorus L. to cattle and buffaloes. *Experientia*, *33*(10), 1358-1359.

Anthocyanin pigments role in plants and its health benefits

S.Sheelamary[1] and Sujayanand G.K [2]

[1]Scientist, Division of Crop Improvement, ICAR-Sugarcane Breeding Institute, Coimbatore
[2]Scientist, Division of Plant Biotechnology, ICAR-Indian Institute of Pulses Research, Kanpur
Corresponding author: *sheelajoshkutty@gmail.com*

Anthocyanins are naturally occurring water-soluble pigments present in all plant tissues throughout the plant kingdom. Depending on their pH the colour may vary from red, purple, blue or black. This anthocyanins are the members of the flavonoid class of phytochemicals synthesized *via* the phenylpropanoid pathway. Food plants rich in anthocyanins include the blueberry, raspberry, black rice, and black soybean. They predominantly found in wines, tea, nuts, fruits, cocoa, cereals, honey, olive oil, vegetables, black currant, red cabbage, red radish and black carrot. Anthocyanins have dietary importance for human health due to their marked use in the treatment of different syndromes like cancer and other cardiac diseases.

For more than a century biologists, biochemists, and physiologists have conjectured for the promising biological effectiveness of anthocyanins during plant growth and human consumption. Anthocyanin apparently plays mainly two major roles at different developmental stages and biological functions attracting pollinators for the purpose of pollination and absorbs strong UV radiation. Besides anthocyanins, other pigments such as carotenoids and flavonols are influenced by final pigmentation of phenotype by vacuolar pH, metal complexes and cell shape. Apart from imparting colouring agent in plants, anthocyanins have group of health promoting benefits, and also defend from diver's oxidants through multiple mechanisms.

CLASSIFICATION OF ANTHOCYANINS

1. Cyanidin: Cyanidin is a natural organic compound which is classified as a flavonoid and an anthocyanin. These kind of anthocyanin is found in grapes, bilberry, blackberry, blueberry, cherry, cranberry, elderberry, hawthorn, loganberry, raspberry, apples, plums, red cabbage, the highest concentrations of cyanidin are found in the skin of the fruit, and biosynthesis of cyanidin 3-O-glucoside in *Escherichia coli* was demonstrated. Antioxidant effects which protect cells from oxidative damage and reduces the risk of heart diseases and cancer. Cyanidin may aid in preventing obesity, diabetes and is having Anti-inflammatory effects. It has an important future role in cancer therapy

2. Malvidin: Malvidin is an anthocyanidin. As a primary plant pigment, its glycosides are highly abundant in nature. Slightly acidic and neutral solutions of Malvidin are characteristically of a red color, while basic solutions yield a blue color. It is primarily

responsible for the color of red wine, *Vitis vinifera* being one of its sources. It is also one of the anthocyanidins responsible for the blue pigment found in the *Primula polyanthus* plant.

3. Delphinidin: Delphinidin is a primary plant pigment. Delphinidin gives blue hues to flowers like violas and delphiniums. It also gives the blue-red color of the grape and can be found in cranberries and concord grapes. Delphinidin, like nearly all other anthocyanidins is pH sensitive, and changes from blue in basic solution to red in acidic solution.

4. Peonidin: Peonidin is an anthocyanidin and a primary plant pigment. Peonidin gives purplish-red hues to flowers such as the peony, from which it takes its name, and roses. It is also present in some blue flowers, such as the morning glory.

EFFECT OF PH ON ANTHOCYANIN

Most anthocyanidins are pH sensitive, and changes from red to blue as pH rises. This happens because anthocynidins are highly conjugated chromophores. When the pH is changed, the extent of the conjugation is altered, which alters the wavelength of light energy absorbed by the molecule. At pH 2.0, peonidin is cherry red; at 3.0 a strong yellowish pink; at 5.0 it is grape red-purple; and at 8.0 it becomes deep blue; unlike many anthocyanidins, however, it is stable at higher pH, and has in fact been isolated as a blue colorant from the brilliant "**Heavenly Blue**" morning glory (Ipomoea tricolor Cav cv). Anthocyanins are more stable at low pH (acidic conditions) which gives a red pigment. Meanwhile, the higher the pH value of anthocyanin will provide color fading of the color blue. So as a food colorant, anthocyanin with a low pH or height pH has a significant effect on the food colorant.

Distribution of anthocyanins

Anthocyanins ubiquitously distributed in the plant kingdom particularly in all seed plants and stored in vacuoles. In many fruits, pro-anthocyanidins and flavonols are the major phenolic compounds at the commencement of fruit development, with the flavonoid pathway typically switching to the synthesis of anthocyanins at the beginning of fruit ripening. Betalains, yellow-to-red nitrogen included compounds are derived of tyrosine in the plant kingdom (are subclass of flavonoid) a hug class of phenolic secondary metabolites that are extensive along with different species and involved in many plant developmental functions. Anthocyanin is often produced in vegetative plant tissues. Fruits such as pear, apple, citrus, Chinese bayberry, peach play a vital function in nutrition and fitness benefits for its rich sources of vitamin C, flavonoids, carotenoids (provitamin A), and other nutraceutical compounds. Because of light colour and having higher solubility, this group is considering a prospective natural tincture to replace synthetic colorants. Due to its significance to the colouring quality of harvested and processed vegetables and fruits, they have been comprehensively inspected by food scientists and horticulturists. Of these healthful materials, anthocyanins belonging to the flavonoids compound family present in fruits and flowers, as attractants for insects

and animals. These compounds have been suggested to reduce cancers, oxidative stress and heart diseases.

Berries i.e., bilberries, black currants, blackberries, blueberries, cranberries, elderberries, raspberries, strawberries are not only delicious, but in fact offer an enormous range of health benefits. All of these berries have in common are anthocyanin that give them rich deep red and purple colouring. Although berries are perhaps the best known sources of anthocyanin other foods with same colorants for example beets, cherries, eggplants, plums, pomegranates, purple cabbage, grapes and red onions also contains these valuable compounds.Grape seed extract an especially rich source of anthocyanin is most widely researched anthocyanin supplement. Another excellent anthocyanain source is a blend of fruit anthocyanins which contains red grape, elderberry, blue berry, aronia berry, pomegranate and red raspberry.

The anthocyanins distribution in grapes is unpredictable depending on climatic and physiological factors. In a number of red grape vines for instance Pinot Noir and Cabernet Sauvignon, the anthocyanins accumulation primarily in the hypodermal cell layers following change of colour of the grape berries in grapes skin. Though there are still a number of exceptional grapes of *V. vinifera* also produce high content in their fruit pulp. The 3-glucoside anthocyanins: Cyanidin, Petunidin, delphinidin and malvidin are available in red wines. Maldivin group of anthocyanin is common and abundantly present in grapes.

Anthocyanins are commonly found in flowers and the fruits of many plants. Most of the red, purple, and blue-colored flowers contained anthocyanins. Red flowers are red hibiscus, red rose, red pineapple sage, red clover, and pink blossom. These red flowers are edible. Blue (cornflower, blue chicory, and blue rosemary) and purple (purple mint, purple passion flower, purple sage, common violet, and lavender) flowers are the common edible flowers. Some of these flowers have been traditionally used as folk medicine, as colorants, and as food. In addition to traditional usage, red, purple, and blue-colored fruits are commonly consumed for their beneficial effects. The colored pigments of anthocyanin from berries, blackcurrants, and other types of red to blue-colored fruits are strong antioxidants. Moreover, anthocyanin-rich black carrot, red cabbage, and purple potato are potential functional foods that have been consumed for prevention of diseases.

FUNCTIONS OF ANTHOCYANINS

Anthocyanin pigments have free radical scavenging ability, anti-oxidative properties and protection against various pathogens. As well as the new projected modulation of signaling cascades and give their antioxidant capacity. They are believed to protect plant cells against ultraviolet (UV) radiation and high light intensity, cold temperature, water stress, wounding and to defend against microbes and phytopathogens. UV-B radiation (280-320 nm) inhibits photosynthesis, peroxidation of

lipids, degradation of proteins, as well as reduces plant biomass and development. Most of radiation is absorbed by DNA is oxidised by UV-B *i.e.,* 240 to 310 nm waveband. Expression of gene might be changed through the development of pyrimidine dimers. Anthocyanins have been discovered as strong inhibitors and novel antioxidants of lipid peroxidation in contrast with other standard antioxidant and its phenolic structure helps in antioxidant actions. Due to many reasons, anthocyanin biosynthesis in fruits becomes indispensable aspect of currently active research area, which is supportive to understand the mechanism better and develop novel fruit cultivars with higher anthocyanin content.

Defence against insect herbivory

Anthocyanins present in flowers and fruits help in attracting the pollinators, seed dispersers for the reproductive success of the plants. Some of anthocyanin pigments like dearomatized isoprenylated phloroglucinols (DIP) in stamens and ovaries ward off aphids and mites but the same pigment acts as attractant in petals. Aposematic colours in fruits (e.g. *Atropa belladonna*) and seeds warn their predators through their toxicity. Rhodoxanthin present in thorns of *Aloe* and *Euphorbia* warn their herbivores.

