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Roughage: Let's Make It Nutritious

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In tropical countries like India, livestock subsist mainly on crop residue based diets and are suffering from the shortage of feed both in terms of quality and quantity. The available roughage and concentrate for livestock feeding can meet only 50 and 10% respectively of their requirement. They are generally fed high fibrous crop residues (wheat straw, rice straw, stovers, etc) characterized by high indigestible fibre due to increased lignification of cellulose i.e. cellulose exists in an undefined complex with lignin, which lowers its digestibility.

Although straw is an important feedstuff, and indeed the staple feed in large parts of the developing world for ruminants, it is not preferred by animals. A characteristic of straw is that it mainly consists of highly lignified cell wall material, which often constitutes upto 80% of the dry matter. It includes cellulose, hemicellulose and lignin in the ratio 4:3:3, respectively, while the rest comprises of nitrogenous compounds and ash. Nutritive value of straw is controlled by its chemical attributes that limit the digestion of cellulose and hemicellulose. These attributes include lignification, silicification, crystallinity of cellulose, etc. which are known to be the inherent nutritive constraints in straw. Although straw produced every year is plentiful, but the amount a ruminant can consume is not sufficient to sustain a reasonable level of production due to its low nutritive value i.e low voluntary intake, slow rate of digestion and low content of available energy, protein, minerals and vitamins and thus animal productivity. Therefore, it has not been maximally utilized for livestock production yet and may be fed as part of the roughage component of the diet. The situation strongly demands the improvement of the nutritive value of high fibrous crop residues through various treatments for the efficient utilization of existing feed resources. Therefore various physical and chemical treatments have been suggested which improves the feed quality either by increasing digestibility or by enhancing palatability, by weakening and breaking down lingo-cellulose bonds in crop residues , thus increasing daily feed intake and enhance the rate of digestion and availability of nutrients.

Supplementation with limiting nutrients also improves the utilization of straw.

Among the various chemical treatments, urea treatment is simple because urea is cheaper, easily available and assumed to be equivalent to anhydrous or aqueous ammonia for upgradation of straws. Sodium hydroxide is the single most effective chemical for improving the digestibility of various low quality roughages. However, these treatments have their own limitations and few are environment unfriendly.

Recently, the biological treatments of crop residues have been developed to improve the accessibility of cellulosic fractions and thus improving their digestibility and feeding value. The major obstruction in biological conversion of lignocelluloses is the physical protection of cellulose by lignin against cellulolytic enzymes. The potential of biological treatments has been explained by the ability of certain microbes to disrupt plant cell wall by partial breakdown of the lignin-carbohydrate complex thus improving their utilization in the rumen by increasing the availability of fermentable energy to ruminal microbes.

The aim of this paper provides an overview of some techniques to improve the nutritive value of straw as livestock feed and hence their performance and productivity.

NUTRITIVE QUALITY AND UTILIZATION OF ROUGHAGES IN RUMINANT

Straw consists predominantly of cell walls, comprised of cellulose, hemicellulose, and lignin. To break down these components cellulase, hemicellulase and ligninase are required. These enzymes are not produced by the animals themselves but the reticulorumen of ruminants maintains microorganisms that do produce cellulase and hemicellulase. However, lignin cannot be broken down in the rumen due to the lack of ligninase enzyme. Even if lignin could be degraded in the rumen it would not provide much energy for the animals. Lignin, however, has important effects on livestock production through effects on degradability and feed intake. Theoretically, lignin located between the cellulose microfibrils is regarded as the most abundant natural aromatic organic polymer that plays a role in resisting compressing forces, providing protection against consumption by insects and mammals, and also inhibiting the rate and degree of microbial degradation.

Silica, an element of the cell walls, reduces palatability and the degradability of straw in the rumen due to its direct action in preventing colonization by ruminal microorganisms. The combination of low intake, low degradability, low nitrogen content and an unbalanced mineral composition means that straw alone may not even meet the animal's maintenance needs. The fiber is very difficult to degrade, which is further complicated by the poor functioning of the rumen due to the unbalanced availability of nutrients, the low protein content, the lack of easily available energy and the low content of essential minerals such as P and S. Hence, due to the low degradability and the poor rate of degradation, animals will tend to consume less.

Roughages comprise over 50% of all feedstuffs fed to livestock animals especially ruminants. They are plant-based feedstuffs with high fiber content which provide a range of nutrients to the animals. They also function to maintain and optimize the efficiency of the GI tract. They are high in fibrous carbohydrates such as cellulose, hemicelluloses and lignin. Their mineral content is influenced by the type of roughage and mineral content of the soil. In general, they are high in calcium, potassium, micro-minerals and fat-soluble vitamins and moderate to low in phosphorus as compared to concentrates. Legumes have a higher calcium and magnesium contents compared to grasses. They are also a good source of the B-complex vitamins. They may contain one or more antinutritional factors such as alkaloids, cyanogenic glycosides, toxic amino acids, and/or mycotoxins. Their nutritional value also varies with the proportion of cell contents to cell wall components and on the extent of cell wall lignification. Their effective use requires matching nutrient requirements of an animal with the nutritional value of roughage and also appropriate processing and supplementation. The composition of the diet influences the extent and rate of their digestion.

Feeding of high-energy feedstuffs has a negative associative effect on the degree of utilization of roughage. One of the primary species responsible for the digestion of roughages is cellulolytic bacteria. The primary end-product of digestion of roughages is acetate which is a relatively weak acid. The primary end-product of fermentation of high-energy feedstuffs is propionate which is a relatively strong acid. An additional end-product of microbial fermentation of high-energy feedstuffs is lactate which is also a stronger acid. Compared to roughages, the digestion rate and extent are higher and the resultant pH of the rumen is lower for high-energy feedstuffs. The lower pH has a negative effect on the microorganisms responsible for digestion of roughages (the cellulolytic microbes are inhibited by a pH of 6.0 or lower). Therefore, the incorporation of high-energy, high non-fibrous carbohydrate feedstuffs decreases the utilization of roughages.

PURPOSE OF ROUGHAGE TREATMENT:

- ✓ To increase voluntary intake by improving digestibility.
- ✓ To increase the energy availability for physiological functions by reducing losses in digestive processes.
- ✓ To dissociate physical &/or chemical bonding between lignin and cellulose, hemi-cellulose.
- ✓ To increase the surface area for providing more exposed surface for the action of microbes as well as digestive enzymes resulting into higher digestibility.

- ✓ To enrich the crop residues with deficient nutrients either by treatment or supplementation.
- ✓ To reduce the bulkiness through densification.

PHYSICAL TREATMENT OF STRAWS

Physical treatments of roughages have received an appreciable amount of research. The mainly used physical methods are grinding, chaffing, bhoosa making, pelleting, irradiation, water washing, water soaking, very fine grinding in ball mills, etc. With all-roughage diets, grinding causes an increase in intake and weight gain. These effects are greater for roughages with lower digestibility and nitrogen can be a limiting factor for improvement by grinding of very poor roughages like straw. They can be ground, soaked, pelleted or chopped to reduce particle size or can be treated with steam or X-rays or pressure cooked. Grinding and pelleting decreases dry matter degradability due to a decreased fermentation rate and decreased total retention time of the solids, resulting in an increased intake but at the same time increases the net energy value of the straw because the nutrients that are digested are utilized more efficiently by the animal.

CHEMICAL TREATMENT OF STRAW

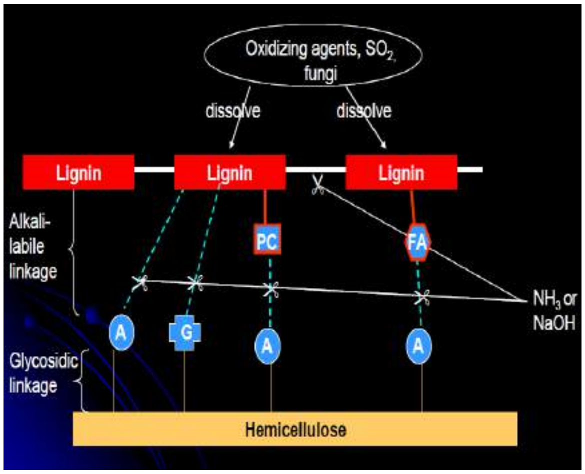
This is the most practical treatment for use on-farm, as no expensive machinery is required, the chemicals are relatively cheap and the procedures to use them are relatively simple. However, the chemicals themselves are not harmless and safety precautions are needed for their use. The most commonly used alkaline agents are sodium hydroxide (NaOH), ammonia (NH_3) and urea.

Straw pellets

Chemicals to improve the utilization of roughages may be alkaline, acidic or oxidative agents. Among these, alkali agents have been most widely investigated and practically accepted for application on farms. These alkali agents can be absorbed into the cell wall and chemically break down the ester bonds between lignin and hemicellulose and cellulose, and physically make the structural fibers swollen. These processes enable the rumen microorganisms to attack more easily the structural carbohydrates, and thus enhancing their degradability and palatability.

NaOH treatment

The principal advantages of the NaOH treatment are increased degradability and palatability of treated straw, compared to untreated straw. However, it is not widely available and may be too expensive to use for small-scale farmers. In addition, its application can be a cause of environmental pollution, resulting in a high content of sodium in the environment. Its various methods are:



Basic principle of chemical treatment (breakage of linkage between lignin and structural carbohydrates)

- ***Beckmann method:*** It involves the soaking of straw into 10 times its weight of 1.5% NaOH solution for atleast 4hrs. The liquid is then drained off and the straw is washed until free from alkali.
- ***Modified Beckmann method:*** This method is closed treatment involving little NaOH (0.75gm/kg).
- ***Dry method:*** It involves the treatment of the straw with small amount of conc. NaOH solution. Straw is sprinkled with NaOH solution while being mixed and then fed directly without washing.

Ammonia treatment

Treatment of straw with anhydrous and aqueous ammonia, urea or other ammonia-releasing compounds has been widely investigated to improve degradability of fibrous constituents. It also adds nitrogen and preserves the straw by inhibiting mould growth. Besides, improvement in degradability of structural carbohydrates, it is an effective means of reducing the amount of supplemental nitrogen, costs of purchasing protein-rich feedstuffs, enhancing acceptability and voluntary intake of the treated straw by ruminants.

Optimum level of ammonia for treatment of crop residues is 2.5-3.5% of D.M. Ammonia reacts slowly than NaOH and reaction speed depends on temperature and moisture. Speed is higher at higher levels. Moreover, the physical strength of ammoniated straw is significantly lower than that of the untreated straw. In addition, the proportion of small feed particles tended to be higher and stimulated more attachment and growth of the rumen bacteria. The reduced particle size and the increased attachment sites could lead to subsequent increased microbial colonization and digestion. So, ammonia treatment increases feed value by making the cell wall more available for the rumen microorganisms and also the increased N content improves microbial growth.

Urea treatment

Straw treated with urea releases ammonia after dissolving in water. For practical use by farmers, urea is safer than using anhydrous or aqueous ammonia because it provides a source of nitrogen (crude protein) in which straw is deficient. Since urea is a solid chemical, it is also easy to handle, transport and is easily available.

Stacks of ammonia treated straw

Urea spraying over the straw

In addition, it is considerably cheaper than NaOH or NH_3. Therefore it is most suitable for small-scale farmers to improve the quality of straws. Addition of $Ca(OH)_2$ to urea improved the IVDMD.

Urea treatment of straw and stover works on the principal of ureolysis and alkali action on the cell through dissolving the structural carbohydrates especially the hemicellulose, swelling of the plant matter in an aqueous environment, reducing the physical strength of cell. Urea treatment of straw leads to an increase in intake (20-25%), digestibility (10-15%) and energy availability to the host animal which otherwise would have been wasted. Urea treatment also enriches the straw for its protein content (up to 9-10%). Simplest criteria of a good treatment may be adjudged by the change in colour of treated straw from clear yellow to brown or dark brown. Treated straw should be absolutely *free from any mold* with smooth texture. As a matter of fact straw treated with 4% urea will result in a protein content of 15-16% when no ureolysis took place.

Basic steps of urea treatment:

I) Chaffing/thrashing of crop residue/stover by chaff cutter to 1-2" size

II) Collect/store the chopped straw at a safe and dry place till further use

III) Weigh 100kg straw for urea treatment

IV) Make the urea solution by dissolving 4 kg urea into 40 liter water

V) Spread the straw layer on polythene or tarpaulin sheet

VI) Fill the urea solution in a container and spray over straw layer uniformly

VII) Fill the urea treated straw immediately in an airtight bag and close it properly

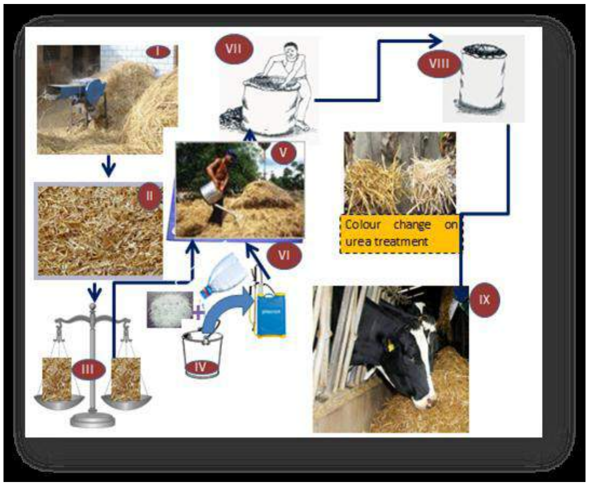
VIII) Ensure the complete air tightness of bag and keep it for at least 2 weeks

IX) Open the bag: remove top 1-1 ½ inch layer and offer the straw to livestock

Precautions:

1. The calf of below six month will not be fed with treated straw.
2. The pregnant cattle are also not being fed with treated straw.
3. Mouldy straw should not be fed to the animals.

4. The treated straw will be fed after exposure of air for at least 10 minute.



Basic steps in urea treatment of straw

Benefits of urea treated straw:

1. Enhanced nutritive value.
2. Treaded paddy straw is liked by cattle.
3. Increase palatability.
4. Intake will increase
5. Maintains the health quality.

Urine treatment

As urine contains urea, so it can be used as a source of urea and ammonia to improve the quality of straw. Urine can be sprayed over the straw in a similar way as is done with urea solutions and can provide a nearly equal improvement of the degradability and nitrogen content as other methods of ammonia treatment.

Moreover, the use of urine is hampered by the difficulty of separation of urine from faeces in ruminant husbandry. This also makes the use of urine rather unhygienic and therefore not advisable to use, although its use is without costs for farmers and is normally available in excess.

Lime treatment

Lime [CaO/Ca(OH)$_2$] is a weak alkali agent with a low solubility in water. It can be used to improve the utilization of straw and also can be used to supplement the ration with calcium. Soaking and ensiling are two methods of treating straw with lime. Although it increases the degradability of straw, but the dry matter intake decreases due to reduced acceptability of the treated feed by animals. Ensiling of straw with 4 or 6% Ca(OH)$_2$ showed a higher IVDMD than using 4 or 6% urea. However, mould growth may occur in the Ca(OH)$_2$ treated straw. The combined application of lime and urea would give better results than urea or lime alone due to increased degradability and an increased content of both calcium and nitrogen. The use of lime may be safer and more cost effective to use than NaOH.

Biological methods

These methods have great potential in comparison to the use of expensive chemicals. They are eco-friendly too. The organism grown on the straw must obtain its energy from the straw itself and degrade cellulose and hemicelluloses. Successful biological treatment involves the application of organism which degrades lignin. The use of fungi and/or their enzymes that metabolize lignocelluloses is a potential biological treatment to improve the nutritional value of straw by selective delignification. This method is difficult to apply in developing countries due to lack of technology to produce large quantities of fungi or their enzymes to meet the requirements. There are also various serious problems to consider and overcome. For example, the fungi may produce toxic substances. It is also difficult to control the optimal conditions for fungal growth, such as pH, temperature, pressure, O_2 and CO_2 concentration when treating the fodder.

White-rot fungi treatment: White-rot fungi, belonging to the wood-decaying *basidiomycetes*, as lignocellulolytic microorganisms are able to decompose and metabolize all plant cell constituents (cellulose, hemicellulose and lignin) by their enzymes. Its various species are effective lignin degraders and have the ability to improve the nutritive value of fodder for ruminant nutrition.

Exogenous fiber-degrading enzyme treatment: Most commercially available exogenous fiber-degrading enzyme products consist of cellulases and xylanases, as produced for non-feed applications. Commercial enzymes used in the livestock feed industry are generally of fungal (mostly *Trichoderma longibrachiatum*, *Aspergillus niger*, *A. oryzae*) or bacterial origin. Enzyme treatment alone or in combination with other treatments increases the degradability of straw by the rumen microorganisms. In addition, fibrolytic enzymes in ruminant feed improves average daily gain of steers, fleece weight and wool production of lambs and in milk yield of dairy cows.

CONCLUSIONS

Ruminant production had and will continue to play a vital role in India. A large proportion of the straw produced is not fed to the livestock. However, its further development is confronted with major problems related to the scarcity of grazing and low quality of crop residues which are the major sources of available feed for ruminant. As an alternative, several treatments have been used to improve the degradability, voluntary intake and nutritive value of straw, such as physical or chemical treatments, but the practical use of these treatments is still restricted in terms of safety concerns, costs and potentially negative environmental consequences. Use of biological treatment i.e ligninolytic fungi, including their enzymes, may be one potential alternative to provide a more practical and eco-friendly approach for enhancing the nutritive value of straw. All these treatments help to improve the nutritive value of the straw, animal productivity and overall profitability of the dairy enterprise.