Health Benefits of Anthocyanins

Anthocyanins found in plants have a wide range of usage. Blue, red, and purple colored pigments extracted from flowers, fruits, and vegetables are traditionally used as dye and food colorant. Besides being used as natural colorants, some of the anthocyanin-rich flowers and fruits have been traditionally used as medicine to treat various diseases. On the other hand, plant anthocyanins have been widely studied for their medicinal values. Anthocyanins possess antidiabetic, anticancer, anti-inflammatory, antimicrobial, and anti-obesity effects, as well as prevention of cardiovascular diseases (CVDs). Therefore, anthocyanins extracted from edible plants are potential pharmaceutical ingredients.

Anthocyanin rich fruits and vegetables may help to boost overall health by offering up an array of nutrients. However, scientists have yet to determine whether taking high concentrations of anthocyanins in supplement form can help to treat or prevent any specific health condition. However, whilst some studies and media publications concentrate solely on the anti-oxidant and anti-inflammatory benefits of Anthocyanin, it is apparent in the research that other mechanisms are potentially as responsible for the health benefits described.This goes beyond just simple antioxidant and anti-inflammatory mechanisms and diversifies as far as anticarcinogenic and cardiovascular protective effects. Some of these additional biological effects include protection against break down of DNA, Hormone-dependent disease development (oestrogen activity), Lipid peroxidation (lipid breakdown) and Fragility of capillary blood vessels. It is the combination of these mechanisms which allows anthocynanins to treat so many diseases. Some of the specific health issues where anthocyanins have been deemed beneficial is given below.

Eye sight

Clarity of vision *i.e.,* visual acuity can be improved through administration of anthocyanin. However, this is not the only part of vision which can be improved. The ability to see in the dark is also enhanced through the provision of anthocyanin. Anthocyanin-rich berries are traditionally known for the goodness to eyes and are often associated with night vision. Most of the berries have high anthocyanins content. Oral administration of bilberry to six weeks old mice has been shown to prevent impairment of photoreceptor cell function during retinal inflammation

Cancer

Cancers are characterised by uncontrolled cell proliferation to create tumours or metastasis. Anthocyanins have been extensively studied for their anticancer properties, as well as antiangiogenesis, based on in vitro and cell culture studies, and animal models. Angiogenesis is the key for cancer development, where it is an important step in the transition of tumors from a benign state to a malignant one. In cancer prevention, antiangiogenesis is the process that prevents formation of new blood vessels that supply oxygen to the tumor cells. Several phytochemicals, including flavonoids and anthocyanins, are potential antiangiogenic agents. Anthocyanins have been extracted and isolated from different plant sources for investigating their anticancer ability on esophagus, colon, breast, liver, hematological, and prostate cancers. Experiments both in Petri dishes and animals have shown that anthocyanins have the ability to reduce or slow cancer cell growth to inhibit the formation of tumours. It seems likely that anthocyanins utilise both anti-oxidative and anti-inflammatory mechanisms to disrupt the process of carcinogenesis. However, it has also been found that anthocyanins can prevent tumour development through a distinctly anti-carcinogenic mechanism through the inhibition of a specific cellular pathway. Anthocyanins may aid in the prevention of breast cancer. In test-tube experiments, scientists showed that anthocyanins extracted from blueberries helped to inhibit the growth of breast cancer cells.

Cardiovascular disease

Cardiovascular diseases are strongly linked with oxidative stress as a key contributor to their pathology. The positive relationship between drinking red wine and reduction of heart attacks has been documented, and this is attributed to the anthocyanins in red grapes, which assist in reducing inflammation, boosting capillary strength, enhancing nitric oxide release and inhibition of platelet formation. Further testing shows that incorporation of anthocyanin into the cell walls of blood vessels significantly increases anti-oxidant protection. Anthocyanins may enhance heart health that anthocyanins appear to improve cholesterol levels and blood sugar metabolism, as well as fight oxidative stress (a process known to play a role in heart disease). Dietary intake of anthocyanins may also help to prevent high blood pressure.

Weight loss

Interestingly researchers have also suggested a relationship between anthocyanins and weight loss. This study provided mice a high fat diet in combination with anthocyanins. Their results found an effective inhibition of body weight and fat (adipose) tissue gain. They also saw the prevention of a number of metabolic disease factors including hyperglycaemia (high blood sugar) and hyper insulinaemia. This provides evidence of anthocyanins role in management of obesity, diabetes and metabolic syndrome.

Cognitive function

A final health related benefit of anthocyanin is through modulation of the nervous system to boost cognition and memory, whilst helping to prevent age related neuro degeneration. Experiments with mice show both enhanced cognitive function and reduction in lipid peroxidation in brain tissues. This is supported by evidence showing that administration of high anthocynanin content from blueberry extract leads to effective reversal of neurodegenerative memory and motor functions.

Obesity

Anthocyanins may protect against obesity. Scientists found that mice fed an anthocyanin-enriched high-fat diet for eight weeks gained less weight than mice fed a high-fat diet without anthocyanins. Anthocyanidin and anthocyanin pigments possess antiobesity properties. Based on a previous study, obese mice fed a diet rich in cyanidin-3-glucoside from purple corn for 12 weeks have reduced body weight, as well as decreases in white and brown adipose tissue weights

Anthocyanin pigments as food colorants and additives

The use of natural colorant and additives in processed foods and beverages is important for increasing consumer acceptability of these products. Anthocyanins are some of the natural colored pigments extracted from plants, which have an attractive hue. Anthocyanins extracted from plants are red, blue, and purple pigments. These pigments are the natural colorants with low to no toxicity. Natural colorants are somehow safe to be consumed even at higher doses compared to synthetic colorants. Anthocyanins, as natural colorants, have value-added properties. These properties are antioxidants, as nutraceutical and many health benefits, such as an antimicrobial effect and prevention of chronic diseases. The use of anthocyanin-based colorants in yogurt drink and some mixed fruit juice is becoming more popular. Some companies did use synthetic dyes in their products. However, these synthetic dyes may be toxic if overconsumed. Recently, acylated anthocyanins are food colorants used in the food industry due to their high stability over nonacylated anthocyanins. A high level of nonacylated anthocyanins are produced from certain fruits, such as elderberry and barberry, at relatively low cost. These commodities have potential as colorants for use in the food industry

Anti-oxidant

Oxidative stress is a state where the quantities of free radical atoms are greater than the capacity of anti-oxidants.This imbalance leads to oxidation of proteins, lipids

and even DNA. This state is a key component of chronic degenerative disease such as heart disease and cancer. The anti-oxidant activity of anthocyanins was confirmed. However, the ability of anthocyanins to counteract reactive oxygen species is different from one type to another, and is wholly dependent upon each compound's chemical structure. Each type of anthocyanin may react differently to a different type of free radical, which somewhat leads to differing research results. Unfortunately some of the positive experimental (in vitro) studies showing high anti-oxidant capacity are not entirely supported by human food trials. However, it is possible that very low concentrations of anthocyanins may also modulate cell signalling and other biological processes by non-antioxidant mechanisms which may explain the difficulty in observing anti-oxidant effects in human trials.

Anti-inflammatory

Studies have also shown that anthocyanins may have an anti-inflammatory role via a number of cellular mechanisms. Anthocyanins inhibit the biological activity of some pro-inflammatory proteins called cytokines by suppressing specific cellular signalling pathways. For example, they can work to inhibit the pro-inflammatory enzyme, cyclooxygenase-2 (COX-2) which is often responsible for pain. In truth it is the combined anti-oxidant and anti-inflammatory cellular activity which facilitates the clinical uses of anthocyanin when treating disease.

CONCLUSION

Anthocyanins are colored pigments in plants that possess several health benefits. These colored pigments appear red in acidic condition and show a blue hue in alkaline solution. Acylated and copigmentated anthocyanidins have higher heat stability, thus maintain the structure even in different pH conditions. Anthocyanins are the value-added colorants that can be used for preventing several diseases, including cardiac vascular diseases, cancers, and diabetes, some metabolic diseases, and microbial infection. These compounds also improve visual ability and have neuroprotective effect. Several mechanisms of action are reported for the anthocyanidins and anthocyanins in prevention of these diseases. In a nutshell, free-radical scavenging, changes in blood biomarkers, COX and MAPKs pathways, as well as inflammatory cytokines signaling are the typical mechanisms of action of these colored pigments in prevention of diseases.

REFERENCES

S Wahyuningsih, L Wulandari, M W Wartono, H Munawaroh, A H Ramelan (2016). The Effect of pH and Color Stability of Anthocyanin on Food Colorant. IOP Conf. Series: Materials Science and Engineering 193 (2017) 012047 doi:10.1088/1757-899X/193/1/012047.

Tariq Pervaiz, Jiu Songtao, Faezeh Faghihi, Muhammad Salman Haider, Jinggui Fang (2017) Naturally Occurring Anthocyanin, Structure, Functions and Biosynthetic Pathway in Fruit Plants. J Plant Biochem Physiol 5: 187. doi:10.4172/2329-9029.1000187

Sustainable disposal of livestock waste for ecofriendly environment forforthcoming generations

Suresh.C[1] and Sujatha.V[2]

[1]Assistant professor, Farmer Training Centre, Tiruvarur
[2]Assistant professor, Veterinary College & Research Institute, Orathanadu
Corresponding author: drsureshthambi@gmail.com

ABSTRACT

Balanced diet for healthy well being can be furnished only by animal husbandry. Ever growing global population should be fed by increasing the agriculture production and productivity. Livestock rearing is now a days intensified, which leads to substantial increase in livestock waste. The waste of livestock includes manure, urine and unused products of livestock. They pollute the environment by spreading the various zoonotic diseases. Livestock waste can be used to produce food, feed, fertilizer and fuel efficiently. Novel technologies have to be identified to fully exploit the utilities of waste. Enforcement of appropriate legislation will be useful to achieve the proper waste disposal adoption among the stakeholders.

Keywords: Waste, Livestock, Disposal, Feed.

INTRODUCTION

Human population increases geometrically. However, food supply can only increase arithmetically. Therefore, food is an essential component to human life, population growth in any area if unchecked, would lead to starvation. The term sustainable development is defined as development to achieve the needs of present generation without compromising future generation's needs. Future generations are mainly related to the environmental problems of resource consumption and pollution and their distribution over long time horizons (Chaturvedi, B.K. 2011).

ENVIRONMENTAL PROBLEMS

Commonly faced serious and complex global environmental problems are Soil erosion, loss of genetic resources, deforestation, desertification population, Air/water/land pollution.

LIVESTOCK WASTE IN THE WORLD

Muller (1980) estimated that the global volume of fecal wastes from broilers, laying hens and breeding chickens (excluding turkeys) is to be over 46 billion tons; turkeys about 2.6 billion tons; cattle almost 932 billion tons; buffalos almost 100 billion

tons; and from pigs nearly 109 billion tons for a total of 1, 188 billion tons of animal wastes. Wastage occurs at all points along food manufacture and in final consumption of food by people. Low acceptability or palatability are limiting factors for those waste products of the livestock and poultry industry and also manure as a feed. However, in most cases, it is considered advisable to explore the potential for an upgraded waste product in the animal feed market first.

MANURE PRODUCTION AND THEIR CHARACTERISTICS

As a result of rapid growth of the industry, not only feedlot operators but also poultry and dairy operators are faced with the problem of disposing of vast quantities of animal waste and litter. There are obvious variations in the characteristics of wastes from livestock feeding operations. Summary of animal waste characteristics are presented in Table 1.

UPGRADING ANIMAL WASTE

Waste materials from the livestock industry can help fulfil the requirements for food, feed, fuel and fertilizer. Rising oil prices, foreign exchange, imbalances, and especially pollution and soil erosion, necessitate the utilization of animal industry wastes in different areas. When selecting their use one should consider the health, quantity and quality of waste and then availabilities, technological and industrial resources and most importantly social change-for example, bias against food produces from wastes

Table 1. Animal waste characteristics

Parameter (Weight per day per 1000 live weight units)	Dairy cow	Beef cattle	Swine	Sheep	Layer	Broiler	Horse
Raw manure (RM)	82	60	65	40	53	71	45
Total solids	10.4	6.9	6	10	13.4	17.1	9.4
Volatile solids	8.6	5.9	4.8	8.5	9.4	12	7.5
BOD	1.7	1.6	2	0.9	3.5	-	-
COD	9.1	6.6	5.7	11.8	12	-	-
Nitrogen (as Total N)	0.41	0.34	0.45	0.45	0.72	1.16	0.27
Phosporous	0.073	0.11	0.15	0.066	0.28	0.26	0.046
Potassium	0.27	0.24	0.30	0.32	0.31	0.36	0.17

1. CONVERTING ANIMAL WASTE TO FOOD

Chemical and physical treatments of animal wastes may not be suitable for direct food production because it may be difficult to monitor the safety for health. Higher fungi-mushrooms have been used as human food for centuries. Mushrooms can transform nutritionally valueless wastes (manure and crop resides) into highly acceptable nutritious, valuable food. Kurtzman (1979) indicated that *Agaricus bisporus* (common mushroom) and *Agaricus bitorquis* can be grown on composted horse manure

or rice straw. After using for mushroom growing, the compost can be returned to the field as fertilizer. Under a controlled environment, mushroom shelters can be productive units yielding up to 120 kg/m^2 each season. Microbial conversion of wastes, including manure, offers the opportunity to convert a large fraction of their nutritional need into an effective demand by helping the undernourished in the Third World to supply their own food and feed.

2. FEED FROM ANIMAL WASTE

Nutrients from waste are, either directly or after some processing, usually upgraded to human food via farm animals. The nutritional evaluation of wastes as an animal feed is, therefore, the most relevant one. It was emphasized that biological testing of nutritional and toxicological characteristics are concerned with nutritional value for the animals, and safety of the animal products for human consumers. Day (1980) has noted that on an annual basis a laying hen produces about twice as much crude protein as manure than in the form of eggs. Smith and wheeler (1979) have concluded that economic value of excreta as a feed ingredient for some ruminants is 3-10 times greater than its value as fertilizer.

Ensilage is effective in making animal wastes safe for refeeding. When properly treated, ensiled wastes undergo lactic acid fermentation, and if the product is held for 10 days in a silo prior to feeding, pathogenic bacteria such as Salmonella, parasidic nematodes, and Coccidia are practically eliminated. Spore forming bacteria, while not destroyed, do not proliferate; these bacteria are usually not harmful. Moreover, ensiled animal wastes look and smell better than untreated excreta. In this system, a workable formula is 60 parts swine or cattle waste, 20 parts air dried poultry litter, and 20 parts ground grain, hay or crop residue. This type of formula is generally known as "wastlage" (N.R.C. 1981).

Wastlage may constitute the entire ration for breeding cattle; enriched with higher energy feed, it can be fed to growing and lactating animals (Muller, 1980). In some commodities, the chemical nature of the waste material for example, the high ash content of chicken manure and high silica content of rice hulls and straw may be unsuitable (N.R.C. 1981). Cooke and Fontenot (1990) showed that even though swine waste and broiler litter are high in ash, sheep and steers absorb phosporous from poultry manure effectively.

The controlled discharge of animal and human wastes may cause environmental pollution and threaten public health. Research in different countries have shown that algae is one of the cheapest ways to treat animal waste waters which is excellent substrate. Algae, the microscopic planktonic plants, are capable of photosynthesis in the presence of sunlight and release of oxygen. The oxygen supports bacterial population that breaks down the organic matter in wastewater. This symbiotic action renders the organic matter in nocuous and at the same time converts the waste into nutrients for algae (Muller 1980). The water then has a much reduced organic matter with biochemical oxygen demand (BOD) ranging from 30 to 80 mg/L and can be discharged with minimal environmental impact. The algae containing 45-65 % crude protein can be

harvested and processed for animal feed (N.R.C. 1981). It should be noted here that for any food or feed materials, proper handling of the raw material and products is needed to assure animal and human safety. The feasibility of waste to feed projects depends on the characteristics, availability and cost of collection and transport of the raw material and the availability of a market for the end product.

3. FUELS FROM ANIMAL WASTE

Developing countries mainly depend on wood, crop residues, animal dung and coal besides animal and human power for their basic energy needs. This energy is essentially used for production, processing and preparation of food. Fuel wood supplies are dependent on a supporting ecosystem that is being disrupted in many areas by population growth. Where wood resources are extremely overused without replanting, serious soil erosion has resulted. As a consequence of fuel wood shortage, dung is increasingly being used as fuel instead of being returned to soil as fertilizer. This type of chain reaction not only destroys the environment but opens the doors for further damage of the surroundings of human beings.

Methane generation is fully explained (Loehr, 1977). In this process, waste mixed with water, called slurry, is fed to an enclosed digester. In the digester, the gas (60-80 % methane) is trapped by an inverted drum covering the surface of the liquid. As gas is produced, the drum rises acting as a gas storage chamber. The gas can then be drawn off for use as needed. This process yields a number of benefits:

a. Produces an energy source that can be stored and used more efficiently.

b. Creates a stabilized residue that retains the fertilizer value of the original material.

c. Reduces fecal pathogens (Enteric viruses, Salmonella, Shigellae, E. Coli, Cholera, Hookworm ova, etc. and improves public health.

d. Reduces transfer of plant pathogens from one year's crop residue to the next year's crop.

4. FERTILIZER FROM ANIMAL WASTE

During the history of human beings, almost all nutrients and organic wastes were returned to the soil. N.R.C. (1981) claims that recent human activities have altered this cycle and organic wastes have been diverted into waterways.

Fly control and destruction of disease vectors occurs in the process. On-site composting of poultry manure within the poultry house resulted in an odorless, fly-free environment and was relatively inexpensive.

Nitrate is highly soluble rendering it highly mobile so that it moves with the soil water Schilfgaarde (1986) indicated that in Iowa in the Big Spring Basin there is a close direct relation between the increase in fertilizer-N-use and the NO3-N recorded in the ground water since 1958. As Chemical fertilizer use goes up and the amount of manure used goes down, NO3 in the drain water also goes up (EPA's maximum nitrate (as N) contaminant level is 10 ppm.