Role of soil organic carbon in climate Mitigation and Sustainable Agriculture

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Abstract

Soil organic carbon (SOC) is of local importance as it determines ecosystem and agro-ecosystem function, influencing soil fertility, water holding capacity and many other functions. It is also of global importance because of its role in the global carbon cycle and therefore, the part it plays in the mitigation or worsening of atmospheric levels of greenhouse gases (GHGs). Carbon sequestration on agricultural lands is possible through a range of soil management strategies and could be substantial with widespread implementation. Sequestration of historic carbon emissions is now essential as mitigation alone is unlikely to stabilize our atmosphere. There are numerous management strategies for drawing carbon out of the atmosphere and holding it in the soil. These strategies vary in effectiveness across different climates, soil types, and geographies. The way in which land is managed following land use change has also been shown to affect SOC stocks. Therefore, we have the opportunity in the future to adopt sustainable land use and land management strategies that lead to greater C storage in the soil, thereby mitigating GHG effects, improving soil fertility and productivity.

INTRODUCTION

Soil organic carbon (SOC) is the carbon associated with soil organic matter. Soil organic matter is the organic fraction of the soil that is made up of decomposed plant and animal materials as well as microbial organisms. Soil carbon pool comprises of two components: SOC and soil inorganic carbon (SIC). The SOC pool includes highly active humus to relatively inert charcoal C. The SIC pool includes elemental C and carbonate minerals (e.g. gypsum, calcite, dolomite, aragonite and siderite).Soil organic carbon is an important attribute of soil quality and its productivity**.** Soils are among the largest terrestrial reservoirs of carbon and hold potential for expanded C sequestration. At the same time, this process provides other important benefits in terms of increased soil fertility and environmental quality. SOC is vital for ecosystem function, having a major influence on soil structure, water-holding capacity, cation exchange capacity, and the soils ability to form complexes with metal ions and to store nutrients (Van Keulen, 2001). Appropriate management of soils to increase SOC levels can therefore increase the productivity and sustainability of agricultural systems (Cole *et al,.* 1997).

Small changes in the soil organic carbon (SOC) stock could result in significant impacts on the atmospheric carbon concentration. Climate change is expected to have significant impacts on soil carbon dynamics (Schils *et al*., 2008, Conant *et al,.* 2011). Environmental change and carbon are intrinsically linked. When contained in greenhouse gases, carbon is a part of the problem. But in its organic form in the soil, carbon represents a major part of the solution. Sustainable land management (SLM) practices, such as mulching, zero tillage, green manuring and water harvesting, enhance soil carbon levels. Maximizing the potential return on investment in SLM practices requires a strategic, integrative approach across the efforts to respond to the grand environmental challenges of our time: climate change, land degradation and biodiversity loss.

Carbon cycle and soil carbon pools

SOC forms part of the natural carbon cycle. Organic material is manufactured by plants through the process of photosynthesis is, using atmospheric carbon dioxide and water as raw materials. The plants (and the animals as part of the food chain) eventually die and return to the soil where they are decomposed and recycled. Minerals are released into the soil and carbon dioxide back to the atmosphere. There is a continuous turnover of organic carbon materials in soil, and SOC is not a uniform material but rather a complex mixture of organic compounds at different stages of decomposition. Approximately ¾ carbon losses in the form of CO2 and reaming carbon involvein humification process and some part of C assimilated in microbes. When the carbon losses in the form of co2 more than 75% than it becomesdangerous for climate.

The top metre of the world's soils stores approximately 2 200 Gt of carbon, two-thirds of it in the form of organic matter (Batjes, 1996). This is more than three times the amount of carbon held in the atmosphere. However, soils are vulnerable to carbon losses through degradation. They also release greenhouse gases to the atmosphere as a result of accelerated decomposition due to land use change or unsustainable land management practices (Lal, 2010). Soil erosion associated with conventional agricultural practices can occur at rates up to 100 times greater than the rate at which natural soil formation takes place (Montgomery, 2007). Peatland drainage worldwide is causing carbon-rich peat to disappear at a rate 20 times greater than the rate at which the peat accumulated (Joosten, 2009).

What determines the global distribution of soil carbon?

The worldwide distribution of SOC reflects rainfall distribution, with greater accumulations of carbon in morereduced oxygen availability in wet soils slows the decomposition of SOM by soil microbes. Drier and well-aerated soils promote more rapid decomposition and accumulate less SOM. Where soil oxygen, soil moisture levels and nutrient status are sufficient, higher temperatures accelerate biological processes such as biomass production and decomposition, and therefore SOC dynamics (Batjes, 2011). That is why draining peatlands provokes a rapid oxidation of stored SOM and releases large amounts of CO2 to the atmosphere, especially in warmer climates. Similarly, conversion of natural grasslands or forests to tilled soils breaks up soil aggregates, produces better aeration, and thus increases the decomposition of SOM and releases of CO2, with higher rates occurring in warm climates. Scientists have shown that in arable agriculture "no-till" land management reduces carbon losses and enhances the potential for carbon sequestration.

Carbon dynamics in agricultural systems

Soil organic carbon (SOC) is the most often reported attribute and is chosen as the most important indicator of soil quality and agricultural sustainability. The different agricultural practices *viz.* cultivation, crop rotation, residue and tillage management, fertilization and monoculture affect soil quality, soil organic matter (SOM) and carbon transformation. Cultivation and tillage can reduce soil SOC content and lead to soil deterioration. Carbon dioxide emissions from agricultural systems occur from: (a) plant respiration; (b) the oxidation of organic carbon in soils and crop residues; (c) the use of fossil fuels in agricultural machinery such as tractors, harvesters and irrigation equipment; and (d) the use of fossil fuels in the production of agricultural inputs such as fertilizers and pesticides.

Carbon uptake occurs through photosynthesis. Carbon sequestration is represented by an increase in the stocks of carbon in any reservoir than the atmosphere. Proper adoption of crop rotation can increase or maintain the quantity and quality of soil organic matter, and improve soil chemical and physical properties. Adequate application of fertilizers combined with farmyard manure could increase soil nutrients, and SOC content. Manure or crop residue alone may not be adequate to maintain SOC levels. Crop types influence SOC and soil function in continuous monoculture systems. SOC can be best preserved by rotation with reduced tillage frequency and with additions of chemical fertilizers and manure. Accumulation of organic carbon in soil can occur following changes in management that either increase the production of residue remaining on the field or decrease the loss of organic carbon in the form of carbon dioxide (Marland *et al.,* 2003). Management options for sequestering soil organic carbon (SOC) include a decrease in tillage intensity, a change from continuous to rotation cropping, and a decrease in fallow period (Paustian *et al.,* 2000). We should focuson a change from conventional tillage (CT) to no-till (NT) agriculture. West and Marland (2002) reported by a variety of experiments that soil carbon can be increased by changing from CT to NT.

Importance of soil organic carbon in agriculture

Soil organic carbon is the basis of sustainable agriculture and soil fertility. Soil organic carbon is important for all three aspects of soil fertility, namely chemical, physical and biological fertility.

Nutrient availability: Decomposition of soil organic matter releases nitrogen, phosphorus and a range of other nutrients for plant growth.

Soil structure and soil physical properties: SOC promotes soil structure by holding the soil particles together a stable aggregates improves soil physical properties such as water holding capacity, water infiltration, gaseous exchange, root growth and ease of cultivation.

Biological soil health: **As** a food source for soil fauna and flora, soil organic matter plays an important role in the soil food web by controlling the number and types of soil inhabitants which serve important functions such as nutrient cycling and availability, assisting root growth and plant nutrient uptake, creating burrows and even suppressing crop diseases.

As a buffer against toxic and harmful substances:Soil organic matter can lessen the effect of harmful substances e.g. toxins, and heavy metals, by acting as buffers, e.g. sorption of toxins and heavy metals, and increasing degradation of harmful pesticides.

Cation Exchange Capacity: As CEC increases for a soil, it is able to retain more of these plant nutrients and reduces the potential for leaching. Soil CEC also influences the application rates of lime and herbicides required for optimum effectiveness. The stable fraction (humus) of SOM is the most important fraction for contributing to the CEC of a soil.

Nutrient Retention and Release: Humus has a highly negatively charged soil component, and is thus capable of holding a large amount of cations. The highly charged humic fraction gives the SOM the ability to act similarly to a slow release fertilizer. Over time, as nutrients are removed from the soil cation exchange sites, they become available for plant uptake.

CONCLUSION

Soil carbon management is an important strategy for improving soil quality, increasing crop yields, and reducing soil loss. Capturing carbon in the soil helps improve soil health and productivity, and stabilize the global carbon cycle, benefiting agricultural production and can help to mitigate climate change.Past long-term experimental studies have shown that soil organic C is highly sensitive to changes in land use, with changes from native ecosystems such as forest or grassland to agricultural systems almost always resulting in a loss of SOC. Therefore, we have the opportunity in the future to adopt sustainable land management strategies that lead to greater C storage in the soil, thereby mitigating GHG effects and improving soil fertility.

REFERENCES

Batjes, N.H. (1996). Total carbon and nitrogen in the soils of the world. European Journal of Soil Science, 47 (2), 151-163

Batjes, N.H. and Sombroek, W.G. 1997. Possibilities for carbon sequestration in tropical and sub tropical soils. Global Change Biology, 3 (2), 161-173.

Conant, R.T., Ryan, M.G., Ågren, G.I., Birge, H.E., Davidson, E.A., Eliasson, P.E., Evans, S.E., Frey, S.D., Giardina, C.P., Hopkins, F.M., Hyvönen, R., Kirschbaum, M.U.F., Lavallee, J.M., Leifeld, J., Parton, W.J., Megan Steinweg, J., Wallenstein, M.D., Wetterstedt, J.Å.M. and Bradford, M.A. (2011). Temperature and soil organic matter decomposition rates synthesis of current knowledge and a way forward. Global Change Biology, 17, 3392-3404.

Cole, C.V., Duxbury J., Freney J., Heinemeyer, O., Minami, K., Mosier, A., Paustian, K., Rosenburg, N., Sampson, N., Sauerbeck, D. and Zhao, Q.(1997). Global estimates of potential mitigation of greenhouse gas emissions by agriculture. Nutrient Cycling in Agroecosystems, 49 (1-3), 221-228.

Joosten, H. 2009. The Global Peatland CO2 Picture. Peatland status and drainage associated emissions in all countries of the World. Wetlands International, Ede, the Netherlands.

Lal, R. (2010). Managing Soils and Ecosystems for Mitigating Anthropogenic Carbon Emissions and Advancing Global Food Security. BioScience 60(9), 708-721.

Marland, G., West, T. O., B. Schlamadinger and Canella, L. (2003). Managing soil organic carbon in agriculture: the net effect on greenhouse gas emissions. Tellus , 55B, 613–621.

Montgomery, D.R. (2007). Soil erosion and agricultural sustainability. Proceedings of the National Academy of Sciences, 104, 13268-13272

Paustian, K., Six, J., Elliott, E. T. and Hunt, H. W. (2000). Management options for reducing CO2 emissions from agricultural soils. Biogeochem. 48, 147–163.

Post, W.M., Emanuel, W.R., Zinke, P.J. and Stangenberger, A.G. (1982). Soil carbon pools and world life zones. Nature. 298, 156-159.

Schils, R., Kuikman, P., Liski, J., Van Oijen, M., Smith, P., Webb, J., Alm, J., Somogyi, Z., Van den Akker, J., Billett, M., Emmett, B., Evans, C., Lindner, M., Palosuo, T., Bellamy, P., Jandl, R. and Hiederer, R. (2008). Review of existing information on the interrelations between soil and climate change (ClimSoil). Final report. Brussels, European Commission.

Van Keulen, H. (2001). (Tropical) soil organic matter modelling: problems and prospects. Nutrient Cycling in Agroecosystems 61(1-2): 33-39.

West,T.O.andMarland,G.(2002).Asynthesisofcarbonsequestration,carbonemissions,andnetcarbon fluxinagriculture: comparing tillage practices in the United States. Agric. Ecosys. Environ. 91, 217–232

Advancement Of Somatic Embyogenesis In Cotton

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There are four domesticated species of the cotton, two tetraploid species from Americas, *Gossypiumhirsutum*and *G. barbadense,* and two diploidspeciesfrom Africa-Asia, namely *G. arboretum and G. herbaceum.* Of the four species, *G. hirsutum*(upland cotton) has dominated the world cotton commerce, being responsible for 95% of the annual cotton, with approximate annual plantation of 35 million ha worldwide and grown in over 50 countries. Since cotton is highly susceptible to biotic and abiotic stresses, it requires intensive crop management. Although conventional breeding programmes have made steady improvement in agronomic traits, not much genetic diversity exists for further improvement. However, transformation techniques have provided ample scope for introduction of foreign genes in cotton, which involves the efficient regeneration system.Regeneration through somatic embryogenesis over organogenesis is preferred because of single cell origin of the somatic embryos and thus reducing the chimeric transformation event. *In vitro* cultured cotton cells have been induced to undergo somatic embryogenesis in numerous laboratories using varied strategies, after first one was reported by Price and Smith in 1979 (Zhang *et al.,* 2001 and Sun *et al.,* 2004).

Although regeneration efficiency via somatic embryogenesis has been improved, problems remained are:- High frequency of abnormal embryo development, the excretion of secondary metabolites from the explant to the medium and low maturation and conversion rate of somatic embryos into plantlets.

Somatic embryogenesis:

Direct Somatic embryogenesis:

Cells or explant directly undergoes embryogenesis in absence of callus proliferation

Indirect Somatic embryogenesis:

Cells or explant first undergo callus proliferation and embryoids develop within the callus tissue

Step for Somatic embryogenesis

1.Callus initiation
2. Callus proliferation
3. Selection of embryogeniccalli
4. Somatic embryo induction
5. Somatic embryo development
6. Maturation of somatic embryos
7. Germination of somatic embryos
8. Hardening and transfer to soil

Factors affecting callus initiation

1. Source of explant and its physiological condition
2. Type of explants
3. Media used
4. Plant Growth regulators
5. Nitrogen source

Maturation of Somatic Embryo

Maturation of embryos refers to their physiological capacity to follow proper germination. It is the terminal event of embryogenesis and characterized by the attainment of mature embryo morphology and sometimes rapid growth continues to occur leading to precocious germination.

Embryo germination and plant recovery

Obtaining cotton plants from somatic embryos is often more difficult than would be expected due to low and abnormal germination. Early literature concerning reports of somatic embryogenesis in cotton did not include detail data on plant recovery except of Trolinder and Goodin (1987).

Synthetic seed

Synthetic seed can be defined as the artificial encapsulation of somatic embryo, shoot buds or aggregates of cell or any tissues which has the ability to form a plant in in-vitro or ex vivo condition. Synthetic seeds can be stored for a long time in appropriate condition. Synthetic seed production and used technology is rapidly growing branch of seed biotechnology. Toshio Murashige in 1970 first coined the term synthetic seed.

Steps for production of synthetic seed

1. Explant is selected from choice of plant
2. In a laboratory using tissue culture techniques callus is induced in the explants.
3. Using tissue culture techniques somatic embryo is induced in the callus.
4. Somatic embryo are proliferated
5. Histodifferentiation and maturation of somatic embryo
6. Desiccation and tolerance induction using tissue culture techniques.
7. Encapsulation of somatic embryo
8. Invitro germination or transported to field for germination.

CONCLUSIONS

Somatic embryogenesis in cotton has been induced from callus obtained from cotyledons, stems, roots, petioles and hypocotyls. However, the best response has been obtained from hypocotyls. Regeneration in *Gossypium* remains largely cultivar/genotype dependent. Somatic embryogenesis can be induced in two ways *viz.,*Direct somatic embryogenesis and Indirect somatic embryogenesis. MS media with Gamborg (B5) vitamins gave better callus initiation. Embryogeniccalli can possibly be identified on the basis of callus morphology and cytology. Among various auxins, NAA recorded greater embryogenic response. In general, explant derived from immature tissues produce embryos more easily.Nitrate as a source of nitrogen in the medium is found beneficial for somatic embryogenesis. Liquid culture step is helpful for embryogenic developmental processes.Vermiculite is helpful for germination of embryos and plantlet recovery.

REFERENCES

Price, H.J. and Smith, R.H. (1979). Somatic embryogenesis in suspension cultures

*Gossypiumklotzschienum.Andress. Planta.,***145**(3):305-307.

Trolinder Norma L and Goodin J. R. (1987). Somatic embryogenesis and plant regeneration in cotton *Gossypiumhirsutum*L. *Plant Cell Rep.,* **6:** 231-234.

Sun Yuqiang, Zhang Xianlong, Jin Shuangxia, Liang Shaoguang&NieYichun. (2004). Somatic embryogenesis and plant regeneration in wild cotton (*Gossypiumklotzschianum). Plant cell, tissue and organ culture*. **75:** 247-253.

Zhang, B.H.; Feng, R.; Liu, F.; Wang, Q. (2001). High frequency somatic embryogenesis and plant regeneration of an elite Chinese cotton variety. *Bot. Bull. Acad. sin.,***42**: 9-16.

Mulberry: The Super Fruit

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Mulberry is a kind of nourishing tonic medicine that can broadly be used to cure some debility symptoms when used with other restoratives. The person, who has symptoms such as anemia, dizziness, or low libido, can take a tonic to build up health with mulberry. Wine made by immersing the mulberry in rice wine or grape wine, is a medicament for weakness after diseases that can also be used to tonify masculine vitality and benefit overall vitality. Mulberry can nourish and promote production of body fluid. The person who has body fluid deficiency often feels their mouth parched and tongue scorched. When mulberry is ripe in the summer, a person can take one ounce every day. This product has a faint scent and sweet taste, suitable for people of all ages. Brew water to take the dry fruit, using 10 grams each time. The person who has dry eyes and uses their eyes a lot during work can drink mulberry juice, which can nourish the body fluid and strengthen sight.