CONCLUSION

- Life style in such a way that to remove those chemicals from our food, feed, and fertilizer and most importantly from our environment.
- Most of the residues, chemicals and pesticides in livestock waste feeding apparently represent no serious threat to humans, and different processing methods of animal wastes eliminate the danger of the pathogenic microorganisms.
- The Interdiciplinary cooperative action between the different disciplines of livestock industry and farm operations toward reducing the pollution coming from animal waste is necessary.
- Regulatory measures have to be implemented to control the environmental pollution to cater the conducive atmosphere in all spheres of Sustainable development to the Forthcoming generations.

REFERENCES

Chaturvedi.B.K,, 2011. Asian Journal of Social Science Review, Vol.01, No, 01 April-September.

Cooke, A.J. and j.P. Fontenot, 1990. Utilization of phosphorus and certain other minerals from swine waste and broiler liter. Journal of Animal Science, 68: 2852.

Day, P.L. 1980. Processing manure for use as feed ingredient. Paper presented at the International Symposium on Biogas, Microalgae and Livestock Wastes, 15-19 Sept. 1980. Taipei, Taiwan. In: Ledward, et al 1983. Upgrading waste for Feeds and Food, Butterworths, London.

Gardner, W.R. and J.E. Watson, 1986. Best management practices for control of nitrogen pollution by farm and feedlot. In: Summer, B.J. and S.S. Anderson Eds. 1986. Toxic Substances in Agricultural Water Supply and Drainage. Defining the Problems. Proceedings from the 1986 Regional Meetings, U.S. Committee on Irrigation and Drainage, Denver, Colorado.

Kurtzman, R.H. 1979. Mushrooms: Single-cell protein from cellulose. In: Annual Report on Fermentation Processes, Vol. 3. Edited by D. Perlman. Academic Press, New York.

Loehr, C.R.1977. Pollution Control for Agriculture. Academic Press, Inc., New York.

Muller, Z.O. 1980. Feed From Animal Wastes: State of Knowledge. FAO, Rome.

N.R.C. 1981. Food, Fuel and Fertilizer from Orgnic Waste. National Academy Press, Washignton, D.C.

Schilfgaarde, Van J. 1986. Agriculture, irrigation and water quality. In: Summer, B.J. and S.S. Anderson, Eds. 1986. Toxic Substances in Agriculture Water Supply and Drainage Defining the Problems. Proceedings from the 1986 Regional Meetings. US. Committee on Irrigation and Drainage, Denver, Colorado.

Smith, L.W. and w. E. Wheeler, 1979. Nutritional economic value of animal excreta. Journal of Animal Science, 48: 144.

Salt Production-Major Livelihood Security of Farmer's in Coastal Odisha

R. Srinivasan, Rajendra Hegde and M. Chandrakala

ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Bangalore-560024, India

** Corresponding author: srinivasan.surya@gmail.com*

Salt comes from dead, dried-up seas or living ones. It can bubble to the surface as brine or crop out in the form of salt licks and shallow caverns. Below the skin of the earth it lies in white veins, some of them thousands of feet deep. It can be evaporated from salt "pans," boiled down from brine, or mined, as it often is today, from shafts extending half a mile down.

The history of the world according to salt is simple: animals wore paths to salt licks; men followed; trails became roads, and settlements grew beside them. When the human menu shifted from salt-rich cereals, more salt was needed to supplement the diet. But the underground deposits were beyond reach, and the salt sprinkled over the surface was insufficient. Scarcity kept the mineral precious. As civilization spread, salt became one of the world's principal trading commodities. Salt is serve to flavour and preserve the foods, it made a good antiseptic, which is why the Roman word for these salubrious crystals (sal) is a first cousin to salus, the goddess of health. Salt is also used for countless other purposes, such as removing snow and ice from roads, softening water, preserving food, and stabilizing soils for construction.

HISTORICAL IMPORTANCE

Salt's tryst with the independence movement is also legendary in India, when Mahatma Gandhi took out a protest in 1930 against the ban imposed by the British on production and distribution of salt by Indians. The act of defiance, led by Gandhi, started from his ashram at Sabarmati in Ahmedabad on March 12, 1930 and ended at Dandi, near Surat on April 6 when he and his followers picked up salt from the shore, symbolically conveying their protest against the British ban.

India is the world's third-largest producer of salt, after the US and China and average annual production of about 145 lakh tones. Private sector plays a dominant role contributing over 65% of the salt production in the country, while the public sector contributes about 2%. The cooperative sector contributes about 9% whereas the small-scale sector (less than 10 acres) accounts for nearly 24% of the total salt production in the country. There are about 13,000 salt works, mostly in small sector, engaged in the

production of salt. The major salt-producing states in India are Gujarat, Rajasthan, Tamil Nadu, Maharashtra, Andhra Pradesh and Odisha. Gujarat produces about 70% of total salt production in our country.

In Odisha, about 20,000 people are engaged in salt production in Ganjam, Puri and Balasore districts. Around 30,000 tonnes of salt is produced from 5,000 hectares of swampy land in the state annually. The salt production and number of salt producers in Odisha have drastically decreased last 5 years, due to low price, high labour wages and natural calamities.

Salt season

In coastal Odisha, salt manufacturing season commences from February and goes up to June till the onset of the southwest monsoon. Major activities of land preparation and bunds making will be taken up February month and once summer started, peak salt production will be taken in March to May months and harvest is taken every 7-8 day's interval.

Production of salt

Salt is the common name for the substance sodium chloride (NaCl), which occurs in the form of transparent cubic crystals. Although salt is most familiar as a food supplement, less than 5% of the salt produced in India and about 70% is used in the chemical industry, mostly as a source of chlorine.

In Coastal Odisha major salt production units are following solar evaporation method. This is the oldest method of salt production. It is being used since salt crystals were first noticed in trapped pools of sea water. Its use is practical only in warm climates where the evaporation rate exceeds the precipitation rate, either annually or for extended periods, and steady prevailing winds. Two prominent methods are used for salt production in coastal Odisha.

1. Single - Pond System

Though production cost will be lower, quality of salt is very much reduced and the production rate is also limited. Impounding of sea water in all the ponds and after evaporation scrapping of salt from all the ponds - a batch wise process – reduced the production cost. However, complete evaporation in the same pond results in the crystallization of all the salts present in sea

water/ brine which makes NaCl impure.

2. Double - Pond system

In the second system, the process of salt recovery from sea water was made with the division of the evaporation basin into two: the first basin, usually called as nurse pond, which is used for the production of NaCl-saturated brine, which will be later fed into the second basin, usually called crystallizer. Thus, it was made possible to achieve continuous salt production (crystallization) and to eliminate those seawater salts, with less solubility than NaCl (i.e. $CaCO_3$ and $CaSO_4$), since these crystallize in the first basin and remain there.

Cost of production

The cost of production calculation is important to assess the profit or loss in salt production industry. Required sample data is collected from the progressive salt producers in coastal Odisha and input, output costs are calculated (Table 1). Total base expenditure is around Rs. 27,000/- per acre in a year and total income is Rs. 60,000/-, overall net return is Rs. 33,000/- per year with 1.2% of benefit cost ratio, if climate and other sectors (electricity and minimum price etc.) are positive.

Table1. Cost of salt production in Coastal Odisha

<table>
<tr><th colspan="2">Input cost</th><th colspan="2">Output (price)</th></tr>
<tr><td>Activities</td><td>Approx. Expenditure (ac)</td><td>Activities</td><td>Approx. Income</td></tr>
<tr><td>Bund formation</td><td>Rs. 15000</td><td>Weekly production</td><td>50 bags (per bag 50 kg)</td></tr>
<tr><td>Labour charge</td><td>Rs. 7000</td><td>Price per kg</td><td>Rs. 2</td></tr>
<tr><td>Electricity charge</td><td>Rs. 3000</td><td>12 weeks (March, April, May) production</td><td>50× 12 weeks =600 bags</td></tr>
<tr><td>Others</td><td>Rs.2000</td><td colspan="2">Each bag 50 kg × Rs. 2= Rs. 100</td></tr>
<tr><td>Total expenditure</td><td>Rs. 27000</td><td>Total income</td><td>600 bags × 100= Rs. 60,000/-</td></tr>
<tr><td colspan="4">Net return: Rs. 60000-27000= Rs. 33000/ ac / B:C ratio: 33000/27000=1.2%</td></tr>
</table>

Current scenario

Salt production has not brought much success to salt farmers in the recent decades and salt manufacturing was not taken up in a large area for the past few years. Because, salt producers felt it's not a profitable business (low price) and also private companies have stopped salt production due to lack of workers and high wages. Among the states, Odisha contributing very negligible amount of salt production in nation level, which is also drastically decreased (Table. 2).