Mulberry contains plentiful nutritious elements, such as minerals and vitamins; it can cure chronic diseases of the digestive tract, promote gastric juice secretion, strengthen the ability for digesting and assimilating, improve the appetite, and eliminate abdominal distention and constipation. Mulberry is suitable also for chronic gastritis and chronic hepatitis. Mulberry has the function of nourishing blood. If the person who has anemia, pallor, dizziness, insomnia, and heart-palpitations regularly takes mulberry juice, they will experience good effects. Women who have the above symptoms after childbirth, or anyone after a long-time sickness or after a major operation, can take mulberry frequently as a restorative. Compounding Those who experience premature aging, such as graying hair and impotence, can take mulberry often. The pill, electuary, and wine all have high efficacy. The effect will be better for blackening hair and beautifying when it is combined with other herbs like Indian gooseberry, green tea, etc. The mulberry juice can also be applied topically to the head to promote healthy hair growth.

HEALTH BENEFITS OF MULBERRIES

- Mulberry fruit contains some nutrients (e.g., small amounts of calcium, iron, vitamin C, and B-vitamins), the anthocyanins improve blood circulation and other body functions to alleviate some symptoms that arise under the conditions like anemia, constipation, premature graying of hair, etc.

- Delicious, fleshy, succulent mulberries are low in calories; but are rich source of many health promoting plant derived compounds, minerals and vitamins that are essential for optimum health.
- Mulberries have significantly high amounts of phenolic flavonoid phytochemicals called **anthocyanins**. Scientific studies have shown that consumption of berries have potential health effects against cancer, aging and neurological diseases, inflammation, diabetes, and bacterial infections
- The berries contain **resveratrol**, another polyphenol flavonoid antioxidant. Resveratrol has been found to be protective against stroke risk by alteration of molecular mechanisms in blood vessels, reducing susceptibility to vascular damage through decreased activity of angiotensin (a systemic hormone causing blood vessel constriction that would elevate blood pressure) and increased production of the vasodilator hormone, nitric oxide.
- In addition, these berries are an excellent source of vitamin-C, which is also a powerful natural antioxidant. Consumption of foods rich in vitamin-C helps body develop resistance against infectious agents, counter inflammation and scavenge harmful free radicals.
- They also contain good amount vitamin A, vitamin E and in addition to the above mentioned antioxidants also contain many other health promoting flavonoid poly phenolic antioxidants such as*lutein, zeaxanthin, ß-carotene* and *α-carotene* in small but notably significant amounts. These compounds help act as protect from harmful effects of oxygen-derived free radicals and reactive oxygen species (ROS) that play a role in aging and various disease process.
- **Zeaxanthin**, an important dietary carotenoid selectively absorbed into the retinal macula lutea where it is thought to provide antioxidant and protective light-filtering functions in the retina of eyes.
- Mulberries are excellent source of iron, which is a rare feature among berries, contains. Iron, being a component of hemoglobin inside the red blood cells, determines the oxygen carrying capacity of the blood.
- They also good source of minerals like potassium, manganese, and magnesium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase.*
- They are rich in B-complex group of vitamins and vitamin K. Contain very good amounts of vitamin B-6, niacin, riboflavin and folic acid. These vitamins are function as co-factors and help

body in the metabolism of carbohydrates, proteins and fats.

- Mulberry contains phytosterols, which are cholesterol-lowering agents. While most studies have been done on Mulberry's effect on blood sugar, the studies have also found that serum cholesterol levels dropped after continous consumption of mulberry.

The dominant taste of the ripe fruit is sweet but usually somewhat bland, due to the high water content and low level of other flavoring ingredients, but a richer flavor develops if the fruit is dried; it can then be used as a raisin substitute. Mulberries contain important nutrients that may improve your health. Nutrients in mulberries include protein and carbohydrates as well as vitamins and minerals such as calcium, phosphorus, potassium, magnesium, carbohydrates, and iron. Mulberries also contain fiber. Its high water content keeps it relatively low in calories. Use of mulberry as a herb therapy (as complex formulas) may address a health problem by using a group of several herbs that have a similar end effect, but with different active components and different mechanisms. For example, a formula comprised of mulberry fruit, Indian goose berry, similar other berries may nourish blood, alleviate constipation, and have antioxidant, antiaging effects. Together, these may reduce adverse oxidative reactions, enhance circulation, alleviate inflammatory processes that yield systemic consequences, and improve the digestion and absorption of nutrients while enhancing the elimination of waste products of metabolism. In recent years, with considerable work on cultivating the mulberry plants under various conditions, mulberry fruit juice has been commercially produced as a health beverage, and it has become very popular all around the world. Use of mulberry leaf extract, mulberry leaf powder, dried mulberry fruit is gaining wide popularity among the masses.

Silage: A boon for fodder scarcity

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The success of livestock industry is mainly depending on feed and fodders. It is well known fact that about 60-65% expenses are incurred on feed and fodder only. Due to ever increasing cost of concentrate feed it would not be affordable to the farmers to include the concentrate for feeding of the animals to get maximum benefits from livestock products. Therefore successful dairying and goat farming it is utmost essential to include the green fodders in feeding system. Unfortunately there is a acute shortage of green fodders due to vary less area under cultivation of fodder crops (4.7% of total cultivatable area). Also due the large number of marginal and small farmers, whose main intention of subsistence cannot allowed the land specially forage cultivation lead to the fodder shortage. Due to which the productivity of the animal is very low. The shortage of green fodder is aggravated during the drought condition which we have witness since last two to three years. Under such circumstances silage could be the one of the alternatives to have a regular supply of green forage throughout the year.

Silage means preservation of green fodder without loss of nutrients under anaerobic or air tight condition and it is also called as pickle of green fodder. Generally during the rainy season there is ample quantity of green grasses are available almost all parts of the country. Such green grasses if cut, chaffed and stored in air tight condition during the post monsoon period it will be a source of nutrition in the form of silage during the lean period.

STEPS OF SILAGE OF SILAGE MAKING

1. **Selection of crop** – Generally fodder cereal crops like maize, jowar, bajra, oat, napier, hybrid napier and other grasses which are rich in carbohydrate are proffered for silage making. If the poor quality grasses like paragrass, guinea grass and other locally available fodder grasses are selected for silage making then 2% urea solution can be used as an additive to improve its quality.
2. **Harvesting of crop –** Crop should be harvested at pre flowering stage to get maximum nutrition in silage material. If it is delayed then the quality of the silage will be poor.
3. **Drying of crop –** After cutting the crop should be dried atleat for 1 -2 days to have moisture content 55-60%.

4. **Chaffing –** After proper dying the crop should be chaffed 2-3cm pieces with the help of chaff cutter, to prevent 30% wastage of green fodder.
5. **Filling of the silo pit** – Various structures are used for storage of silage material depending upon the availability of the green fodders, number of animals and availability of labours. Bunker silo is popular silo pit which is constructed with the bricks and cement etc. On an average one cubic feet of silo pit can store about 18-20 kg of green fodder material. This structure is used when there is a ample quantity of green fodder, more number of animals and more labour. While filling the silo pit the chaffed material should be distributed evenly and pressed or trampled constantly to remove the air from the pit.

The small, marginal and landless farmers those who are having 3-4 animals can prepare the silage by using various sizes of the plastic bags. About 500-700 kg of green fodder material can be stored in such plastic bags. So, 10 such plastic bags are sufficient to store the green fodder material in the form of silage for feeding of 3-4 animals. This technology is becoming popular among the small farmers because, it is cheap, not laborious and convenient to filling and transporting the silage material.

6. **Sealing of silo pit –** After completion of filling of the bunker silo pit it should be sealed properly with the help of earth and cow dung slurry to prevent entry of water and air inside the structure.
7. **Opening of silo pit –** Silage becomes ready for feeding of the animal within 60-65 days however, by using culture it becomes ready within 35-45 days. If there is a no scarcity of the fodder than silo pit can be kept as such for several years. Once it is opened then it should be finished within 10-15 days. Also the required quantity can be removed for feeding of the animals and the pit should be closed as earlier process with remaining quantity in the pit. Generally when colour of silage material changes from green to golden yellowish colour then it is assumed that it is prepared. Also it gives pleasant aroma like ripening of fruit.

Bunker silo & Plastic bag for silage

COMPOSITE SILAGE

When cereal crops rich in carbohydrate and legume crops rich in protein are cut, chaffed and stored together under anaerobic condition is called composite silage. For getting the good nutritive quality of the silage it is advocated that about 70-80% green fodders belong to cereal group such as maize, jowar, bajra and 20-30% should be from legume fodders such as cowpea, lucerne, berseem etc. Inclusion of cereals in large quantities is the pre requisite because they contain more CHO, which is essential for the formation of lactic acid, butric acid, and acetic acid during the decomposition which helps to maintain the keeping quality of the silage. Otherwise inclusion of large quantities of legumes may decay the silage material.

Table 1: Nutritive analysis of silage

Sr. No	Parameter (%)	DHN-6 fodder	Maize bran	Composite silage
1	Moisture	62.74	61.21	60-70
2	Crude protein	9.03	7.65	8.8-12.09
3	Ether extract	0.86	3.07	1.3-3.3
4	Crude fiber	27.80	15.24	17-26
5	Total Ash	9.55	2.03	6-8
6	NFE	52.76	71.11	48-60

Handling Of Livestock and Livestock Products for Marketing

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Fresh meat is a highly perishable good and prone to spoilage, must be treated with utmost care for consumer protection. Meat must be produced, transported, stored and marketed under hygienic conditions. Often fresh meat is shipped from one region around the globe to markets with higher demands. Industrial meat processors, when faced with a shortage of raw meat materials, are able to import large quantities of frozen meat trimmings from around the world for further processing. In industrialized countries fresh meat is mostly generated in modern slaughter facilities and an uninterrupted cold chain is applied during cutting, transportation and marketing. Meat inspection and quality control procedures are put in place and implementation is monitored by Government authorities. Depending on the location, basically two different marketing systems can be observed.

FRESH MEAT

In rural settings of industrialized countries, the whole meat marketing chain is often covered by traditional butcheries selling fresh meat produced in the immediate surroundings, thus avoiding long supply chains. In urban centres and industrial areas, the number of small butcheries selling their own produce directly to consumers decreased substantially over the last decades. With growing populations and increasing demands for meat, better suited marketing systems were needed. Modern supermarket outlets took on this role. Such high volume meat production and trade require stringent quality control systems to avoid health hazards for the consumers.

A fast industrialization process took place joined by a concentration of urban population and the development of mega cities, serious problems in food supply emerged. Serious health hazards for consumers can emerge. In recent years, supermarkets are emerging in such areas, but prices may be higher and meat is often not affordable to lower income groups.

In developing countries with agricultural based economies, fresh meat is still mainly distributed through traditional wet markets or simple meat stalls. These wet markets and meat stalls are often attached to slaughter places or in the proximity of rural slaughter facilities and in the absence of functional cold chains, fresh meat is purchased in the early morning and cooked and consumed the same day. In all above mentioned cases, strict regulations on meat hygiene and safety must be applied. In order to facilitate the efforts of Governments and regional and international authorities, FAO and WHO have established the Codex Alimentarius. The various codes are frequently updated and availed to authorities as guidelines for the establishment of appropriate food safety regulations.

Milk

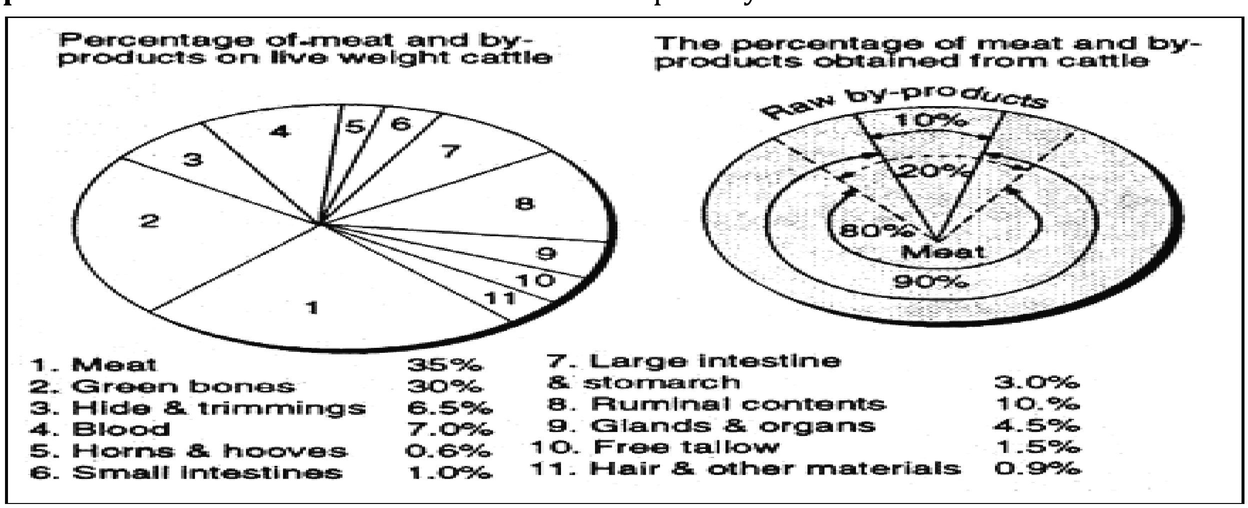
Marketing of milk is particularly difficult for small-scale producers scattered in rural areas throughout the developing world. The logistics of moving small quantities of a perishable commodity are covered in collection but the marketing aspects require organisational and technical skills and an understanding of quality and safety issues. Choice of product and technologies must be suited to the scale and location of the operation, while the price, promotion and packaging must meet local requirements.

The economic importance of animal by-products:

Collaborative programmes for training informal market operators have been carried out and guidelines for organising producer marketing groups and improving quality and packaging are being developed and disseminated. The aim is to ensure that milk and dairy products marketed by small traders are wholesome as well as affordable. Because imports are important in many developing countries, information on markets and specifications are included.

Livestock production and marketing

At the household level, livestock plays a critical economic and social role in the lives of pastoralists, agro-pastoralists, and smallholder farm households. Livestock fulfills an important function in coping with shocks, accumulating wealth, and serving as a store of value in the absence of formal financial institutions and other missing markets. This implies that, given the economic growth in Ethiopia and the region, the market demand for livestock and livestock products is likely to continue growing in the future. The government recognizes the importance of livestock in poverty alleviation and has increased its



emphasis on modernizing and commercializing the livestock sub-sector in recent years.

CONCLUSION

Focusing on four key livestock classes—cattle, sheep, goats, and chicken—this chapter undertakes three tasks: (1) it provides a characterization of the livestock subsector, (2) it assesses livestock and livestock product value chains based on primary data, and (3) analyzes the trends in marketing and trade of live animals and animal products. Carrying out these tasks relies on the critical review of existing literature and policy documents, as well as extensive use of both secondary and primary data, including household and traders' surveys.

Importance of Genomic Selection and Genetic Association Study For Livestock Improvement

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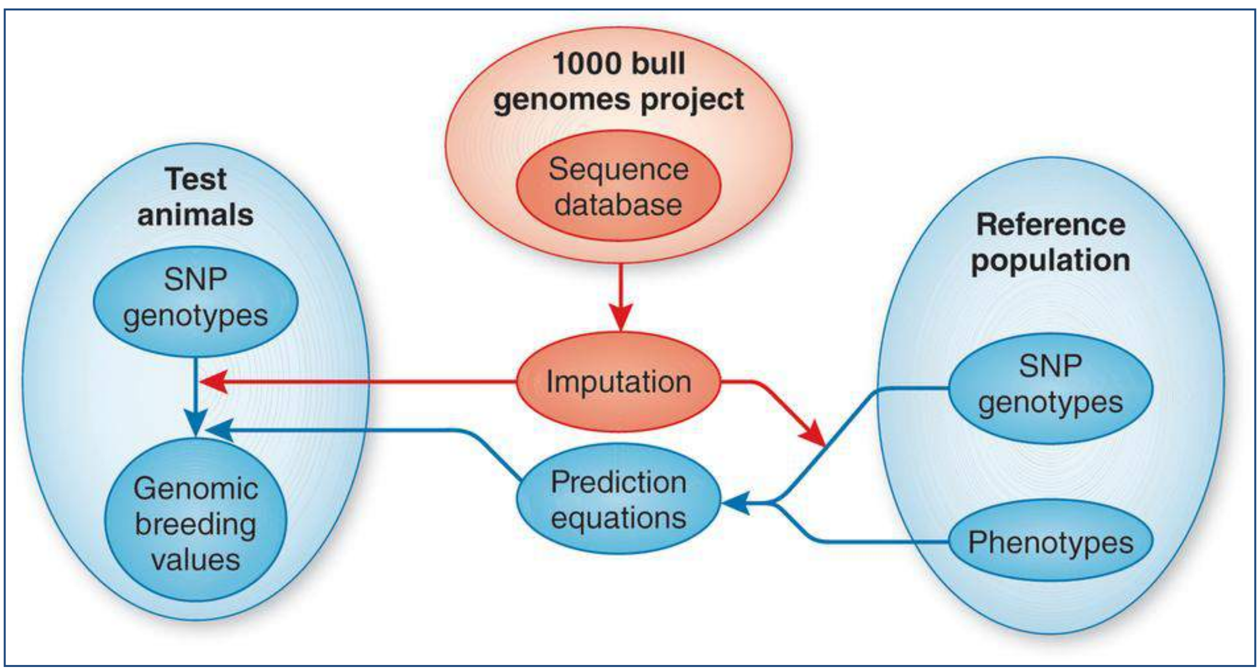
GENOMIC SELECTION (GS)

GS is the selection of an individual based on the molecular breeding value approaches assessed through evaluating all the genetic markers which is located throughout the genome of that individual.

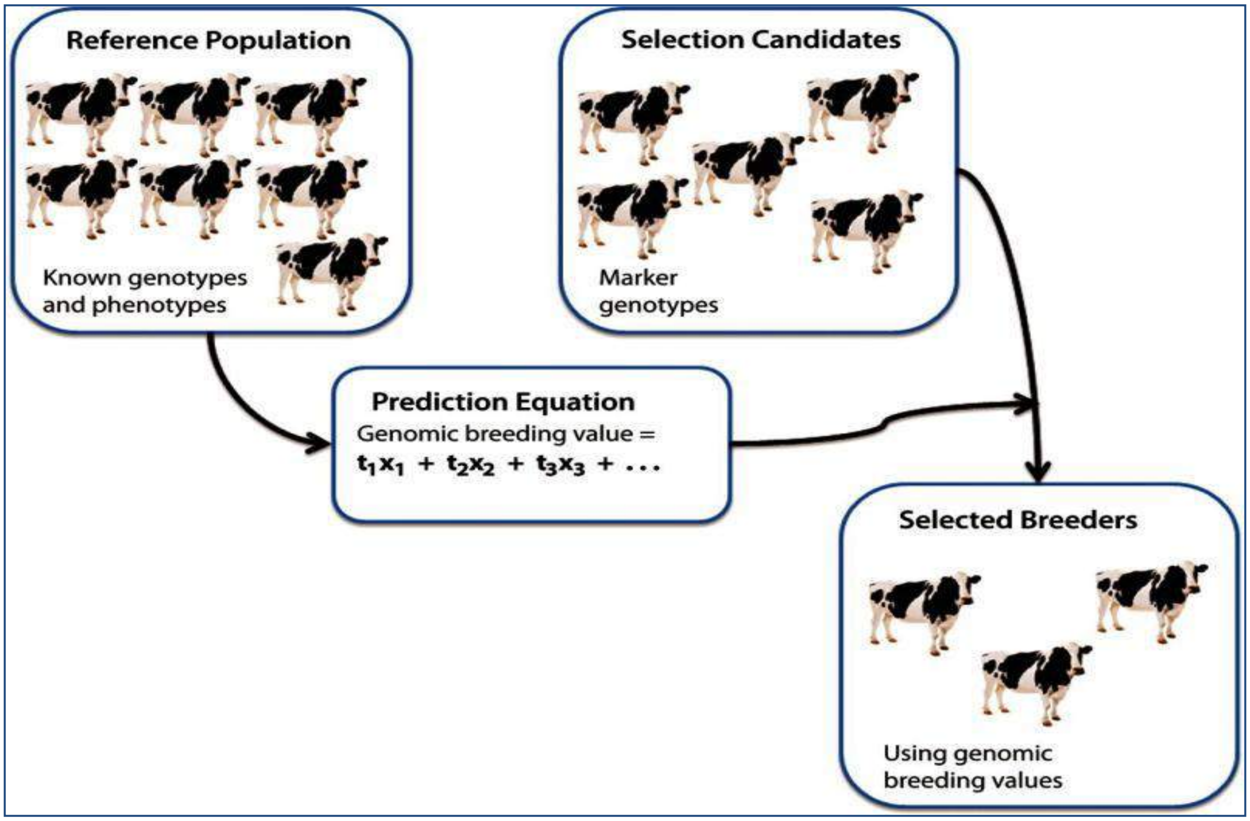
Sequence-based genomic selection of cattle:

Genomic selection is new method to traditional marker-assisted selection where selection are created based on few markers. As compared to identify individual loci significantly associated with a complex trait, genomics uses all marker data as predictors of performance.

PRINCIPLE OF GENOMIC SELECTION:



principle that genotypes can be compared "directly" .



Selection is mainly used for genomic selection predictions, which help to more rapid and lower cost gains from breeding. Genomic prediction combines marker data with pedigree data help to increase the accuracy of the prediction of breeding and genotypic values.

GENETIC ASSOCIATION STUDY (GAS)

GAS is the analysis of a sequence such as a region of a chromosome or a gene for its involvement in controlling the phenotype of a specific trait or disease. GAS of genetic association aims to test whether single-locus alleles or genotype frequencies, differ between two groups of individuals (such as diseased subjects and healthy controls). Genetic association studies are mainly the

Genetic association can be between phenotypes, between a phenotype and a genetic polymorphism. Association between genetic polymorphisms occurs due to non-random association of their alleles. Most of genetic variation in the human genome is in the form of SNPs mainly which is due to point mutations that produce single base-pair differences among chromosome sequences. GWAS have become an important tool for discovering susceptibility genes for complex diseases.

CONCLUSION

Information like genotype frequencies, linkage disequilibrium (LD), and recombination rates, across populations help use to conduct GWA analysis using millions of SNP markers. Linkage disequilibrium (LD) is the study of population genetics for the non-random association of alleles at two or more loci. LD indicates a situation in which the genetic markers occur more or less frequently in a population than would be expected from a random formation of haplotypes from alleles based on their frequencies. Genetic association studies are used to determine whether a genetic variant is associated with a disease or trait: if association is present, a particular allele, genotype polymorphisms will be seen more often than expected by chance in an individual carrying the trait.

Concept of climate change and impact on livestock production and reproduction

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Abstract

Animal agriculture is the major contributor to increasing methane (CH_4) and nitrous oxide (N_2O) concentrations in Earth's atmosphere. Generally, there are two-way impacts of livestock on climate change. The first part is the livestock contribution to climate change, while the second part is concerned with livestock getting affected by climate change. Hence, improving livestock production under changing climate scenario must target both reducing greenhouse gas (GHG) emission from livestock and reducing the effect of climate change on livestock production. These efforts will optimize livestock production under the changing climate scenario. The role of livestock on climate change is primarily due to enteric CH_4 emission and those from manure management. Adapting to climate change and reducing GHG emissions may require significant changes in production technology and farming systems that could affect productivity. Many viable opportunities exist for reducing CH_4 emissions from enteric fermentation in ruminant animals and from livestock manure management facilities. The direct impacts of climate change on livestock are on its growth, milk production, reproduction, metabolic activity, and disease occurrences. The indirect impacts of climate change on livestock are in reducing water and pasture availability and other feed resources. It is important to understand the livestock responses to the environment and analyze them, in order to design modifications of nutritional and environmental management, thereby improving animal comfort and performance.

INTRODUCTION

Livestock production is the world's dominant land use, covering about 45 % of the Earth's land surface, much of it in harsh and variable environments that are unsuitable for other uses. Climate change could impact the amount and quality of produce, reliability of production, and the natural resource base on which livestock production depends. Climate is an important factor of agricultural productivity. The changing climate is expected to have severe impact on livestock production systems across the world. World demand for animal protein will rise as the population and real incomes increase and eating habits change. Therefore, animal production plays and will continue to play a key role in food supply. While the increasing demand for livestock products offers market opportunities and income for small, marginal, and landless farmers. Livestock production globally faces increasing pressure because of negative environmental implications particularly because of greenhouse gas (GHG) emission. Global climate change is expected to alter temperature, precipitation, atmospheric carbon dioxide (CO_2) levels, and water availability in ways that will affect the productivity of crop and livestock systems. Climatic changes could increase thermal stress for animals and thereby reduce animal production and profitability by lowering feed efficiency, milk production, and reproduction rates. Environmental stress reduces the productivity and health of livestock resulting in significant economic losses. Heat stress affects animal performance and productivity of dairy cows in all phases of production. Heat stress also negatively affects reproductive function (Amundson *et al.* 2006). Normal estrus activity and fertility are disrupted in livestock during summer months. As a result of negative weather impact on livestock rearing, the poor shepherds/farmers whose principal livelihood security depends on these animal performances are directly on stake. Housing and management technologies are available through which climatic impacts on livestock can be reduced, but the rational use of such technologies is crucial for the survival and profitability of the livestock enterprise. The livestock sector has been much maligned since the publication of *Livestock's Long Shadow* by FAO (2006) and the allegation that the industry contributes more to climate change than the automobile industry does. However, the real relationship between livestock and climate change is much more complex. Livestock play a critical role in rural poverty reduction; therefore, livestock development is vital for farmers in developing world in particular.

GHG EMISSION AND CLIMATE CHANGE

Increases in the concentrations of GHGs will reduce the efficiency with which the Earth's surface radiates to space. More of the outgoing terrestrial radiation from the surface is absorbed by the atmosphere and reemitted at higher altitudes and lower temperatures. These result in a positive radiative forcing that tends to warm the lower atmosphere and surface. Because less heat escapes to space, this is the enhanced greenhouse effect – an enhancement of an effect that has operated in the Earth's atmosphere for billions of years due to the presence of naturally occurring GHGs: water vapor, carbon dioxide (CO_2), ozone, methane (CH_4), and nitrous oxide (N_2O). Different GHGs have differing abilities to warm the atmosphere. Any changes in the radiative balance of the Earth, including those due to an increase in GHGs or in aerosols, will alter the global hydrological cycle and atmospheric and oceanic circulation, thereby affecting weather patterns and regional temperatures and precipitation

DIFFERENT SOURCES OF GHGS

There are two ways that GHGs enter Earth's atmosphere. One of them is through natural processes like animal and plant respiration. The other is through human activities. The main human sources of GHG emissions are fossil fuel use, deforestation, intensive livestock farming, use of synthetic fertilizers, and industrial processes. There are four main types of forcing GHGs: CO_2, CH_4, N_2O, and fluorinated gases. The main feedback of GHG is water vapor. The GHGs are (1) carbon dioxide – accounts for around three-quarters of the warming impact of current human GHG emissions. The key source of CO_2 is the burning of fossil fuels such as coal, oil, and gas, though deforestation is also a very significant contributor. (2) Methane – accounts for around 14 % of the impact of current human GHG emissions. Key sources of CH_4 include agriculture (especially livestock and rice fields), fossil fuel extraction, and the decay of organic waste in landfill sites. Methane doesn't persist in the atmosphere as long as CO_2, though its warming effect is much more potent for each gram of gas released. (3) Nitrous oxide – accounts for around 8 % of the warming impact of current human GHG emissions. Key sources of N_2O include agriculture (especially nitrogen-fertilized soils and livestock waste) and industrial processes. N_2O is even more potent per gram than methane.

AGRICULTURAL CONTRIBUTION TO CLIMATE CHANGE

Modern agriculture and food production and distribution are major contributors of GHGs. Agriculture is directly responsible for 14 % of total GHG emissions, and broader rural land use decisions have an even larger impact. Deforestation currently accounts for an additional 18 % of emissions, Agriculture has significant effects on climate change, primarily through the production and release of GHGs such as CO_2, CH_4, and N_2O. Further, alterations in land cover can change its ability to absorb or reflect heat and light, thus contributing to radiative forcing. Land use changes such as deforestation and desertification together with fossil fuels are the major anthropogenic sources of CO_2. In addition, animal agriculture is the major contributor to increasing CH_4 and N_2O concentrations in the Earth's atmosphere. The global food system, from fertilizer manufacture to food storage and packaging, is responsible for up to one-third of all human-caused GHG emissions. The global release of CH_4 from agricultural sources accounts for two-thirds of the anthropogenic CH_4 sources. These sources include rice growing, fermentation of feed by ruminants (enteric CH_4), biomass burning, and animal wastes. CH_4 is a potent GHG, and its release into the atmosphere is directly linked with animal agriculture, particularly ruminant production (Sejian*et al*. 2012). Apart from this, livestock wastes also contribute enormously to the agricultural sources of CH_4 and N_2O.

IMPACT OF CLIMATE CHANGE ON LIVESTOCK PRODUCTION

Impact on growth:

It is known that livestock that are exposed to highambient temperatures augment the efforts to dissipatebody heat, resulting in the increase of respirationrate, body temperature, and consumptionof water and a decline in feed intake (Marai*et al*. 2007). Apart from feedintake, feed conversion also significantlydecreases after exposure to heat stress. Exposure of the animal to a highenvironmental temperature stimulates the peripheralthermal receptors to transmit suppressivenerve impulses to the appetite center in the hypothalamusand thereby causes a decrease in feedintake (Marai*et al.*2007). The decrease in feedintake could be due to the adaptive mechanism ofanimal to produce less body heat. Growth, theincrease in the live body mass or cell multiplication,is controlled both genetically and environmentally(Marai*et al*. 2007). Elevated ambient temperature is considered to be one of the environmental factors influencing growth and average daily weight gain in livestock. The reason for the effects of elevated ambient temperature on growth reduction could be due to the decrease in anabolic activity and the increase in tissue catabolism (Marai*et al*. 2007). The increase in tissue catabolism could be attributed to the increase in catecholamines and glucocorticoid after exposure to heat stress in livestock.

Impact on milk production:

The effect of elevated temperature on milk productionis probably most deleterious for any animal production system which forces animal toreduce feed intake, resulting in lowered milk yield. The heat stress not only decreases the milk yield in the animals but it also drastically affects the quality of milk (Bernabucci and Calamari 1998). Apart from high temperature, humidity is also an important factor influencing milk yield in the animals. The decreases in milk production can range from 10 to >25 %. As much as 50 % reduction in milk yield can be due to reduced feed intake during thermal stress, and other 50 % might depend on heat-related lactogenic hormone fluctuations (Johnson 1987). Besides the thermal stress, the decline in milk yield is also dependent upon breed, stage of lactation, and feed availability (Bernabucci and Calamari 1998). The effect of heat stress is more in high-yielding cow as compared to low-yielding cow. Milk fat, milk protein, solid not fat (SNF), and total solid percentages were lower in the summer season in dairy cows. Thermal stress also appears to bring about some decrease in percentage of lactose and acidity in the milk which in turn affects the milk freezing point. In addition to this, the heat stressexposed animals' milk has lower value of calcium (Ca), phosphorus (P), and magnesium (Mg) and high chloride (Bernabucci*et al*. 2013). In heat-stressed cow, the proportion of short-chain (C4–C10) and medium-chain (C12–C16) fatty acids are low, while long-chain fatty acid (C17–C18) are more in milk (Bernabucci*et al*. 2013). These changes in the fatty acid chain may be due to reduced synthesis of these free fatty acids (FAA) in the mammary glands as well as due to negative energy status of the cow exposed to thermal stress. Heat stress also has a negative impact on the milk casein (α- and β-casein). The lower content of α- and β-casein tends to increase the pH of milk and lower P content, during the summer months (Kume*et al*. 1989).

Impact on reproduction:

Reproductive axis is one plane where stresseffects are the most pronounced and have grosseconomic impact. Livestock farmers in arid andsemiarid environment primarily depend on theirlivestock for their livelihood security. The keyconstraints in arid and semiarid tropical environment are their low biomass productivity, high climatic variability, and scarcity of water (Sejian, 2013). All these constraints make these regions a major challenge for sustainable livestock production. In particular, the reproductive potential of livestock in these areas is influenced by the exposure to harsh climatic conditions, namely, high ambient temperature, and long-distance walking in search of food and water resources. It is an established fact that reproduction processes are influenced during thermal exposure in ruminant species and glucocorticoidsare paramount in mediating the inhibitory effects of stress on reproduction (Kornmatitsuk*et al.*2008). Heat stress significantly reduces the level of primary reproductive hormone estradiol. Thermal stress influence on estrous incidences and embryo production is a well-established fact (Sejian*et al*. 2013). In the changing scenario of climate change, thermal stress along with feed and water scarcity is the major predisposing factor for the low productivity of ruminants under hot semiarid environment. Livestock grazing under hot semiarid environment face extreme fluctuations in the quantity andquality of feed on offer throughout the year (Martin *et al.*2004). Undernutrition affects reproductive function in ruminants at different levels of the hypothalamic-pituitary-gonadal axis (Chadio*et al.*2007). Nutrient deficiency that results following reduced feed intake after heat exposure potentially acts on the reproductive process and affects estrusbehavior and ovulation rate.

Impact on pasture and feed availability for livestock:

Climate change and associated environmentalstress such as drought, high/low temperature,ozone, elevated CO_2, soil water logging and salinity affect the pasture and forage availabilityto livestock. Collectively,stresses may reduce the harvested forage yield,alter its nutritive value and change species composition of the sward. The most important impacts of climate changeon grazing lands will likely be through changes in both pasture productivity and forage quality. In warmer climates, increased heat stress and increased evaporative demand would likely have negative effects on pastures (Cobon and Toombs 2007). Further, drought, an environmental stress with periods of limited or no water during the growing season reduces forage production for grazing and haymaking.Prolonged drought forces livestock andhay producers to better manage their fields to minimize recovery after the drought ends.

Impact on water availability for livestock:

Researches pertaining to impact of climate changeon water resources for livestock are very scanty.Water resources in particular are one sector whichis highly vulnerable to climate change. Climatechange and variability have the potential to impactnegatively on water availability and access to and demand for water in most countries. Climatechange will have far-reaching consequences forlivestock production, mainly arising from its impact on rainfall patterns which later determinethe quantity and quality of grassland and rangeland productivity (Assan 2014). As per IPCC (Intergovernmental Panel on Climate Change) the net impact of climate change on water resources and freshwater ecosystems will be negative due to diminished quantity and quality of available water. The impact of climate change can aggravate water problem in hot semiarid areas leading to overgrazing which ultimately culminate in rapid runoff in these areas leading to flooding. Frequent droughts might be a cause of concern in terms of disease and parasites distribution and transmission, apart from the physical losses to livestock. Further, the drying of water resources will create a situation where livestock need to walk long distances in search of water, creating an additional stress to these animals. Hence, it's going to be a huge challenge for livestock researchers across the globe to develop appropriate strategies to ensure access to water for livestock production.

REFERENCES

Amundson, J.L., Mader, T.L., Rasby, R.J. and Hu, Q.S. (2006). Environmental effects on pregnancy rate in beef cattle. J AnimSci 84:3415–3420 and endocrine responses in Malpura ewes under semi-arid tropical environment. Trop Anim Health Prod 45:107–116.

Assan, N. (2014). Possible impact and adaptation to climate change in livestock production in Southern Africa. IOSR J Environ SciToxicol Food Technol 8(2):104–112.

Bernabucci, U., Basiricò, L. andMorera, P. (2013). Impact of hot environment on colostrum and milk composition. Cell MolBiol 59(1):67–83.