Table2. Selected State-wise Production of Common Salt in India (2008-2009 to 2013-2014)

States/UT	2008 -2009	2009 -2010	2010 -2011	2011 -2012 @	2012-2013 @	2013-2014 @
						(In ' 000 Tonne)
Andhra Pradesh	3.01	4.39	2.99	3.05	4.03	4.43
Daman and Diu	-	-	-	-	-	-
Goa	0.02	0.03	0.02	0.02	0.02	0.02
Gujarat	149.0	178.7	145.1	170.1	194.24	180.95
Himachal Pradesh	0.02	0.02	0.01	-	-	-
Karnataka	0.15	0.14	0.14	0.13	0.15	0.16
Maharashtra	1.88	1.85	1.80	1.55	1.60	1.45
Odisha	**0.23**	**0.30**	**0.14**	**0.10**	**0.34**	**0.19**
Rajasthan	20.52	29.87	14.28	21.89	18.25	17.01
Tamil Nadu	16.52	24.01	21.44	24.77	26.70	25.87
West Bengal	0.12	0.19	0.13	0.09	0.14	0.11
India	**191.5**	**239.5**	**186.1**	**221.7**	**245.47**	**230.19**

Source : Indian Bureau of Mines, Govt. of India

MAJOR REASONS FOR LOW SALT PRODUCTION

The Humma and Binchanapalli Salt Production and Sales Cooperative (HBSPSC) formed in 1942, is more than 70-years old, holding 730 acres of salt producing land, but now 123 acres of land lease is cancelled. Due to this cooperative could not take up salt production in entire area in the last few years. Total salt production area is shrinking day by day due to several reasons, which are

- ✓ The cooperative does not have financial strength to dig up bore wells for all its salt beds.
- ✓ State government is unable to pay salary to cooperative employees for several months.
- ✓ Salt producers attached to HBSPSC say deepening of Chilika canal has led to fall in density of salinity in the sea brine that reaches their salt beds.
- ✓ Has to pay higher tariff for electricity.
- ✓ Cooperative loan interest is high (12%), unlike agriculture sector.
- ✓ No minimum support price (MSP) for salt.

Reductions of salt production in coastal Odisha have caused unemployment and affect the livelihood security of around 5,000 peoples in these area and they are migrating to other states for jobs. Therefore state government has to take proactive policy that helps to salt producers and salt production land for attaining high salt production and secure livelihood security for them.

SUMMARY

Salt production is a major livelihoods security of coastal Odisha farmers, but now days their job security is under threat, due to getting low price and high labour wages. If salt production is started in agricultural lands, those lands are not suitable to any other purpose due to excess deposition of salt in lower layers of the soils. Therefore, the government has to take immediate action to protect the on salt producers, by assuring minimum support price for salt and also through proper organization of private sectors.

Toxicological aspects of common plant poisoning in ruminants

Haritha C. V.[1], Khan Sharun[2*], Manjusha K. M.[2] and Amitha Banu S.[2]

[1]Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh
[2]Division of Surgery, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh
**Corresponding Author: sharunkhansk@gmail.com*

ABSTRACT

A large number of plants can cause signs of toxicity when ingested by animals. Consumption of some plants even at small quantities can result in rapid death. The most common plant species that are responsible for pant toxicity in ruminants includes*Ricinus communis*, *Lantana camara*, *Nerium oleander*, *Abrus precatorius*, *Pteridium aquilinum*and*Datura stramonium*. Consumption of cyanogenic plants and nitrate containing plants can also cause toxicity in ruminants.The diagnosis of plant toxicity can be challenging in veterinary medicine since in most cases the history of exposure to a toxic plantsmight be lacking.For most of the plant poisoning cases the treatment is general with symptomatic and supportive therapysince there is no antidote for most of the toxins.Removing the poisonous weeds from the grazing area and providing good quality forages reduces the risk of plant poisoning.

Keywords - Plant poisoning; Ruminants; *Ricinus communis*; *Lantana camara*

INTRODUCTION

Toxic plants affecting ruminants are of major concern for both the practicing veterinarian and farmer. Numerous poisonous plants have known to cause negative impact on the livestock industry. Although grazing is considered as normal routine in livestock management,it exposes the animals to a variety of poisonous plants particularly when there is reduction in fodder availability.Ingestion of poisonous plants by animals produces toxic effects like physical upset, loss of productivity and even death. There are several factors that contribute to plant poisoning like season and weather conditions, feeding of livestock with poor quality roughage, transportation and handling. Poisoning can occur either by accidental ingestion of plants with usual feed or by wilful consumption of toxic plants when pastures are dry.

Animals which are already under nutritional stress are more susceptible to plant poisoning. Good practices of grazing with proper observation of grazing animals along with intense knowledge about poisonous plants and strategic approaches to therapy helps to resolve the problem.Plants that are seen in a particular geographical region may not be found in other regions due to difference in geographical distribution.

Invasion of poisonous plants into non-native areas affect this distribution. For most of the plant poisoning cases the treatment is general with symptomatic and supportive therapysince there is no antidote for mostof the toxins.The ultimate goal of treatment should be removal of toxins from the body.Treatment includes administration of activated charcoal and stabilization of the animal with fluid and electrolytes. Removing the poisonous weeds from the grazing area and providing good quality forages reduces the risk of plant poisoning.

The present paper aims to discuss in detail about the common plants that are responsible for plant toxicity in ruminants and their respective therapeutic strategies.

Ricinus communis

Common names: Castor oil plant, Castor bean

Ricinus communis is an extremely toxic plant that is commonly known as castor oil plant or castor bean.The toxic principle present in this plant is a water-soluble ribosome-inactivating protein called ricin which is mostly concentrated in its seeds.Ricin is a heat labile protein which can be destroyed during the extraction process. The leaves and fruits of the plant contains an alkaloid, ricinine which can stimulate the central nervous system (Audi *et al*., 2005).Mechanism of toxicity is mainly due to the inhibition of protein synthesis. The other devastating effects includes apoptosis, direct damage to cell membrane by altering membrane structure and function, and release of cytokine inflammatory mediators (Day *et al*., 2002). A glycoprotein lectin called agglutininis also present in castor bean plant which is having more affinity for the red blood cell thus causing agglutination and thereafter haemolysis. *Ricinus communis* agglutinin is poorly absorbed from the gut and hence significant haemolysis is not observed in oral ingestion cases (Hegde and Podder,1992).

Figure 1 - *Ricinus communis* plant, Fruits (Left) and Seeds (Right)

Among the farm animals horses seem to be the most susceptible with ruminants having intermediate susceptibility,whereas the chicken being most resistant animal(Aslani *et al*., 2007). The initial toxicity signs include nausea, gastro-intestinal irritation, abdominal pain, diarrhoea, tenesmus, dehydration, cessation of rumination, muscle twitching,dullness of vision, convulsions, weakness, profuse watery diarrhoea

and dehydration within 6–24 h.Biochemical examination reveals a high packed cell volume and increased levels of serum creatine kinase, aspartate aminotransferase (AST),blood urea nitrogen(BUN) and creatininevalue along with leukocytosis and hyperbilirubinemia. Necropsy lesions include gastroenteritis, necrosis and haemorrhage in heart and kidney.

Diagnosis can be made from case history and clinical signs exhibited by the animal. Due to the non-specific nature of the clinical manifestations in plant toxicity, one cannot confirm the intoxication merely based on the clinical signs unless the suspicious particles are not found in vomitus, faecesor in the intestine. Hence confirmatory diagnosis is necessary with the detection of toxins either in clinical or feed samples.Confirmatory diagnosis can be made by using antibody based immunoassay which helps to detect and quantify the toxin(Roy*et al*., 2003; He*et al*., 2010)Ricinine can be detected successfully instead of ricin using paper chromatography, UV detection and liquid chromatography (Knight and Walter, 2001).

Management of *Ricinus communis* poisoning includes general and symptomatic therapy as there is no antidote against ricin. Administration of activated charcoal to adsorb toxins would be helpful. Intravenous hydration and fluid replacement is necessary to combat dehydration and fluid loss in affected animals.

Nerium oleander

Common names: Oleander, Oleana, Rose bay

Nerium oleander is a flowering shrub commonly grown as an ornamental plant in gardens and parks.It is originated from Mediterranean countries and widely distributed in tropical and subtropical regions (Knight and Walter, 2001).Oleander is known to be poisonous to animals (Frohn and Pfander, 1983).*Nerium oleander* and *Thevetia peruviana* (yellow oleander) are the two common varieties in which all the plant parts are known to be toxic (Langford and Boor, 1996).The toxic principle present in oleander are mostly cardiac glycosides which includes oleandrin, folinerin and digitoxigenin that exhibits cardiotoxicity.The mechanism of action of cardiac glycosides is mediated through the inhibition of Na+/K+-ATPase pump resulting in electrolyte disturbance and thus affecting the electrical conductivity of heart by increasing the intracellularcalcium ion concentration (Joubert, 1989).

Figure 2 -*Nerium oleander*plant (Left) and *Thevetia peruviana* (yellow oleander) plant (Right)

The major toxic signs exhibited by animals are associated with disturbances in cardiac and gastrointestinal system. The toxic effects exhibited by oleander includes ventricular arrhythmia which leads to ventricular fibrillation and finally death of the animal. Initial stages of intoxication in ruminants include ruminal atony with moderate tympany (Aslani *et al.,* 2004). Other clinical signs includes abdominal pain, frequent urination, bradycardia, tachycardia, depression, and weakness.