Bernabucci, U. and Calamari, L. (1998). Effect of heat stress on bovine milk yield and composition. ZootecNutrAnim 24:247–257.

Chadio, S.E., Kotsampasi, B., Papadomichelakis, G.,Deligeorgis, S., Kalogiannis, D., Menegatos, D. andZerwas, G. (2007). Impact of maternal undernutrition on the hypothalamic-pituitary-adrenal axis responsiveness in the sheep at different ages postnatal. J Endocrinol 192:495–503.

Cobon, D.H. and Toombs, N.R. (2007). Climate change impacts on the water resources of the Cooper Creek catchment. In: Proceedings of MODSIM Congress' Christchurch, pp 483–489.

FAO (2006). World agriculture: towards 2030/2050: prospects for food, nutrition, agriculture and major commodity groups. Interim report, Global Perspective Studies Unit, Food and Agriculture Organization of the United Nations, Rome.

Johnson, H.D. (1987) Part II, chapter 3: Bioclimate effects on growth, reproduction and milk production. In: Bioclimatology and the adaptation of livestock. Elsevier, Amsterdam.

Kornmatitsuk, B., Chantaraprateep, P., Kornmatitsuk, S. andKindahl, H. (2008). Different types of postpartum luteal activity affected by the exposure of heat stress and subsequent reproductive performance in Holstein lactating cows. ReprodDomestAnim 43:515–519.

Kume, S., Takahashi, S., Kurihara, M. andAii, T. (1989). The effects of a hot environment on the major mineral content in milk. Jpn J ZootechSci 60:341–345.

Marai, I.F.M., El-Darawany, A.A., Fadiel, A. and Abdel-Hafez, M.A.M. (2007) Physiological traits as affected by heat stress in sheep – a review. Small Rumin Res 71:1–12.

Martin, G.B., Rogar, J. andBlache, D. (2004). Nutritional and environmental effects on reproduction in small ruminants. ReprodFertil Dev 16:491–501.

Sejian, V. (2013). Climate change: impact on production and reproduction, adaptation mechanisms and mitigation strategies in small ruminants: a review. Indian J Small Rumin 19(1):1–21.

Sejian, V., Indu, S., Ujor, V., Ezeji, T., Lakritz, J. and Lal, R. (2012) Global climate change: enteric methane reduction strategies in livestock. In: Sejian V, Naqvi SMK, Ezeji T, Lakritz J, Lal R (eds) Environmental stress and amelioration in livestock production. Springer-VerlagGMbH Publisher, Germany, Berlin, Heidelberg, pp 469–502.

Sejian, V., Maurya, V.P., Kumar, K. and Naqvi, S.M.K. (2013). Effect of multiple stresses (thermal, nutritional and walking stress) on growth, physiological response, blood biochemical and endocrine responses in Malpura ewes under semi-arid tropical environment. Trop AnimHealth Prod 45:107–116.

Orchid: Its Commercialization and Varietal Development

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Orchidaceae family is the most diverse, advanced and evolved flowering plants and widely adapted genera found in different ecosystems and habitats on earth. They are the one of oldest flowering plants originated 100 million years ago, spread across all corners of the world. Orchids are one of the most diverse and advance groups of plants in this family and its size ranges from the tiny and miniscule botanicals to the gigantic forest epiphytes; with flowers of various shapes, sizes color and scents, and inhabiting a wide degree of environment. Orchid habitats are widely distributed and they are found in almost all continents except Antarctica. They are one such special group of plants listed in 'red book' of IUCN and were banned for collection from forests as per Indian laws and covered under *The Convention in International Trade in Endangered Species of Wild Fauna and Flora* for export and imports.

What's in an Orchid Name?

The name "orchid" came from the first named orchid plant, *Orchis* (most likely from *Orchis morio* L.). The name means "testicles" in Greek, which makes it more masculine. The name refers to the paired underground bulbs of the Mediterranean orchid because of its similarity to the male reproductive organ. Also, it is practiced in olden times that plants resembling a particular human organ or part, is believed to be a cure for ailments of that part. With this name, orchids are definitely not feminine. The name was used by the Greek philosopher Theophrastus from Lesbos (372-289 BC), in his *Enquiry into Plants*. Dioscorides adopted the word "orchis" which probably referred to the same "orchis" of Theophrastus, in a manuscript of medicinal plants. He also expounded on the aphrodisiac properties of orchids, a concept which lasted until the 15th to 16th century. Thus, the first named orchid was believed to be an aphrodisiac and could revitalize reproductive fertility. Finally, John Lindley used the term to name the orchid family in his book "The Genera and Species of Orchidaceous Plants" (1830-1840).

Traditional Uses of Orchids

At present, orchids are used as cut-flowers (a multi-million dollar business), house plants and for landscaping. However, there are other uses of orchids aside from these. The orchid *Vanilla planifolia*, which is native to Central America, and is cultivated in the West Indies and Java for its vanillin flavor (CNN, 2015). In the past, orchids have been used for a wide variety of both spiritual and material purpose.

The Philippine local folks have an extensive use for orchids, specially the genus *Dendrobium* (Palmer, 2001). *Dendrobium taurinum* was used to make a wash to remedy loss of hair. A tonic decoction was made from *Dendrobium crumenatum* and it was also used for ear ache and ear infections. The old stalks from this orchid were cut and used as ties. The dried stems of *Dendrobium heterocarpum* were used to make a belt to hold up the loincloth. The stems or canes of several species of *Dendrobium*, including *D. macrophyllum*, have had local use in various aspects of weaving, basketry and wickerwork. *D. crumenatumis* used is used for straw plaiting and making straw hats. The yellow material used to decorate artifacts is provided by local species of *Dendrobium*. This is due to the fact that the orchid stems turn yellow on drying, the color being intensified by exposing the stems to heat from the sun or fire. The outer covering of the stems are cut into strips, which are either woven into artifacts such as mats and armbands, or fixed around objects such as arrows and fire sticks. The many types of articles decorated in this way include domestic implements, clothing, body ornaments, cremonial articles, funerary relics and weapons. The yellow strips made from *D. crumenatum* stem were used for decorative purposes in basketry and hat making, and *D. heterocarpum* was used to decorate items of clothing. *D. tetraedre* is used in small hand-woven baskets and in cigar cases. Yellow bark from *D. secundum* is used to decorate bows and arrows, personal ornaments and funerary relics.

The rich Indian orchid diversity is known by its varied colors, shape, scented and aesthetic nature. Apart from floriculture traits for cut flower and potted plants; many flowers, pseudo-stem and bulbs of orchids are being used in Ayurveda, Tibetean and Siddha medicine with various names *viz.*, *dbang lags, Jeevak*, *Vridh* and *Rishbhak etc*. The Eastern Himalayas, Western Ghats and Indo-Burma region were the three hot spots in India harboring more than 800 species. Five states in North-East India have orchids as their state flower indicates their sacred value and cultural importance in society.

Modern Uses of Orchids

Orchids are primarily grown because of their beautiful flowers. They are mass produced by the thousands or millions to support the world cut-flower industry. Also, interest in orchids arose due to their exotic beauty, rarity, and hidden mystery. Orchids are also raised as rare house plants, wherein most of their owners are orchid specialists and hobbyists. In their native habitat, orchids are used by the country's town folks in many ways. Flowers are used in wedding ceremonies, in honoring guests, or as offering in burial; the seed capsule of Vanilla is used for flavoring; some of the orchid petals are used as garnishing in dishes; and some orchids with scented flowers are even used as an aphrodisiac, sexual stimulant or as herbal medicine. Orchids are also produced in large numbers as a landscape plant, potted house plant used to accent particular areas in the home. Small flowered orchids nowadays are now gold or silver electroplated to be made into fine life-size jewelry for women. Some East Asian cultures use various species of orchids for medicinal purposes; excessive collection for both medicinal and horticultural uses has threatened the survival of some endangered orchid species (Schuiteman, 2007).

Orchid Propagation

In the early years of orchid culture, people have no idea of how to propagate these plants. Orchid hobbyist usually gets their orchids from forests. Then, they found out that orchids also produce fruits (capsules) when their flowers are pollinated naturally by bees or artificially by man. Each orchid fruit contain thousands of seeds. Orchid seeds are very small (about 470-560 microns long, 80-129 microns wide) and weight about 6 micrograms. Their size is one of the factors which gave them the tendency to be dispersed by wind for thousands of kilometers, away from their original habitat (Seaton and Pritchard, 2008). However, not all of these seeds germinate and grow into mature plants in nature. Most (but not all) orchid seeds need a symbiotic fungus or mycorrhizae, usually of the genus *Rhizoctonia*, in order to germinate (Rasmussen, 1995). The fungus needs to infect the seeds in order for it to survive in its early stages of development. The mycorrhizae infect the basal part of the seed and release an enzyme which converts starch in the surrounding area into simple sugars. These will be the energy source or food of the germinating embryo up to its development into a mature plant. Not all of the seeds grow in nature. Only the seed which land on a suitable surface (a rock, a bark of a branch or on the ground) and infected with its particular mycorrhizae, germinates and grows into a plant. This comprise only about an average of only 1%. However, through science and technology, almost 99% of the seeds could now be raised into mature plants through embryo culture.

Embryo culture or embryo rescue is one of the techniques used in the commercial breeding and propagation of orchids. Thousands of plants could be produced in this method in a year, due to the fact that orchids literally produce thousands to millions of seeds (about 6,200 in *Cephalanthera grandiflora* and 2-3 million in *Cattleya labiata*). In this method the viable seeds or ovules are sterilized and placed inside a flask containing artificial growing media. The media consist of mineral salts, vitamins, amino acids, sugars and growth hormones. After a year or so inside a flask, seedlings are then brought out into the nursery where they grow into maturity. From these plants that are produced, a breeder usually selects the best flowering plant, registers it and then clones this selected plant through the conventional division, cutting or kiekis

Figure 1- Propagation of orchid through kiekis method

method (Fig.1), or better still, through plant tissue culture.

Plant tissue culture, particularly meristem culture or mericloning is the most efficient way of mass producing a selected species or hybrid. In this method, the shoot tip or very young inflorescence is severed, sterilized, and its actively growing region is obtained and cut into minute pieces (Fig.2) and inoculated into a flask containing artificial culture media (Fig.3). The tissue is permitted to undergo callus formation, and then grows into minute orchid plantlets. These callus and plantlets are then further divided to produce the required number of plants inside the laboratory. When the right numbers of plants are obtained, then, the plantlets are then hardened and transferred into the nursery where they are permitted to grow into maturity. The plants produced in these way are true-to-type and identical to that of the mother plant. A disadvantage of this method of propagation is that the seedling that is produced will takes many years to flower (Hartmann *et al.*, 2011).

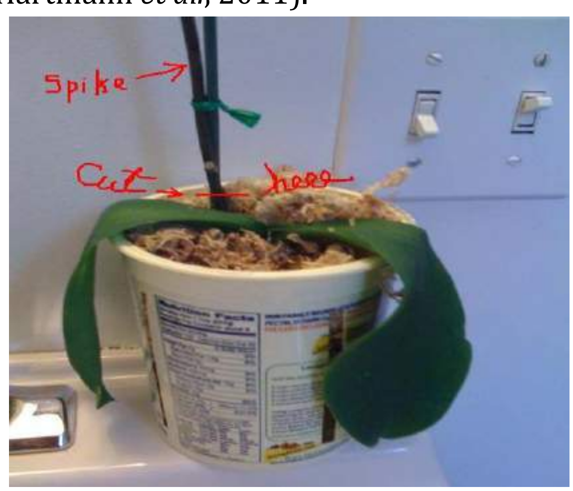

Figure 2- Propagation of orchid through shoot tip cut method

Figure 3- Growing orchid in artificial culture media

Varietal development of orchids in India

Due to degradation of natural forest cover, illegal exports and excessive collections by researchers, amateur growers and hobbyists, the orchid population faced phenomenal decease in their own natural habitats. Studies indicated, nearly 50 species became endangered and threatened category in India. Due to non-availability of modern hybrids in India, the large scale imports were made with huge investments. These imported varieties are 15 to 16th generations hybrids developed by Thailand, Taiwan, Japan, Australia and USA *etc*. Even though, the initial performance of imported hybrids is good, their performance was degraded in course of time, mainly due to varietal vulnerability and their lesser chances for better adaptation to the local Indian conditions.

Due to persistent demand the India became a dumping site for segregating populations that won't qualify as varietal standards as per Indian Seed Act, 1966 and PPV & FR Act, 2001. However, the varieties developed from native gene pool (indigenous species) adapts to local conditions (G x E) and performs well with free from pests and diseases. Further, development of new varieties using native orchid resources helps to understand the genetical control of traits and assist to construct genetic maps and indirectly decreases the pressure for habitual collections from forest areas due to the closer resemblance to native species.

However negative linkage, differential ploidy level, long juvenile phase and compulsory dependence on tissue culture for progeny development are observed to be challenges for varietal improvement of orchids.

After the launching the breeding programmes at National Research Centre for Orchids at Sikkim, inter-generic hybrids (1 no.), primary hybrids (2 no.), secondary hybrids (5 no.), tertiary hybrids (6 no.) and somaclonal mutants (2 no.) were developed. More than 3,500 germplasm collections were maintained under *ex-situ* conservation at center and mass multiplication of RET species is another challenge. The state flower of Mizoram and endangered species, *Renanthera imschootiana* known as 'Red Vanda' was registered with NBPGR (IC 566525/INGR 10113) for floral characters.

In the year 2012, the breeding cycle of orchids was re-invented in India after the flowering of primary hybrid from first indigenous cross, PBX-05-56/2012 (*C. lowianum* x *C. tigrinum*), which was initially bred in 1903 from United Kingdom. Two scented lines PBX-05-772 & PBX-05-751 were developed by 2013 using native scented species, *Cymbidium iridiodes* as male parent. The three varieties *viz.*, *Cymbidium* 'B. S. Basnet', *Aranda* 'Kunga Gyatso' and *Dendrobium* 'V. Nagaraju' were released for cultivation.

FUTURE ASPECTS

Since 1856 when the first orchid hybrid *Calanthe dominyi* flowered, a very large number of artificial hybrid have been produced both at intergeneric and interspecific level. To date, more than 1,25,000 hybrids have been registered with an average of 10,000 or more every year. The success and ease with which such a large number of hybrids are produced every year depends upon the fact that most of the orchid genera and species have no generic barriers and they cross freely with each other. It must be mentioned that most of the orchid genera are still in the process of evolution and most of the orchids groups are in reality only artificial constructs. The other two factors which have played a major role in the development of orchid hybrids are polyploidy and introgressive hybridization.

REFERENCES

CNN Money (2015. "The World's Priciest Foods." Cable News Network.

Hartmann, Hudson T., Dale E. K., Fred T. D. and Robert L. (2011) Geneve. *Hartmann & Kester's Plant Propagation Principles and Practices* (8th ed.). Upper Saddle River, NJ: Pearson Education, 2011.

Palmer, T. (2001) "Dendrobiums of the Philippines: Traditional Uses." In:Orchids of the Philippines (22nd Annual Orchid Workshop, August 4, 2004) Houston, Texas, USA: The Houston Orchid Society. pp.47.

Rasmussen, H. N. (1995) Terrestrial orchids from seed to mycotrophic plant. Cambridge University Press, Cambridge.

Schuiteman, A. (2007) "Biodiversity and conservation of orchids: the importance of Kew's fieldwork." Kew.org blog post. Royal Botanic Garden, Kew.

Seaton, P. T. and Pritchard H. W. (2008) Life in the freezer. Orchids: **76:** 762-773.

Calf Pneumonia

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Calfhood diseases have a major impact on the economic viability of cattle operations, due to the direct costs of calf losses, treatment and long-term effects on performance.. Calf pneumonia is a major problem in dairy and beef herds. Pneumonia usually occurs in young housed calves (five weeks to five months old) either being reared as dairy replacements or in beef systems, usually reared indoors. It is a significant cause of morbidity and mortality in calves, both during the pre-weaning period and shortly following weaning. It is a multifactorial disease, and the most common post-mortem diagnosis incalves.

Cause

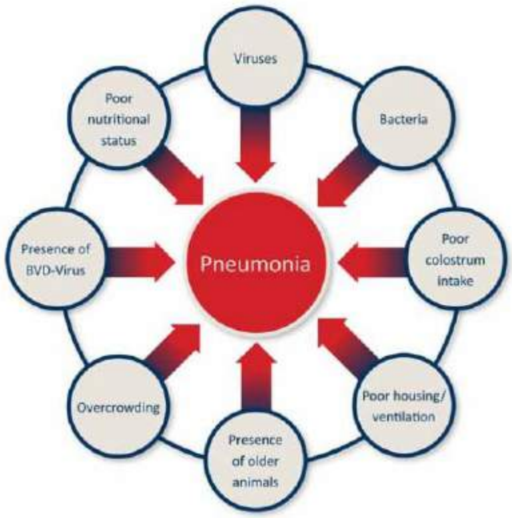
Pneumonia in pre-weaned calves is a multi-factorial disease involving a well known group of viruses (bovine herpesvirus 1, bovine respiratory syncytial virus, BRSV; parainfluenza 3 virus, PI3, bovine coronavirus) and bacteria (*Mycoplasma bovis*, *Pasteurella multocida*, *Mannheimia haemolytica*, *Histophilus somni*) and environmental risk factors.

Predisposing factors

Warm, wet weather
Mixed age groups
Stress such as weaning or disbudding
Overcrowded buildings and high stocking density
Poor ventilation

Susceptible age group of calf

Most disease occurs in the weaned calf and in fattening stock. Calves less than four weeks often have antibody protection, but can develop pneumonia if they did not receive enough colostrum or



colostrum of poor quality. Disease occurs when natural defences are low, or there is a high load of infection in the environment. Pneumonia can occur at any time of the year, although most cases are seen during winter housing.

Forms of the disease

- Acute pneumonia
- Chronic pneumonia

Symptoms

Acute pneumonia

- Dullness and depression

- High temperature
- Increased respiration rate
- Nasal discharge
- Coughing
- Reduced food intake
- In severe cases there may be death

Chronic pneumonia

Chronic pneumonia is more gradual in onset and the cow may appear to still eat well but may have a slight nasal discharge, sometimes with an increased respiration respiratory rate and cough.

Treatment

Antibiotics, anti-inflammatories and immune boosters should be prescribed for treatment.

Prevention

Following care should be taken to reduce risk of pneumonia:

- Young calves should all receive 10% of their bodyweight in good-quality, first-milked colostrum within 12 hours of life to provide vital immune defence
- *Ventilation* should be adequate, often if ammonia can be smelled it is a sign of poor ventilation
- Feeding calves inadequately will reduce calf growth and their immune system response
- Keep calves pan dry and well-bedded
- Keep age groups separated
- Cows should be vaccination for IBR, BVD, PI3 and BRSV this can provide some pneumonia protection to their offspring
- Prevent aspiration pneumonia
- Minimize weaning stress

Mycotoxicosis in poultry

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Poultry industry is rapidly growing industry in the world. India has achieved self sufficiency in food production and is marching ahead towards attaining nutritional security for its people. In this context, poultry eggs, which is highly nutritious and the cheapest source of high quality protein and the poultry meat that is comparatively leaner and less expensive than that red meat. But disease like mycotoxicosis occurs by ingestion of pre-formed toxins elaborated by fungi in cereals. In general, mycotoxins lower the profitability in poultry industry due to huge economic losses by decreasing growth rate, feed conversion efficacy, carcass yield, carcass quality and increased susceptibility to other diseases caused due to their immunosuppressive effects (Vasanti *et al.,* 1998). Although there are upwards of 350 mycotoxins identified in nature (CAST, 2003), aflatoxins, ochratoxins and zearalenone are the most significant due to adverse effects on egg production in the commercial egg industry. There are hundreds of different mycotoxins which are diverse in their chemistry and effects on animals. It is likely that contaminated feeds will contain more than one mycotoxin.

PROBABILITIES OF CONTAMINATION

Warm humid climate provides congenial atmosphere for the growth of fungi and production of toxins. *Aspergillus flavus* which is known as storage fungi may infect and produce aflatoxins in crops in the fields also. Food grains are normally harvested at higher moisture content and then dried to bring down the moisture content up to safe level before storage. Delay in drying to safe moisture levels increases risks of mould growth and mycotoxin production. Natural calamities like floods or torrential unseasonal rains during pre, mid or post-harvest stages may render the crops vulnerable to microbial attack. Faulty storage conditions may also enhance the chances of microbial attack and production of mycotoxins. Various mycotoxins along with their effects were presented in Table.1.

Table: Moulds and mycotoxins important in intensive animal production.

Mould genus	Mycotoxin	Affected grains	Effects	Affected species
Aspergillus spp	Aflatoxins B1,B2,G1,G2	Corn, peanuts cottonseed meal, sorghum	Liver toxin immune depressant, intestinal hemorrhage, carcinogenic	All species including man
Aspergillus and *Penicillium*	Ochratoxin	Maize, cereals, rice	Kidney degeneration	Mainly pigs and poultry
Aspergillus and *Penicillium*	Cyclopiazonic acid	Cereals, peanuts, corn	Kidney toxin, shell quality	Poultry and pigs
Fusarium	Deoxynivalenol	Cereals, corn	Reduced appetite, sometimes vomiting, neurological effects	Pigs, poultry
Fusarium	T-2	Cereals, oilseeds	Reduced egg production, poor shell quality	Poultry
Fusarium	Zearalenone	Corn ,hay, grass, grain, screenings	Reproductive	Pigs, sheep
Fusarium	Fumonisin	Corn, grain screenings	Neurological	Horses, pigs, poultry
Claviceps	Ergot	Sorghum,(C. africana)	Reduced growth	All species
Alternaria	Tenuazoic acid	Cereals, fruit		All species

Toxic Effect of Mycotoxins

Fungal pathogens include *Aspergillus, Penicillium and Fusarium* has been proposed as the pathogenic agent associated with mycotic hemorrhagic bowel syndrome (HBS) in dairy cattle. Healthy cows with an active immune system are more resistant to mycotic infections as compared to dairy cows in early lactation, which are immune suppressed.

Aflatoxins

Aflatoxins are a family of extremely toxic, mutagenic, and carcinogenic compounds produced by *Aspergillus flavus* and *A. parasiticus*. *A. flavus* isolates produce aflatoxins B1, and B2 while *A. parasiticus* isolates produce aflatoxins B1, B2, G1 and G2

Zearalenone

Zearalenone and zearalenol are estrogenic metabolites of several species of *Fusarium*. Zearalenone is the cause of hyperestrogenism in swine. *F. graminearum* is the major zearalenone producing fungus of the *Fusarium* species that cause corn ear and stalk rots, but other species of *Fusarium* produce zearalenone, as well as other mycotoxins.

Trichothecenes

Trichothecenes are a family of 200-300 related compounds that apparently exert their toxicity through protein synthesis inhibition at the ribosomal level. Several species of *Fusarium* such as T-2 toxin and diacetoxyscirpenol (DAS) are commonly found in agricultural commodities. The toxic effects of trichothecenes include anemia, leukopenia, skin irritation, feed refusal, gastrointestinal effects such as vomiting, diarrhea, and bowel inflammation.

T-2 Toxin

T-2 toxin is produced primarily by *F. sporotrichioides* and *F. poae*, but is also produced by other species of Fusarium. The toxicity of T-2 toxin in laboratory animals is well-documented. T-2 toxin is a very potent mycotoxin associated with gastroenteritis, intestinal hemorrhages and death.

Fumonisin

Fumonisin toxicity is thought to result from disruption of sphingolipid biosynthesis. Fumonisins B1, B2, and B3 are produced in fungal cultures or found in naturally contaminated corn samples.

Ochratoxin A

This mycotoxin is produced by species of *Penicillium* and *Aspergillus*, and is a causative agent of kidney disease in pigs that has been referred to as mycotoxin porcine nephropathy, producing symptoms including diarrhea, increased water consumption, diuresis and dehydration. Ochratoxins, mainly produced by *Aspergillus ochraceus* and *Penicillium verrucosum,* are primarily nephrotoxic and secondarily hepatotoxic in poultry (Marquard and Froehlich, 1992). Laying hens show reduced egg production and characteristic yellow-brown staining of egg shells due to the deposits of urate in the cloaca.

Citrinin

Citrinin can co-occur with ochratoxin, is produced by both *Penicillium* and *Aspergillus* which also targets the kidney. Symptoms of pruritis, pyrexia and hemorrhagic syndrome in a dairy herd were attributed to citrinin .

ECONOMIC IMPACT OF MYCOTOXINS

The economic effects of mycotoxins are manifested in several obvious and direct ways but also in more subtle expressions. A study carried out in a poultry farm at the outskirts of Hyderabad during an outbreak of aflatoxicosis, showed that over a three-week period, following exposures to aflatoxin in the diet, the egg production in the 11,000 layer poultry farm went down from an initial 90 per cent level to 60 per cent level. Soon after the withdrawal of the incriminating diet, the egg production started picking up, but never reached the original level. During this period the economic cost in terms of reduced egg output, medication, non-utilization of the contaminated feed, cost of food analysis, *etc.* were calculated to be over Rs 45,000. This amount is equal to about 10 per cent of the initial cost of the establishment of the farm. The various impacts were :

1. **Mortality in poultry**

Occasionally outbreaks of mycotoxicosis around the world have resulted in devastating effects on the poultry industry. Good examples of such outbreaks are:

1) Turkey Disease (aflatoxicosis) outbreak in turkeys in the UK,

2) Outbreak of ochratoxicosis in turkeys

3) Outbreak of T-2 toxicosis in laying hens (Devegowda *et al.,* 1996)

2. Increased health care and veterinary costs

To prevent the adverse effects of mycotoxins in humans and animals, many therapeutic and preventive strategies must be put in place that add to the cost of maintaining human and animal health.

3. Decreased livestock profitability

Livestock profitability largely depends on the amount of milk, meat or eggs produced per unit of feed consumed and/or the number of progeny produced. Mycotoxins interfere with the absorption of nutrients, inhibit several digestive enzymes and reduce feed conversion efficiency, all of which increase production costs. Mycotoxins such as zearalenone and T-2 toxin increase embryonic mortality and reduce fertility and hatchability (Leeson *et al.,* 1995).

4. Loss of forage crops and feeds

Mycotoxin-contaminated crops and feeds are unfit for human and animal consumption. Severely infested crops and feeds must be destroyed.

5. Impact of mycotoxins on egg production

Aflatoxins, the most important group of mycotoxins, mainly produced by *Aspergillus flavus* and *Aspergillus parasiticus* are primarily hepatotoxic and secondarily nephrotoxic in poultry. Aflatoxins have been found as natural contaminants in feed stuffs such as groundnuts, maize, sunflower, soyabean, sorghum, cotton seed and oats (Ellis *et al.,* 1991). The loss of hatchability due to embryonic death was the most sensitive indicator of aflatoxicosis in broiler breeders and leghorns, although the production decline can be delayed and requires several weeks to return to normal (Devegowda *et al*., 1996). Aflatoxicosis is characterized in broilers by bruising, and in highly susceptible immature species, such as ducklings, subcutaneous hemorrhages. It is evident that high-producing hens will be susceptible to aflatoxicosis since the liver is responsible for synthesis of the precursors of both yolk lipids and albumen incorporated into eggs. Egg size, egg weight and yolk weight decrease in egg (Eaton and Groopman, 1994). In Japanese quail, the impairment of feed conversion, egg production, egg weight hatchability and exterior and interior egg quality due to aflatoxin-induced liver damage and delayed maturation in males and females.

INTEGRATED APPROACH TO PERVENTION OF MYCOTOXINS

Management practices

Adequate ventilation of poultry housing to reduce relative humidity removes moisture available for fungal growth and toxin formation in feeders.

Growing resistant varieties

In view of the hazardous effects of mycotoxins, efforts are being made to develop mould resistant varieties which will be mould free not only in fields as standing crops but during storage also they will restrict development of moulds.

Harvest practices

Harvest at a relatively low moisture content (<14.0%) if possible. Do not delay harvesting unduly as the mycotoxin content of grain already infected by *Fusarium* spp could increase significantly.

Post-harvest practices

Sieve out broken and damaged kernels to achieve the required grade. Ensure transport containers and bins are clean, dry and free of insects and mouldy. If drying is required, prevent over drying and over-heating of the circulated air as this leads to cracked and damaged kernels.

Prevention of mould growth

In stored grain, mould damage may be prevented mainly by three kinds of methods viz. drying of grain, controlled atmosphere storage and chemical treatment.

Drying of grain

The most effective mycotoxin control measures is to dry the commodity such that the water activity (a_w) is too low to support mould growth and/or prevent mycotoxin production. To prevent the growth of most moulds the a_w needs to be 0.70, which translates to a moisture content of approximately 14% for maize and 7% for groundnuts at 20°C.

Controlled atmosphere storage

The significance of underground storage lies behind the philosophy of grain cooling and depleting the oxygen content to the desired level whereby the microbes and insects cannot grow. Air-tight storage also works on the same phenomenon where the depletion of oxygen by grain respiration manipulates disinfection by inhibiting aerobic fungi, elimination of mycotoxin production and conservation of desirable quality factors in the grain.

Dietary Management

Increasing dietary levels of nutrients such as protein, energy, dietary fiber, buffers and antioxidants may be advisable (Galvano *et al*., 2001). Transition rations can reduce stress in fresh cows and reduce effects of mycotoxins. Strategic use of mould inhibitors could also be beneficial.

Detoxification

Cooking at atmospheric pressure can destroy about 50 percent of the toxins (Galvano *et al*., 2001). Dry roasting and oil roasting of groundnut reduces aflatoxins to a significant degree. Cooking rice under 15 lbs pressure for 5 minutes gave maximum destruction of aflatoxins as compared to ordinary cooking or cooking with excess water. The detoxification can also be done by treating with ammonia gas under pressures of 2 to 3 atmospheres for 15 to 30 minutes at a temperature of around 90^0C.

Mycotoxin binding agents

The most commonly used strategy of reducing exposure to mycotoxins is the decrease of their bio-availability by the inclusion of various mycotoxin binding agents or adsorbents, which leads to a diminishing of mycotoxin uptake and distribution to the blood and target organs. This works in particular well with aflatoxins, as this group of toxins has a chemical structure which favors adsorption, especially by materials of mineral origin, like clay and zeolite. For an effective mycotoxin removal strategy, the nutritionist and the feed mill shall look into a more detailed approach. While selecting a toxin binder one need to pay attention to the binding efficacy, binding stability, effective inclusion rate and least active on nutrients.

Different types of Binding Agents

Zeolites

Zeolites are hydrated aluminosilicates of sodium, potassium, calcium, and barium. They can be readily dehydrated and rehydrated, and are used as cation exchangers. Zeolite gives very good result in binding aflatoxin B1 and zearalenone (Piva *et al.,* 1995).

Bentonites

Bentonite has been shown to bind aflatoxin B1 in vitro and reduce its toxic effects. Sodium bentonite and a synthetic zeolite mixture (80:20 ratio) did not depress feed intake or nutrient apparent digestibility while preventing aflatoxin accumulation in the liver of growing lambs and decreasing aflatoxin recovery in urine by several fold

Hydrated sodium calcium aluminosilicate (HSCAS)

HSCAS, a phyllosilicate derived from natural zeolite, is perhaps the most extensively investigated sorbent. There is a evidence of high affinity of HSCAS for aflatoxin B1 both in vitro and in vivo form. Indeed, its protective properties are very low toward ochratoxin and zearalenone and nil toward trichothecenes.

Clays

Clays such as kaolin, sepiolite and montmorillonite have a variable ability to reduce toxic effects of aflatoxin B1. However, their efficacy is limited to aflatoxin B1 and is lower than that of HSCAS and benton ite.

Activated charcoals

Activated carbons are an important group of sorbents. They are a family of carbonaceous substances obtained by pyrolysis of several organic compounds and manufactured by activation processes aimed at developing a highly porous structure (Galvano *et al.,* 1996). The highest abilities were noted in the adsorption of aflatoxin B1 and ochratoxin, whereas the lowest were seen in the adsorption of deoxynivalenol.

Biological binding agents

The elimination of other mycotoxins than aflatoxins (e.g. trichothecenes, zearalenone, ochratoxins or fumonisins) from contaminated feedstuffs by the use of adsorbents did not lead to any satisfactory results so far, as most of the adsorbing agents bind them only weakly in vitro and are practically ineffective in vivo.

Interestingly, modified mannanoligosaccharide (Mycosorb, Alltech Inc.) derived from the cell wall of *S. cerevisiae* was reported to have even higher binding capacity (95% aflatoxin, 80% zearalenone, fumonisin up to 59%, and vomitoxin up to 12%; (Devegowda *et al.,* 1998).

CONCLUSION

Several effective ways for prevention and control hazardous fungi and their dangerous mycotoxins have been presented. The methods include biological control and physical and chemical treatments. Care must be taken by animal feed processors and poultry producers to ensure mycotoxins do not enter the food chain.

REFERENCES

CAST (2003). Mycotoxins: Risks in Plant, Animal, and Human Systems. *Council for Agricultural Science and Technology.* Task Force Report 139; Ames, Iowa, USA.

Devegowda G, Aravind BIR and Morton MG (1996). *Saccharomyces cerevisiae* and mannan oligosaccharide to counteract aflatoxicosis in broilers. *Proceeding of the Australian Poultry Science Symposium*, Sydney. pp. 103-106.

Eaton DL and Groopman JD (1994). The Toxicology of aflatoxins: Human health, Veterinary and Agriculture Significance. Academic press: San Diego, USA.

Ellis WO, Smith JP, Simpson BK and Oldham DH (1991). Aflatoxins in food: Occurrence, biosynthesis, effects on organisms, detection and methods of control. *critical reviews in food science & nutrition abbreviation,* 30(4): 403-39.

Galvano F, Piva A, Ritienia and Galvano G (2001). Dietary strategies to counteract the effects of mycotoxins : A review. *Journal of Food Protein,* 64(1):120-131.

Leeson Steven, Diaz, and Summer D, John (2001).Poultry metabolic disorders and Mycotoxins. University Books press, pp. 274-280.

Marquard RR and Frohlich AA (1992). A review on recent advances in understanding ochratoxins. *Journal of Animal Science*, 70:3968-3988.

Vasanthi S and Bhat RV (1998). Mycotoxins in food: Occurrence, health and economic significance and food control measures. *Indian Journal of Medicine Research,* 105: 212-224.

Stakeholders and Their Roles In Conservation Of Animal Genetic Resources (AnGRS) Of India

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This paper deals about different stakeholders and their roles involved in conservation of farm animal genetic resources in India. The role of each set of stakeholder is varying but the ultimate goal is to conserve the present resources for future generations.

Animal Genetic Resources (AnGRs) of India includes cattle, buffalo, sheep, goat, pig, camel, horse, yak, mithun, donkey and poultry breeds of our country. NBAGR, GoI is the authority for identication, characterization, evaluation, documentation, conservation and utilization of AnGRs of our country.

Conservation:

It can be defined as the management of the biosphere of human use for benefits in present time together with maintaining its potential to meet the future needs. The conservation includes the preservation (maintenance of genetic variability) along with up-gradation (improvement) of the genetic potential and management of a breed for use in future.