Since there is no specific remedy, the general treatment includes symptomatic and supportive care. Activated charcoal can be administrated to eliminate or reduce toxins from the gastrointestinal tract. Providing adrenergic blockers along with atropine helps the animal to relieve from tachycardia and atrioventricular block.Rehydrating the animal is of utmost importance while dealing with affected animals.Calcium containing fluids are contraindicated as it potentiates the action of cardiac glycosides (Knight and Walter, 2001). Administration of anti-digoxin antibodies found to be highly effective in managing digoxin toxicity hence considered as the first line of treatment(Joubert, 1989). But administration of anti-digoxin antibodieshavelimitations in livestock management owing to its high cost and scarce availability.

Abrus precatorius

Common names: Rosary Pea, Bead Vine, Coral Bead Plant, Crab's Eyes, Jumbi Beeds, Love Bead

It is commonly grown as an ornamental plant where the seeds are used in jewellery and handicrafts.The toxic principle of the plant is a lectin called abrinwhich is present in its seeds.Mechanism of action is by inhibition of protein synthesis which is mediated through ribosomal subunit inactivation.Cattle are more prone to abrin poisoning compared to other animal species.Toxicity of abrin is similar to ricin poisoning. Clinical signs associated with oral ingestion includes gastroenteritis with vomiting and diarrhoea which then leads to circulatory collapse.Animal may exhibit local signs such as conjunctivitis and dermatitis(Rajeev, 2012).

Figure 3 -*Abrus precatorius* plant and seed (Right)

Further exposure can be prevented by keeping the animal away from the source. Management of abrin poisoning can be done by administering activated charcoal at the

total dose of 250-500g in large ruminants. Anti-abrin serum can also be given as a specific antidote. Administration of saline purgatives at the rate of 100-200g and alkalinisation of urine will help to excrete the absorbed toxins.Symptomatic treatment along with fluid therapy will facilitate faster recovery.

Lantana camara

Common names: Lantana weed, Wild sage,Red sage

Lantana camara is the most popular ornamental garden plant. Some varieties of *L. camara* complex are known to cause toxicity in ruminants especially to sheep.The toxic effect is due to the presence of some triterpene ester metabolites, lantadene A and B .The leaves and immature berries are more toxic to livestock. Metabolism of lantadeneA occurs extensively in the liver to yield more polar compounds which are then excreted into the bile. The drastic effect of lantana poisoning includes cholestasis and hepatotoxicity due to the continuous absorption of toxins from the rumen.As a result, ruminal stasis and anorexia develops. Other related consequences of cholestasis are jaundice and photosensitisation. Accumulation of bilirubin due to failure of biliary secretion causes jaundice. Photosensitisation develops due to the accumulation of phylloerythrin. Experimental studies shows that lantana poisoned sheep becomes dehydrated and hypokalaemic.

General line of treatment includes administration of laxatives to remove toxins from the body (Blood *et a1.,* 1983). Manual removal of the toxic rumen contents enhance the recovery. Administration of activated charcoal can be done to adsorb the toxins in the rumen and helps to prevent further absorption. Antihistaminic and antibiotics should also be administered. Moving the animal into the shade helps to prevent the development photosensitive dermatitis (Blood *et al* 1983).

Figure 4 -*Lantana camara*plant and flower (Right)

Cyanogenic plants

The common cyanogenic plants include Sorghum, Sudan grass, Corn, Lima beans, Cherry, Apple,Peach and Apricot. The toxic principle in cyanogenic plants are cyanogenic glycosides like amygdalin, prunacin, linamarin, lotaustralin, dhurrin, and taxiphyllin.These glycosides as such are not toxic but they become toxic when they get hydrolysed in the body.Processing of the plants like freezing, chopping or chewing render them more toxic due to release of enzymes(Gracia and Shepherd, 2004).It is reported that the level of toxicity increases depending on the factors such as ruminal pH and microflora, rapid ingestion,consuming large amount of immature cyanogenic plant, amount of cyanogenic glycoside or free HCN in the ingested plants. Excess application of nitrogen fertilisers and herbicides like2,4-Dichlorophenoxyacetic acid increases the toxicity. Increase in pH of rumen and abomasum potentiates the toxicity. It has shown that at a pH less than 5.0, the enzymes that separate the glycosides gets inactivated and the risk of toxicity decreases.


Figure 5 –Sorghum or *Sorghum bicolor*(Left) and Lima beansor *Phaseolus lunatus*(Right)

Hydrogen cyanide is released in the rumen which combines with methaemoglobin to form cyanmethemoglobin.This complex inactivates cytochrome oxidase enzyme and inhibits the last step of oxidative phosphorylation. Utilisation of oxygen does not occur resulting in cessation of cellular respiration. Death of the animal in cyanide poisoning is due to histotoxic anoxia.The lethal dose of HCN for ruminants is about 2mg/kg of body weight. Plants containing over 200ppm of these glycosides are categorised as toxic.

Clinical signs are exhibited within minutes to a few hours.Death in animals usually occurs within 2 hours after consuming the lethal dose of cyanogenic plants.Laboured breathing, dyspnoea, restlessness, tremors,terminal clonic convulsions and opisthotonus are the clinical signs shown by the intoxicated animal. Initially the mucous membranes are bright and cherry-red color due to oxygen abundance in blood. Later it turns cyanotic due to hypoxia.Then the animal enters into coma and die if not treated promptly.Diagnosis can be made by qualitative analysis of cyanogenic material in rumen content or plant sample by using the picric paper test.For this rumen contents and forages should be preserved in the frozen condition until analysis.

Treatment involves 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.

Nitrate containing plants

Nitrate poisoning is a condition which may affect ruminants consuming certain forages like Oats, Cape weed, Sorghum,Maize, Lucerne,Turnip tops, Sudan grass,Wheat,Barley which contains nitrate in excess amounts. In normal conditions nitrate ingested by ruminants is converted to ammonia and then to bacterial protein in the rumen where the conversion of nitrate to nitrite is much faster than conversion of nitrite to ammonia. Excess intake of nitrate containing plants results in accumulation of nitrite in the rumen.This nitrite enter into bloodstream and will convert haemoglobin to methaemoglobin which leads to prevention of oxygen transport.Hence the animal dies due to anoxia in nitrate poisoning. The conditions like drought, cold weather, herbicide application, wilting causes the plants to accumulate more nitrate. The nitrate content in the plant tissues depends on factors like type of plant species, stage of maturity and part of the plant. Immature plants contain higher concentrations of nitrate than mature plants. The leaves and flowers contain less nitrate because most of the nitrate is located in the bottom third of the plant.

Clinicalsigns of nitrate poisoning include salivation,abdominal pain,vomiting, and diarrhoea. Whereas the nitrite poisoning results in clinical signs such as salivation, tremors, staggering, bloat, dyspnoea,rapid and noisy breathing, chocolate coloured mucous membranes.Pathological lesions include reddening and stripping of the gastrointestinal epithelium,pinpoint haemorrhages in internal organs,pooling of blood in the stomach wall and poorly clotting blood with coffee brown colour. Diagnosis of nitrite poisoning can be made from history of exposure to plants, clinical signs and pathological lesions.Antidote for nitrate poisoning includes intravenous administration of methylene blue which converts the methaemoglobin to haemoglobin.

Points to be considered for the prevention of nitrate poisoning are:

- Feed the animals with mature forages
- Do not allow the animals to graze highly fertilised crops
- Feed only dried cereal hays
- Avoid the animal from grazing the plants one week after rainfall and cloudy weathers
- Silaging of high nitrate content plants
- Avoid feeding green chop that has heated after cutting
- Mouldy hay should not be fed to animals

Pteridium aquilinum

Common names: Bracken fern, Brake, Hog Pasture Break

Bracken fern (*Pteridium aquiline var. pubescens*) is a poisonous weed that are not preferred by ruminants due to high silicon content that reduces its palatability. It is widely distributed in many places around the world where it grows in woodlands and

other shaded places, on hillsides and open pastures (Stegelmeier *et al*., 1999).All parts of the fern are poisonous. Thiaminase inhibitors present in the plant causes thiamine deficiency. Consumption of milk from poisoned cows is harmful to humans. Poisoning usually occurs during late summer when scarcity of the fodder happens.In cows the diseases usually takes acute form after the consumption of large amount of plant. Nor-sesquiterpene glycoside called ptaquiloside present in plant causes aplastic anaemia in cattle, which has delayed onset of action.Overtime consumption causes bovine enzootic haematuria which gives urine the characteristic red color.

Figure 6 - Bracken fern plant (*Pteridium aquiline var. pubescens*)

Clinical signs in cattle and sheep include 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 (Davis *et al.*, 2011). Poisoning can be treated with administration of thiamine hydrochloride,batyl alcohol, activated charcoal and saline cathartics

Datura poisoning

Common names: Devil's trumpet, Mad apple, Jimsonweed, Thornapple

Figure 7 - *Datura stramonium*plant and seed pods (Right)

Datura stramonium is an annual plant with white funnel shaped flowers. It is cultivated as an ornamental plant. Generally animals do not prefer to consume this plant due to strong smell and unpleasant taste.The whole plant is considered as toxic

including the nectar.Seeds are the most toxic part(Glen, 2008). Toxic principle present in the plant includes alkaloids like atropine, hyoscyamine, scopolamine, and other anticholinergic alkaloids.Initial symptoms exhibited includes rapid pulse with increased heart rhythm, pupil dilatation, dry mouth, and vision impairment (Everest *et al*., 2005). Later there will be decreased body temperature, nausea, loss of muscle coordination, violent tremors,aggressive behaviour, slow breathing, rapid and weak pulse.Management includes provision of supportive and symptomatic care. Administration of an antidote, physostigmine should be done in severe intoxication.

Table 1 – Brief information on the major plants responsible for toxicity in ruminants

Plant	Active compounds	System affected	Treatment
Lantana camara	Lantedene A and B	Hepatotoxic	Liver supplements Fluids and electrolytes
Abrus precatorius	Abrin	Cytotoxic	Symptomatic and Supportive care
Nerium oleander	Oleandrin, Thevetin	Cardiotoxic	Anti-digoxin fab fragments, Atropine, Beta blockers
Castor bean (*Ricinus communis*)	Ricin, Rcinin,	Gastrointestinal toxicity	Symptomatic and supportive care, Activated charcoal
Bracken fern	Thiaminase inhibitors and ptaquiloside	Aplastic anaemia., Bovine enzootic haematuria, Bladder carcinoma	Thiamine Batyl alcohol
Corn, Sorghum, Tapioca, Apple	Cyanogenic glycosides	Hematotoxic	Sodium nitrate and Sodium thiosulfate
Oats, Wheat, Lucerne	Nitrates and Nitrites	Hematotoxic	Methylene blue
Datura stramonium	Tropane alkaloids	Anticholinergic	Physostigmine

CONCLUSION

Numerous poisonous plants have known to cause negative impact on the livestock industry.Grazing is considered as normal routine in livestock management, but it exposes the animals to a variety of poisonous plants particularly when there is a reduction in fodder availability. For most of the plant poisoning cases the treatment is

general with symptomatic and supportive therapy since there is no antidote for most poisons.Delay in treatment and unattained cases may lead to loss of animal, partially or completely.Toxin specific antibodies are available for treating several plant toxicity. Unfortunately, due to the high costs and scarce availability of these antidotes veterinarians may not have ready access to all of those that are clinically useful in managing plant toxicity.

REFERENCES

Aslani, M. R., Maleki, M. O. H. S. E. N., Mohri, M., Sharifi, K., Najjar-Nezhad, V., & Afshari, E. (2007). Castor bean (Ricinus communis) toxicosis in a sheep flock. *Toxicon*, 49(3), 400-406.

Aslani, M. R. (2004). Poisonous plants of Iran and their effects on animals. 1st. Edn., Mashhad, Mashhad University Press., 210-212.

Audi, J., Belson, M., Patel, M., Schier, J., & Osterloh, J. (2005). Ricin poisoning: a comprehensive review. *Jama*, 294(18), 2342-2351.

Blood, D. C., Radostits, O. M., & Henderson, J. A. (1983). Veterinary Medicine, Bailliere Tindall.London.

Davis, T. Z., Stegelmeier, B. L., Green, B. T., Welch, K. D., Panter, K. E., & Hall, J. O. (2011). Acute toxicity of selenium compounds commonly found in selenium-accumulator plants. Poisoning by plants, mycotoxins and related toxins, 525-531.

Day, P. J., Pinheiro, T. J., Roberts, L. M., & Lord, J. M. (2002). Binding of ricin A-chain to negatively charged phospholipid vesicles leads to protein structural changes and destabilizes the lipid bilayer. *Biochemistry*, 41(8), 2836-2843.

Everest, J.W., T.A. Powe Jr., and J.D. Freeman. 2005. Poisonous plants of the Southeastern United States. Alabama Cooperative Extension. ANR-975. http://www.aces.edu/pubs/docs/A/ANR-0975/ANR-0975.pdf (accessed 25 Jan. 2013).

Frohn, D and Pfander, HJ (1983). A colour atlas of poisonous plants. 1st. Edn., London, A Wolf Science Book. 47-48.

Glen N (2008). Guide to Toxic Plants in Forages.https://www.extension.purdue.edu/extmedia/WS/WS_37_ToxicPlants08.pdf

Gracia, R., & Shepherd, G. (2004). Cyanide poisoning and its treatment. Pharmacotherapy: *The Journal of Human Pharmacology and Drug Therapy*, 24(10), 1358-1365.

Hegde, R., & Podder, S. K. (1992). Studies on the variants of the protein toxins ricin and abrin. *European journal of biochemistry*, 204(1), 155-164.

He, X., McMahon, S., Henderson II, T. D., Griffey, S. M., & Cheng, L. W. (2010). Ricin toxicokinetics and its sensitive detection in mouse sera or feces using immuno-PCR. *PloS one*, 5(9), e12858.

Joubert, J.P. J.(1989). Cardiac glycosides. In: P.R. Cheeke (ed.), Toxicants of Plant Origin, vol. II, (CRC Press, Boca Raton, FL), 61–96.

Knight, A. P., & Walter, R. G. (2003). A Guide to Plant Poisoning of Animals in North America, 2001. Teton NewMedia.

Langford, S. D., & Boor, P. J. (1996). Oleander toxicity: an examination of human and animal toxic exposures. Toxicology, 109(1), 1-13.

Rajeev N. (2012). Heamatopathological changes in rats following experimental feeding of Abrus precatorius seeds. *International journal of Pharmacology and Phytochemical Research*, 1(5), 283-286.

Roy, C. J., Hale, M., Hartings, J. M., Pitt, L., & Duniho, S. (2003). Impact of inhalation exposure modality and particle size on the respiratory deposition of ricin in BALB/c mice. *Inhalation toxicology*, 15(6), 619-638.

Stegelmeier, B. L., Edgar, J. A., Colegate, S. M., Gardner, D. R., Schoch, T. K., Coulombe, R. A., & Molyneux, R. J. (1999). Pyrrolizidine alkaloid plants, metabolism and toxicity. *Journal of natural toxins*, 8(1), 95-116.

Lethal genes types and classification

Savalia, K. B., Ahlawat, A.R., Verma, A.D., Odedra,M. D and Dodiya P.G.

College of Veterinary and Animal Husbandry
Junagadh Agricultural University, Junagadh (Gujarat)
**Corresponding Author: dranshuahlawat@gmail.com*

Background In the nucleus of each cell, the DNA molecule is packaged into thread-like Structures called chromosomes Normal cells of every individual have two kinds of chromosomes- autosomes and sex chromosomes. Sex chromosomes carry sex-determininggenes. There are two sex chromosomes in normal somatic cells which determine the sex of anindividual.Therest of the chromosomes areknown as autosomes.Autosomes are chromosomes that don't carry any genes that determine the sex of theindividual.
The genetic diseases, which are linked with sex chromosomes, are known as sex-linkeddiseases. The other diseases are known as autosomal genetic diseases which could be recessive or dominant.

Every individual has two copies of each gene, one copy on each of the chromosome pair. The genetic diseases are caused by a single error or mutation in genes present in our genome. Some diseases require both copies of a particular gene to be damaged or mutated (Recessive diseases), whereas others need only one gene copy damaged (Dominant diseases). In recessive genetic diseases, the genetic error usually needs to be inherited from both parents to get the disease. Inheritance of the mutant gene only from one parent usually causes the individual to be a carrier of the disease, but without any symptoms.

Genetic dominant /recessive disorders have been identified in livestock populations since modern animal breeding programs began, and hundreds of these disorders have now been catalogued (Nicholas et al.,2014). In the past, test matings were used to identify carriers of recessive disorders (Robertson.,1950), but most recessive mutations were identified after the carrier bull had sired many daughters and had sons used for artificial insemination (AI) (e.g., bovine leukocyte adhesion deficiency(Shuster.,1992), complex vertebral malformation (Agerholm,2001), and deficiency of uridine monophosphate synthase (Shanks,1984). Novel recessive mutations can also quickly spread through a population by using popular bulls before routine screening is possible because such defects are not directly observable, e.g., Jersey haplotype 1 (Sonstegard,2013).

LETHAL GENES:

All genes or genetic factors are not useful to the organism.There are some genetic factors or genes, when present in any organism cause its death during early stage of development. **Lethal alleles** (also referred to as **lethal genes** or lethals) are **alleles** that cause the death of the organism that carries them. They are usually a result of mutations in **genes** that are essential to growth or development. They may even cause death of the individual either in homozygous dominant or homozygous recessive condition.

Lethal genes are classified as:

1. Recessive lethals
2. Dominant lethals
3. Conditional lethals
4. Balanced lethals
5. Gameticlethals

1. Recessive lethal

A pair of identical alleles that are both present in an organism that ultimately results in death of that organism are referred to as recessive lethal alleles Most of the lethal genes are recessive lethals. It is expressed only when they are in homozygous condition.Recessive lethal alleles do not cause death in the heterozygous form because a certain threshold of protein output is maintained. In the homozygous form, the protein output does not meet the threshold, causing death.

Some alleles associated with human genetic disorders are recessive lethal e.g. Achondroplasia, a form of dwarfism. A person heterozygous for this allele will have shortened limbs and short stature (achondroplasia), a condition that is not lethal. Other examples of diseases caused by recessive lethal alleles are cystic fibrosis, Tay-Sachs disease, sickle-cell anaemia, and brachydactylic. One coat colour of ranch foxes is caused by a recessive lethal gene. This gene causes a death if both recessive alleles are possessed by the same individual.