Some basics behind the existence of genetic diversity (in the form of AnGRs) in our country:

1. Result of evolutionary process
2. Adaptation to harsh climatic condition
3. Thrive well against poor management
4. Made out of G X E interaction

Causes for threat to AnGRs (genetic diversity):

1. Breed dilution
   a. Due to indiscriminate crossbreeding
   b. Narrow minded breeding policy – favours only for milk production instead of improving the overall efficiency under a given environmental condition
2. Transformation of multi-purpose (milk, draught, manure) animal production into single objective animal production system (only for milk)
3. Change in the mind-set of people (so called modernization or globalization or unorthodox approach…)
   a. Rural folks started to think in economical term about rearing low producers of our AnGRs. But, they ignored that our AnGRs can thrive well

in zero-input system in our tropical conditions. A few decades ago, our ancestors wisely acted and kept different breeds as their pride and part of life which was laudable

4. Cluelessness of scientific community to explore, appreciate the uniqueness of mysterious AnGRs and finally to make the breed become economically viable
5. Existence of weak link among different stakeholders

A HOLISTIC APPROACH FOR CONSERVATION OF AnGRs

Whose responsibility to conserve the AnGRs?

1. I as a "livestock keeper"
2. I as a "veterinary officer"
3. I as a "member of scientific community"
4. I as an "Administrator"
5. I as a "Politician"
6. I as a "responsible citizen of India"
7. It is every animal's rights to live on the Mother Earth and each animal has its own role to play in its eco-system

Role of Livestock keepers:

1. Can try to appreciate the comprehensive value of our AnGRs
2. Can come forward to form breed society or breeders association – it will help them to sort out their problems regarding AnGRs
3. Can try to maintain a simple, lucid records about their animals and its performances
4. Can show enthusiasm to adapt scientific animal production system
5. Can explore the uniqueness of each AnGR and utilize them in a novel way

Role of Veterinary officers:

1. Can try to adhere with the national breeding policy i.e., can avoid unsystematic crossbreeding
2. Can educate the gene keepers about their live national heritage and encourage them for conservation
3. Can play intermediate role between livestock owners and government to fulfill the demand – supply pathway
4. Can document the information on AnGRs available in his jurisdiction

Role of Scientific community:

1. Can plan out the numerous alternative strategies for various real world situation to conserve our AnGRs
2. Can table the issues such as pastoralists rights to graze the animal in forest, use of common resource properties (CRP), loans, incentives to the concerned authority
3. Can workout the effective population size (Ne) for each breed in its breeding tract for maintenance of genetic variability
4. Can evaluate the sire using modern approaches and can ensure the availability of indigenous breeds germplasm for A.I. It has been a perennial problem for long time
5. Can involve in wise breed wise census to prioritize the breeds for conservation and can act timely
6. Can play lead role for livestock stakeholders to start organized farm in the breeding tract
7. Can execute the advanced technique such as MOET, ONBS, CNBS, ET, etc.
8. Can explore the new avenue to market our AnGRs products which may contain uniqueness

9. Can research on transgenesis, cloning to regenerate the near extinct species
10. Can conduct the breed shows annually and reward the livestock keepers and thereby spread the awareness among the public

Role of Administrator:

1. Can realize the importance of AnGRs and speed up the process in all the possible ways like sanctioning loan, issuing incentives, appreciating the stakeholders, etc.
2. Can establish biodiversity park at urban and metro cities for children and public to get them awareness about nature's gift
3. Can establish at least one government farm for each breeds at their breeding tract
4. Can start at least one regional centre of NBAGR for each state
5. Can recruit project specific (here it is conservation of AnGRs) scientists with some interesting plan of work to revive our AnGRs.
6. Can recruit the huge numbers of veterinary graduates, post-graduates and PhD holders at various level to work under field condition with appropriate rewards

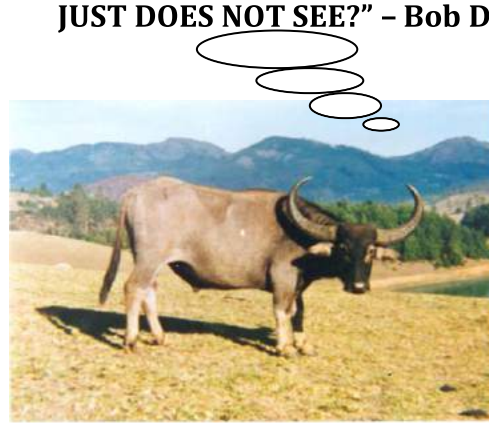
Role of Politician:

1. Can allocate the budget skillfully for specific purpose based on priority
2. Can appreciate the genetic diversity and act promptly against genetic death, breed dilution by amending the law favours traditional pastoralists, livestock keepers for conservation of AnGRs

Role of responsible citizen of India:

1. Can join with NGO to contribute for effective conservation of AnGRs
2. Can purchase livestock products of our AnGRs
3. Can love our wonder AnGRs and feel for them

"HOW MANY TIMES MUST A MAN TURN HIS HEAD AND PRETEND THAT HE JUST DOES NOT SEE?" – Bob Dylan's



Application of Stem Cells in Veterinary Practice

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Stem cells have enormous uses in animal cloning, drug discovery, gene targeting, transgenic production and regenerative therapy. Stem cells retain the ability to become some or all of the more than 200 different cell types in the body. Hence, unique regenerative potential of these cells make their use indispensible in the area of therapeutics. They are unspecialized cells that can give rise to specialized cells and capable of dividing and renewing themselves for long periods (Arias,2008).Based on the potency stem cells can be totipotent ,pluripotent ,multipotent oligopotent ,unipotent and based on source it can be divided as embryonic, fetal, adult, amniotic fluid, cord blood and induced pluripotent stem cells. Stem cell microenviroment (niche) provides support and stimuli to control stem cell properties. The application of stem cells in human medicine is well established and it is commonly used for chronic and accidental injuries and in veterinary medicine they rapidly become a visible tool for regenerative therapy of chronic ,debilitating and various unresponsive clinical diseases and disorders.

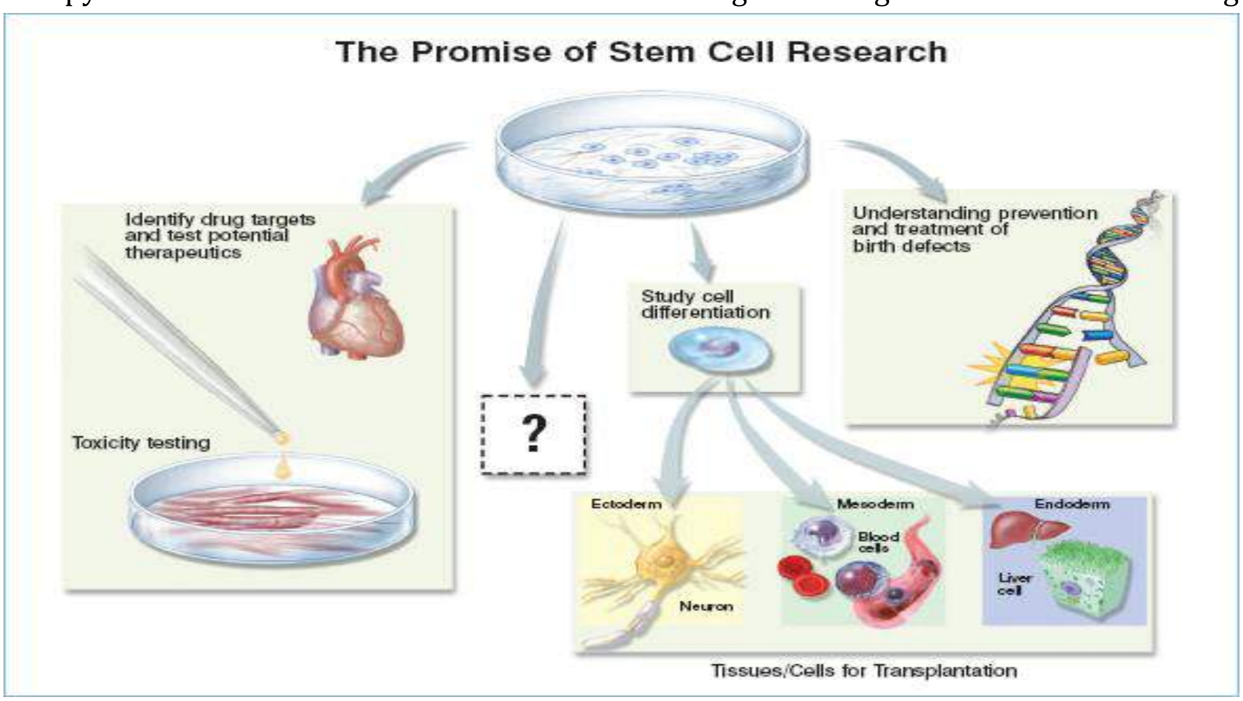
Sources of stem cells

Stem cells can be classified as Embryonic StemCells (ESCs) and Adult Stem Cells (ASCs) depending on their source . The plasticity is the ability of stem cells to differentiate which may form one cell type or multiple types of cells. Totipotent means ability to differentiate into all three germ layers including placenta , similarly pluripotent stem cells can form all three germ layers except placenta. The multipotent stem cells can differentiate into multiple cell types of particular tissue type whereas unipotent can form only one cell type.The first successful report of mouse embryonic stem cells (ESCs) was followed by isolation and characterization of EScells in other species like hamster, mink, rabbit, ratmonkey, marmoset, chicken, human, baboon, dog, cat, horse, pig, cow, sheep, goat and buffalo (Evans *et* *al*., 1981, Martin *et al*.,2002) Adult stem cells are of various types, hemopoeitic stem cells, mesenchymal stem cells, neural stem cells, skin stemcells, retinal stem cells etc. Mesenchymal StemCells (MSCs) can be isolated from bone marrow, fat, umbilical cord blood (UCB), amniotic fluid, placenta, dental pulp, tendons, synovial membrane and skeletal muscle . They have the potential to differentiate into cells of various tissues like fibroblasts, muscle, bone, tendon, ligament, and adipose tissue. Friedenstein and co-worker isolated these cells as colony-forming unit fibroblasts from murine bone marrow. Further, Caplan (1991) for the first time named these cells as mesenchymal stemcells. MSCs have been isolated from a number of species like human, rat, mice, dog, cat, pig, horse, sheep, goat, cattle . MSCs can be isolated and cultured easily with high ex vivo expansion rate. This makes these cells an attractive tool in regenerative medicine for cell therapy.

Stem cell research has huge therapeutic potential:

Research in stem cell field can enoromously help the field of agriculture as well as biomedical, veterinary and pharmaceutical research(Brown et al., 2012., Gade et al., 2012). It was applicable in many scientific studies such as, in understanding of cancer biology(Ricardo et al., 2003), genomic fingerprinting and development of the embryo at an early stage, application in drug screening and tissue engineering(Gurtener et al., 2007), helpful in generating transgenic animals and animal biotechnology ,testis xenografting and spermatogonial stem cell transplantation. Stem-cell therapy is the use of stem cells to treat or prevent a disease or condition. Stem cells are thought to mediate repair via five primary mechanisms:

1) providing an anti-inflammatory effect, 2) homing to damaged tissues and recruiting



other cells, such as endothelial progenitor cells, that are necessary for tissue growth, 3) supporting tissue remodeling over scar formation, 4) inhibiting apoptosis, and 5) differentiating into bone, cartilage, tendon, and ligament tissue. To further enrich blood supply to the damaged areas, and consequently promote tissue regeneration, platelet-rich plasma could be used in conjunction with stem cell transplantation. The efficacy of some stem cell populations may also be affected by the method of delivery; for instance to regenerate bone, stem cells are often introduced in a scaffold where they produce the minerals necessary for generation of functional bone .

Stem cells have also been shown to have a low immunogenicity due to the relatively low number of MHC molecules found on their surface. In addition, they have been found to secrete chemokines that alter the immune response and promote tolerance of the new tissue. This allows for allogeneic treatments to be performed without a high rejection risk

Veterinary applications

Research currently conducted on horses, dogs, and cats can benefit the development of stem cell treatments in veterinary medicine and can target a wide range of injuries and diseases suchas myocardialinfarction,stroke, tendon and ligament damage, osteoarthritis, osteo chondrosis and muscular dystrophy both in large animals, as well as in humans. Most stem cells intended for regenerative therapy are generally isolated either from the patient's bone marrow or from adipose tissue. MSCs can differentiate that make up bone, cartilage, tendons and ligaments, as well as muscle, neural and other progenitor tissues; they have been the main type of stem cells studied in the treatment of diseases affecting these tissues.Embryonic stem (ES) cells, induced pluripotent stem (iPS) cells, and cord blood-derived cells are also beginning to be investigated in the laboratory but have not yet been applied to the clinical scenario. Companion animals can serve as clinically relevant models that closely mimic human disease .

There are two main categories of stem cells used for treatments: allogeneic stem cells derived from a genetically different donor within the same species and autologous mesenchymal stem cells, derived from the patient prior to use in various treatments. A third category, xenogenic stem cells, or stem cells derived from different species, are used primarily for research purposes, especially for human treatments.

1. Nerve cells could treat stroke, Parkinson's, Alzheimer's, multiple sclerosis, spinal cord damage, and brain damage, even when it is congenital. This has particular potential as the brain is 'immune privileged' and does not reject tissue from anotherindividual.
2. Heart muscles cells could treat heart attacks and congestive heart failure
3. Skeletal muscle cells could treat muscular dystrophy.
4. Insulin-producing cells could treat diabetes. Although many cases of diabetes are caused by an immune response, transplant experts are trying to prevent this.

5. Cartilage cells could treat osteoarthritis.
6. Blood cells could treat cancer, immune deficiencies, inherited blood diseases, andleukaemia.
7. Liver cells could treat hepatitis and cirrhosis
8. Skin cells could treat burns and other skin wounds, and replace scars.
9. Bone matrix cells could treat osteoporosis
10. Retinal cells could treat several forms of blindness
11. Animal research is looking at the possibility of regrowing missing teeth.

Suspensory ligament injuries are a common problem in horses that can result in performance-limiting lameness. Over the years, veterinarians have used many methods to help horses with ligament injuries, but the success rate remains low, particularly hind limb suspensory injuries.Injection of stem cells from a horse's bone marrow into the injured area of the proximal suspensory ligament provides good responses.Though not proven yet, bone marrow stem cells are thought to stimulate natural ligament regeneration that should more closely resemble the original tissue (WSU,2009).

Limitations of stem cell therapy:

1. Many ethical issues arises from the use of oocytes and blastocyst and their donation.
2. The usefulness of stem cell therapy is restricted by the body's rejection of cells and tissues. Structures present on the cell surfaces cause the cells to be rejected when transplanted into another body. The therapeutic use of stem cells is also restricted by the fact that their differentiation is somewhat unpredictable. The fear of uncontrolled growth and cancer limits the use of stem cells, especially embryonic stem cell for their potential to teratoma formation (Zhili et al., 2014).
3. A major difficulty that scientists continue to encounter is the identification of stem cells in adult tissues and successfully trigger differentiation into desired cell type is another challenge for the researchers.
4. The cost of stem cell therapy is extremely expensive. The high cost of stem cell therapy is certainly beyond the financial ability of ordinary citizens. Though the potential of stem cell therapy sounds promising, the high price tag takes away all hope for ordinary people with incurable diseases.

CONCLUSIONS

The science of stem cells is a field with great potential for treating injury and disease. Stem cells are undoubtedly, most promising for cell-based therapies thereby provides a powerful and flexible option for physician and veterinarians to restore function and improve human and animal health through novel techniques. Stem cell therapy in regenerative veterinary medicine is a viable option for the equine as well as the small animal veterinarian, offering a safe and clinically effective tool for the clinician to assist in his/her treatment of the animal with difficult wounds or unresolved musculoskeletal or joint pain whereas research is still going on in other farm animals.

REFERENCES

Arias A(2008). Drosophila melanogaster and the development of biology in the 20th century. Methods Mol.Biol.420: 1-25.

Brown S, Harman R, Black L (2012). Adipose- derived stem cell therapy for severe muscle tears in working german shepherds: Two case reports Stem cell Discovery, 2:41-44.

Evans, M.J. and Kaufman, M.H. (1981). Establishment in culture of pluripotential cells from mouse embryos. Nature, 292(5819):154-156.

Friedenstein, A.J., Chailakhjan, R.K., and Lalykina, K.S. (1970). The development of ? broblast coloniesin monolayer cultures of guinea-pig bone marrow andspleen cells. Cell Tissue Kinet., 3:393-403.

Gade N, Pratheesh M, Nath A, Dubey P, Amarpal Y, Sharma T(2012) .Therapeutic potential of stem cells in veterinary practice. Vet.world.5: 499-507.

Gurtner C, Callaghan J, Longaker T (2007).Progress and potential for regenerative medicine.Annu.Rev.Med.58: 299-312.

Martin, D.R., Cox, N.R., Hathcock, T.L., Niemeyer G.P., and Baker, H.J. (2002).Isolation and characterization of multipotential mesenchymal stem cells from feline bone marrow. Exptl. Hematol., 30:879-886.

Ricardo P, Michael Fc, Sean JM (2003). Applying the principles of stem cell biology to cancer. Nat.Rev.cancer.3:895-902.

Wahington state University (WSO) (2009).WSU researching stem cells and surgical technique to heal equine suspensory ligament injuries. College of veterinary Medicine. 6:4.

Zhili R, Meiyan W, Zeng H, Martin S, Ananda G, Yongy, Yangx, Xuemei F (2014). An effective approach to prevent immune rejection of human ESC- derived allograft cell stem cell. 14: 121-123.