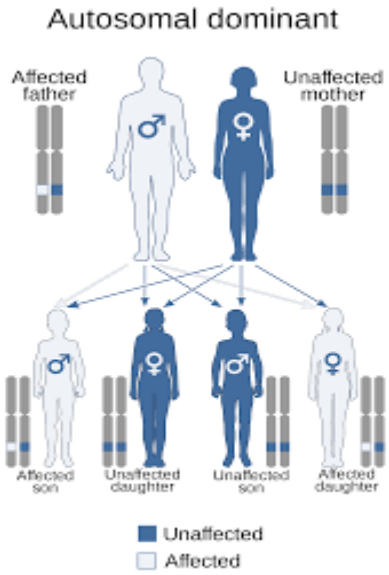
In bovine syndactylism, also known as mule footdisease. This malformation has an autosomal recessive character. This is due to incomplete penetrance and variable expression of this trait (Johnson *et al.* 2006). In this condition a non-division or fusion of digits, and it mostly appears as synostosis of phalanges.Bovine leukocyte adhesion deficiency (BLAD), deficiency of uridine monophosphate synthase (DUMPS), complex vertebral malformation (CVM), bovine citrullinaemia (BC) and factor XI deficiency (FXID) are autosomal recessive hereditary disorders, which have had significant economic impact on dairy cattle breeding worldwide.Deleterious recessive alleles that are masked in outbred populations are predicted to be expressed in small, inbred populations, reducing both individual fitness and population viability.

2. Dominant lethal

Alleles that need only be present in one copy in an organism to be fatal are referred to as dominant lethal alleles. These alleles are not commonly found in

populations because they usually result in the death of an organism before it can transmit its lethal allele on to its offspring.

There are some lethal genes which reduce viability even in heterozygotes, are said as dominant lethal, e.g. epiloia gene in human beings. This cause mental defects, abnormal skin growth and tumours in heterozygotes, therefore, they die before reaching adulthood. The dominant lethal may be produced in every generation through mutation.



These alleles are not commonly found in populations because they usually result in the death of an organism before it can transmit its lethal allele on to its offspring.An example in humans of a dominant lethal allele is Huntington's disease, a rare neurodegenerative disorder that ultimately results in death. Because the onset of Huntington's disease is slow, individuals carrying the allele can pass it on to their offspring. This allows the allele to be maintained in the population.An example of recessive lethal allele occurs in the Manx cat. They process a heterozygous mutation resulting in a shortened or missing tail. Homozygous offspring for the mutant allele cannot survive birth, when two heterozygous Manx cats are crossed.

In bovines, Achondroplasial (Bull-dog calves) is a condition produced by a dominant lethal factor, but is not lethal in the heterozygous state.

3. Conditional lethal

Alleles that will only be fatal in response to some environmental factor are referred to as conditional lethals. The lethal genes require a specific condition for their lethal action are said as conditional lethals., Drosophila and many other organisms are termed as temperature sensitive mutations. Each of them needs a definite, generally high temperature to express their lethal action. A chlorophyll mutant of barley allows normal chlorophyll development at a temperature of 19°C or above, but it develops albina or abnormal white seedlings at temperature below 8°C. Temperature is not only

responsible to bring out conditional lethals. Some conditional lethals require light, nutrition etc.

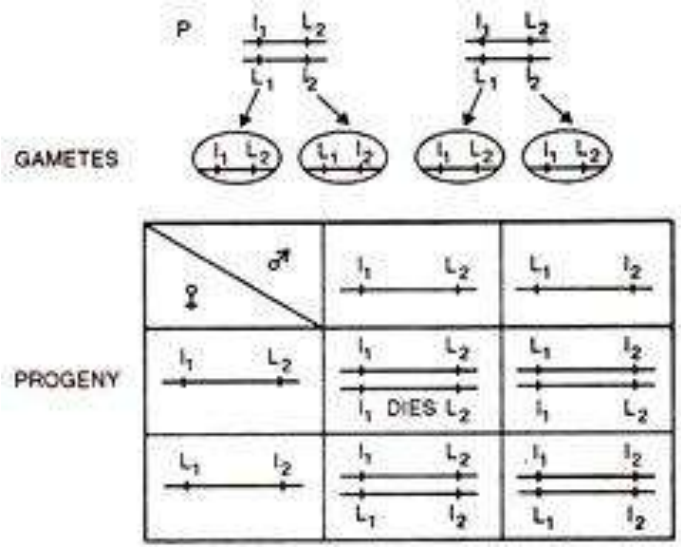
Another example of a conditional lethal is favism, a sex-linked inherited condition that causes the carrier to develop hemolytic anaemia when they eat fava beans.Favism is a, inherited condition that results from deficiency in an enzyme called glucose-6-phosphate dehydrogenase The disease was named because when affected individuals eat fava beans, they develop hemolyticanemia, a condition in which red blood cells break apart and block blood vessels. Blockage can cause kidney failure and result in death (Bowman & Walker, 1961). Affected individuals may also develop anemia when administered therapeutic doses of antimalarial medications and other drugs (Allison, 1960). Note, however, that the defective glucose-6-phosphate dehydrogenase allele only causes death under certain conditions, which makes it a conditional lethal gene.

4. Balanced Lethals

The balancing effect between two different lethals in self permanent stock is called balanced lethal system- Muller (1918). Lethal genes linked in repulsion phase of linkage are said as balanced lethals. They are maintained in repulsion phase due to tight linkage. Crossing over is very low. In repulsion phase, the recessive allele of one gene and the dominant allele of the other gene are present in the same chromosome.

Mating between individuals heterozygous for these balanced lethals will produce 4 types of zygotes. 1/4 will be homozygous for the recessive lethal and will not survive. Another 1/4 of the zygotes shall be homozygous for the other recessive lethal and will die.

The only progeny which will survive, will be the heterozygotes for the 2 recessive lethals. Therefore, a balanced lethal system maintains the genes closely linked to the lethal genes in a permanent heterozygous state. Balanced lethals are seen in mice, Oenothra, Drosophila etc.



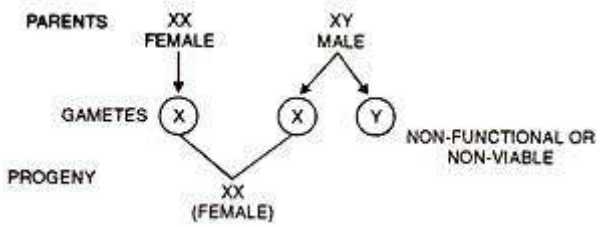
(A balanced lethal system having 2 recessive lethal genes (l_1 and l_2). Only 2 of the 4 heterozygotes survive (l_1L_2/L_1l_2)

5. GameticLethals(Meiotic drive)

Some genes make the gametes incapable of fertilization. Such genes are said as gameticlethals. Meiotic drive may be called a mechanism that leads to the production of unequal numbers of functional gametes by a heterozygote.

It has been found in certain males of Drosophila pseudoobscura, produce only half amount of sperm as compared to a normal males. When these males are mated to normal females, most of the progeny are females. It demonstrates that the sperm cells produced by these males contain the 'X' chromosome only and their sperms having 'Y' chromosome are non-functional.

It may be clarified as follows:



REFERENCES

Agerholm, J.S.,Bendixen, C., Andersen, O. and Arnbjerg J.2001. Complex vertebral malformation in Holstein calves. *J. Vet.Diagn. Invest*.**13**:283–9.

Allison, A. C.1960. Glucose-6-phosphate dehydrogenase deficiency in red blood cells of East Africans. *Nature* **186**: 531–532.

Bowman, J. E. and Walker, D. G. 1961. Action of Viciafaba on erythrocytes: possible relationship to favism. *Nature*. **189**(4764): 555-556.

Johnson, E.B., Steffen, D.J., Lynch, K.W.and Herz, J.2006. Defective splicing of Megf7/Lrp4, a regulator of distal limb development, in autosomal recessive mule foot disease*. Genomics*.**88**:600–609.

Nicholas, F. and Hobbs, M.2014. Mutation discovery for Mendelian traits in non-laboratory animals: a review of achievements up to 2012. *Anim. Genet*. **45**:157–70

Robertson, A. andRendel, J.M. 1950. The use of progeny testing with artificial insemination in dairy cattle*. J. Genet*. **50**:1–31.

Shanks,R.D.,Dombrowski, D.B., Harpestad, G.W.and Robinson J. L.1984. Inheritance of UMP synthase in dairy cattle. *J.Hered*.**75**:337–40.

Shuster, D. E., Kehrli, M. E., Ackermann, M. R.and Gilbert, R. O. 1992. Identification and prevalence of a genetic defect that causes leukocyte adhesion deficiency in Holstein cattle. *Proc. Natl. Acad. Sci*.**89**(19): 9225-9229.

Sonstegard,T.S., Cole, J.B., VanRaden, P.M., Van Tassell, C.P., Null, D.J.and Schroeder, S.G.2013.Identification of a nonsense mutation in CWC15 associated with decreased reproductive efficiency in Jersey cattle. *PLoS One*. **8**(1):e54872.