Light Trap: An Eco-Friendly Tool For The Managemnt Of Insect Pests

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The attraction of moths and other nocturnal insects to light is a well-known phenomenon and has been used for collecting nocturnal insects since the beginnings of scientific entomology in the 18th century. The first purpose built devices which could be termed actual light-traps were used by the Romans in the 1st century AD (Morge, 1973). Many of the insect species, mostly nocturnal are known to be positively phototrophic and are attracted towards artificial light in large numbers. Entomologists may utilize this phenomenon to capture night flying insects (looper moths, green hoppers *etc.)* in a device called LIGHT TRAP. While insects are attracted in a lesser degree to open fire, oil lamps, paraffin lamps, kerosene lamps and other light sources, the most effective lamps are those with a high emittance in the UV part of the spectrum (350 nm to 550 nm). The lamps which normally come within this range of spectrum are Actinic BL light, mercury vapour lamps, black light lamps and fluorescent tubes.

Overall there are two main approaches in the use of light traps. The qualitative approach aims at maximizing record and/or catch efficiency. For faunistic purposes, and for inventorying or assessing larger areas, it is usually preferable to use high-powered lights (*e.g*. 125 W lamps) and to choose sampling sites for maximum effect and across habitat-types, such as ridge tops, forest edges, etc. For ecological and habitat-related studies which require standardized comparisons and often target habitat- or niche-specific species it is better to use low-powered lamps (*e.g*. 8 W fluorescent tubes) placed well inside the target habitats.

Basic elements of Light Trap:

A) Light: Source (electric bulb [incandescent, ultraviolet, florescent, mercury vapor], flame [oil, kerosene, gas, wood], lantern)

B) Collector: Container (pan, bucket, bag, net, box, cage, walk-in enclosure,)

C) Usual Additional Elements: killing system, baffle, funnel, hood

Components of Light Trap

A) Light Assembly and Support Assembly: Light assembly attaches to support assembly at the underside of triangular mounting frame.

B) Ballast and Starter Assembly: Ballast and starter assembly is attached to the top of frame.

C) Baffling System: Baffling system consists of three baffles that are most preferably made of white 4 mm polyethylene and are about 9 inches x 4½ inches.

D) Collection assembly: Collection assembly is located below light assembly and baffle assembly.

Light sources used in light traps:

1. **Electrical Sources:** Incandescent Tungsten filament lamp 100 to 150 watt, Latest Energy saver Compact Fluorescent Lamps (CFL), Mercury Vapour lamps & Sodium lamps, Black light or Ultra Violet lamps 15 to 20 watt, MV lamps 80, 125 and 160 watt followed by 15 watt UV lamps are the best source attracting majority of the insects.
2. **Non-electrical Sources:** Kerosene lamps or petromax, LPG gas lamps, Carbide (Acetylene) gas lamps, Oil torches using waste mobile oil, Solar photovoltic generators

Insect reactions to light and its applications to pest management

- Most insects have two types of photoreceptive organs, compound eyes and ocelli.
- Compound eyes are made up of a large number of light-sensitive units termed ommatidia.
- An ommatidium contains an elongated bundle of photoreceptor cells, each having specific spectral sensitivities.
- The ommatidia are packed in a hexagonal array so as to cover a large visual field with certain spatial resolution and to perceive the motion of objects.
- The spectral sensitivities of photoreceptors determine the visible light wavelength for insects, which often expands into the ultraviolet (UV) region, which is invisible to humans.
- A compound eye typically contains three types of photoreceptor cells with spectral sensitivity peaking in the UV, blue, and green wavelength regions, respectively, as exemplified in honeybees.
- At any rate, it is likely that many insects can perceive UV light as a unique color. It is well known that insects fly toward streetlamps or other outdoor illumination at night.
- This innate phototactic behavior has provided the basis of the design of electric insect killers. Equipped with UV-emitting fluorescent tubes, the insect killers effectively attract insects such as moths and beetles and prevent these insects from entering into greenhouses and stores that are open at night.

Factors Affecting Responses to Light

- Light intensity and wavelength
- Combinations of wavelengths
- Time of exposure
- Direction of light source
- Contrast of light source
- Intensity and color to that of ambient light

Suppression of Nocturnal Insect Activities by Yellow Light

- Fruit-piercing moths such as *Eudocima tyrannus* (L.) and *Oraesia emarginata* (L.) damage fruit in orchards.
- Damage can be prevented by running yellow fluorescent lamps in the orchard at night.
- This strategy makes use of the fact that when moths encounter light above certain brightness at night, under which their compound eyes are light adapted as in the daytime, the light adaptation suppresses nocturnal behaviors such as flying, sucking the juice of fruit, and mating.
- This technique of suppressing behavior using yellow fluorescent light is also used to prevent damage to chrysanthemums and carnations by the cotton bollworm *Helicoverpa armigera* Hubner (Shimoda and Honda, 2013).

Light-adapted

Dark-adapted

Designs of Light Trap

Rothemsted Light Trap Robinson light trap New Jersey Light Trap Stephens Light Trap PEST-O-FLASH Light Trap	Universal Light Traps JNKVV Light trap models Solar Insect Light Trap Black Light Traps NCIPM Light Trap

Factors affecting light trap catches

Weather and Moonlight

A) Ambient population of adults

1. Host availability
2. Migration
   Immigration
   Emigration

B) Light source

1. Spectral composition
2. Intensity

C) Responsiveness of insects

1. Intensity of surrounding light
2. Flight activity of adult
3. Location of trap
4. Height of trap

D) Trap design

1. Light distribution
2. Prevention of escape
3. Capacity of collection chamber
4. Protection of specimen from rain water

Effect of Moonlight on Insect Catches

Lunar periodicity plays an important role in catch efficiency. In short, the stronger the moonlight is, the less attraction a lamp has to insects. The ratio between catch in new moon nights and catch in full moon nights has been given as 2.67: 1 and as 2.59: 1 (Nowinszky *et al.,* 1979). While it was once suspected that insect activity in general might be lower in moon nights, it

has since been shown that lamp attraction is weaker.

In fact insect activity seems to be higher in bright, moonlight nights as indicated by comparisons of light-trapping with other methods such as suction traps (Bowden, 1981) and pheromone traps (Dent & Pawar, 1988). When insect activity actually diminishes in moon nights this is usually due to other negative weather factors, especially rapidly falling temperatures as commonly observed in clear nights.

REFERENCES

Bowden, J. (1981). The relationship between light- and suction-trap catches of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), and the adjustmentof light-trap catches to allow for variation in moonlight. *Bulletin of Entomological Research*, **71**: 621-629.

Dent, D. R. and Pawar, C. S. (1988). The influence of moonlight and weather on catches of *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) in light and pheromone traps. *Bulletin of Entomological Research*, **78**: 365-377.

Morge, G. (1973). Entomology in the western world in antiquity and in medieval times. *In:* Smith, R. F., Mittler, T. E.and Smith, C. N. (Eds). *History of Entomology*. Annual Reviews Inc. Palo Alto, CA: 37-80.

Nowinszky, L.; Szab ,S. O; Oth G. T; Ekk, I. and Kiss, M. (1079). The effect of the moon phases and of the intensity of polarized moonlight on the light-trap catches. *Zeitschrift f¨ur Angewandte Entomologie*, **88**: 337–353.

Shimoda, M. and Honda, K. (2013). Insect reactions to light and its applications to pest management. *Applied Entomology Zoology*, **48**:413–421.

Genetics for disease resistance – Scope in dairy animals and poultry

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Livestock diseases adversely affect animal production throughout the world. Livestock keepers and other stakeholders involved in promoting animal health can draw on a number of approaches to reducing these negative effects. Options at the herd level include chemotherapy, vaccination, the control of disease vectors, and appropriate management methods but these strategies fails due to growing resistance to the drugs. There is a need of intervention with growing awareness of the development of pathogen resistance to the therapeutic agent , which has led to calls for reduction in the use of antibiotics and other drugs throughout the human and animal medicine, The possibility of between species transfer of resistances particularly from livestock pathogen to human pathogen and to fullfill the demand of consumers who are interested in organic foods. Resistance to disease is a combined effect of adaptability, preventive measure, immune system , nutrition, genetics and management. The immune system is the adaptive defense system that has evolved in vertebrates to protect them from invading pathogens, The major histocompatibility complex which is found to occur in all mammalian species plays a central role in the development of the immune system. It is an important candidate gene involved in susceptibility/resistance to various diseases. It is associated with intercellular recognition and with self/nonself discrimination. It plays major role in determining whether transplanted tissue will be accepted as self or rejected as foreign. Scope in dairy animal and poultry depends in part upon the heritability of the trait or traits used to measure disease resistance, as well as the amount of variation among animals. The heritability of traits associated with resistance to many important diseases is often low to high and considerable variation among animals exists, breeding for disease resistance depends upon whether there are trade-offs with other economically important traits.. There are certain constraints such as microbes can change their genetic makeup much faster than we can change the host's genetic ability to resist them, data regarding the immune response, disease resistance and

economic production traits are not always available, genetic correlation between production and disease resistance are often antagonistic, milk yield in cattle has antagonistic correlation with metabolic and physiological traits. Thus an approach in which disease are ranked in terms of their importance and also in terms of their amenability to genetic selection and need to genetically improve resistance has to be established. The benefit of achieving improved resistance should be assessed.

INTRODUCTION

Livestock diseases adversely affect animal production throughout the world and it imposes a large cost on livestock production system, as all production system being vulnerable to diseases. Productivity of dairy animal depends on the genetic factors governing the production as well as genetic factors controlling disease resistance or susceptibility. Based on the direct costs of individuals diseases, total disease cost have been estimated to be up to 20% of turnover in developed countries and as high as 35-50% of turnover within livestock sector in the developing world (Bishop *et al,*2014). Options at the herd level include chemotherapy, vaccination, the control of disease vectors, and appropriate management methods. However, there are often constraints to the sustainability of such disease control strategies. Breeding for disease resistance stems partly from awareness of the development of pathogen resistance to the therapeutic agent , which has led to calls for reduction in the use of antibiotics and other drugs throughout the human and animal medicine (Axford *et al*. 2000), the possibility of between species transfer of resistances particularly from livestock pathogen to human pathogen, avoidance or reduction in the need for therapy. With the increase in importance of organic farming , to enable the human population to be adequately fed on traditional plant and animal organism and to lessen the impact of ecological perturbation involved with modern pharmaceutical intervention. For these reasons, new approaches or alternatives to addressing animal diseases are needed. One approach is genetic selection for animals resistant to disease. Breed differences for disease related traits have been documented in many different species. However, it is difficult to determine why some animals become sick while others remain healthy. Animal health is influenced by many factors including genetics, nutrition, age, stress, management system, season, pathogen dosage, immunological background, epidemiology, animal biological status, and many other variables. These factors interact, thus confounding our ability to understand the mechanisms of disease resistance.

Understanding of immune system

Knowledge of the mode of disease infection and host response is essential to comprehend the complexity of selecting for disease resistance. Three sets of gene affects resistance: those responsible for innate immunity, those that determine the specificity of the adaptive immune response, and those affecting the quality of acquired immune responses(Axford *et al*,2000). Nramp1 is a gene controlling resistance to intracellular pathogens and determinant of innate resistance. It is involved in regulation of MHC class 1 gene (Behl *et al*.,2012). It is found to be associated with bovine brucellosis resistance and susceptible phenotypes. Adaptive immune responses are distinguished from innate immune mechanism by a higher degree of specific reactivity for the inducing agent and recall memory. It can be cell mediated or antibody mediated and involves antigen –presenting cells, thymus-derived cells and bone marrow – derived cells, antigen recognition molecule MHC (Major histocompatibility complex) class I and class II proteins on APCs, T cells and B cells where as quality of adaptive immunity depends on interaction between APCs, T cells and B cells.

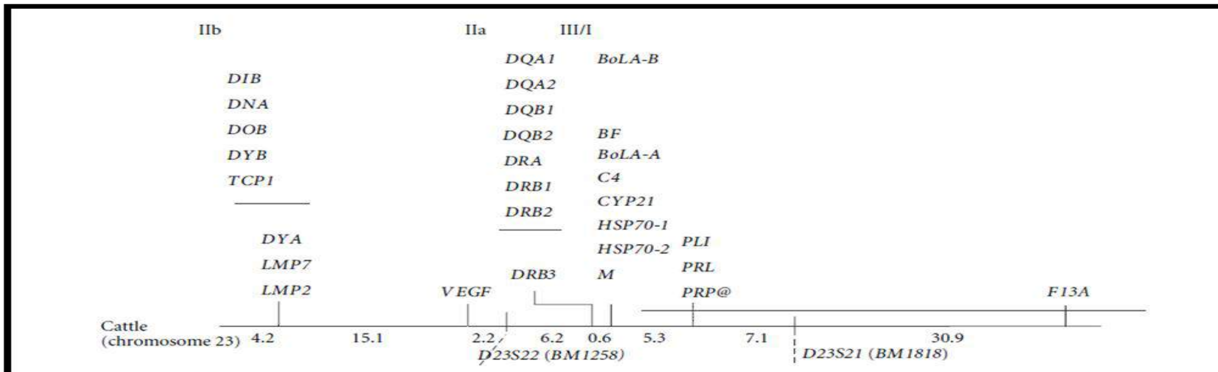

FIGURE 1: Genetic Linkage map of the major histocompatibility complex region in cattle (World Organisation for Animal Health (OIE)

Major Histocompatability Complex

The major histocompatibility complex which is found to occur in all mammalian species plays a central role in the development of the immune system. It is an important candidate gene involved in susceptibility/resistance to various diseases. It is associated with intercellular recognition and with self/nonself discrimination. It plays major role in determining whether transplanted tissue will be accepted as self or rejected as foreign.

The bovine MHC genes have been mapped to the bovine autosome 23 (BTA 23) and is referred to as Bovine Lymphocyte antigen (BoLA). The genomic organization of the MHCs of ruminants differs from that of mice and humans as class II region in ruminants is split into two subregions which are separated by at least 15cM ,from DYA in the class IIb region to DRB3 in class IIa region. (Fig.1)

Scope of Selecting for Disease Resistance

Before we go to the scope of selecting for disease resistance there are various terms which are confusing or sometime interperated wrongly. First is disease resistance which is defined as the ability of the host to exert some degree of control over pathogen life cycle (Bishop,2012). Second is tolerance, it is animal's ability to withstand the pathogenic effects of infection. Third one is resilience, it describes an animals ability to maintain performance in the face of disease challenge and the genetic resistance is the genetic component to resist pathogen.

Scope for genetics of disease resistance depends on feasibility, sustainability and desirability. The concern about feasibility was articulated by Fisher (1930). If a gene has a favourable effect on host survival (strictly speaking on reproductive success) then natural selection will fix the gene. Therefore additive genetic variation will not persist for traits that influence survival, such as resistance to important diseases. This is a powerful and oft-repeated argument. Certainly, many traits related to survival or reproductive success have low heritabilities (Nicholas 1987). However, a survey by Morris (1998) suggested that the average heritability of a range of disease and production traits was similar. Further, differences in the breeds has been shown for traits associated with many different diseases(FAO,2007). The evidence falls into three areas: differences among breeds or strains (Table.1 and 2), association of specific genes or genetic regions(Table. 3) and the existence of significant heritabilities.

Genetic selection for disease resistance

Selection for disease resistance is costly. Potential costs associated with measuring disease resistance include reduced production, mortality, decreased longevity, diagnostic costs, and therapeutic expenses although it can be done through two methods- Direct selection and Indirect selection (Fig.2.)

Direct selection

Direct selection for disease resistance can occur in three different scenarios (Rothschild, 1998).

First, animals may be observed in a given production system or environment for lack of clinical expression of a disease. Under this selection approach, it is assumed that the disease pathogen is constantly present. The second direct approach is to uniformly challenge all breeding stock with infection. This approach can be costly depending upon the pathogen's virulence and clinical expression of the disease but is a reliable measure of disease resistance. A third approach is to challenge relatives or clones of the breeding stock, especially if the disease has a high mortality rate. This latter approach is also a reliable method of determining genetic resistance. Templeton et al., (1990) increased natural resistance to brucellosis in calves from 20% to 59% after breeding cows to a naturally resistant bull.

Indirect selection

Indirect selection for disease resistance can be achieved by selecting for indicators of disease resistance. Indicators of disease resistance include pathogen products (i.e. pathogen reproductive rates, pathogen byproducts), and biological or immunological responses. For effective selection, indicator traits must be heritable, highly genetically correlated with resistance to the disease or diseases of interest, accurate to measure, and affordable. Here we can take the example of mastitis in cattle which is one of the most prevalent disease of dairy cattle, which causes huge economic losses to the dairy industry worldwide. The incidence rate of clinical mastitis world wide estimated to be 25%-60% .Genetic promoters of mastitis resistance is mainly SCC (somatic cell count) it enumerate the concenteration of udder epithelial cells and WBC which are shed in milk and are used routinely in milk quality. SCC was the most suitable indirect trait for reduction of mastitis through selection (Mrode and Swanson, 1996). Heritability of SCC varied from 0.07 to 0.19 (Schutz et al, 1994, Roger et al, 1995) and genetic correlation of SCC with mastitis was high ranging from 0.65(Philepsson et al.,1995) to 0.97 (Lund et al.,1994). BoLA loci found to have a potential as marker in breeding for mastitis resistance.

Marker assisted selection and candidate gene

Now that genetic linkage maps are available for the common farm animal species, work has intensified to find quantative trait loci (QTL) and candidate genes for each diseased condition. The great potential of marker- assisted selection for disease traits is that it bypasses the need for challenging animals with the disease organism, and the associated ethical concern. Most genes related to disease resistance have been discovered using inbred strains of mice. Only a few genes have been linked to disease resistance in cattle. The Nramp1 gene (natural resistance-associated macrophage protein) isassociated with the innate immune system. Nramp1 has been linked with resistance to brucellosis (Harmon et al., 1989), tuberculosis, and salmonellosis (Qureshi et al. 1996). Recently, a region on chromosome 1 was associated with infectious keratoconjunctivitis (pinkeye) in cattle (Casas et al., 2006). Comparative genomics may make the identification of disease loci easier and more affordable. It may be possible to identify similar genes associated with disease susceptibility/resistance among human, mice and livestock.

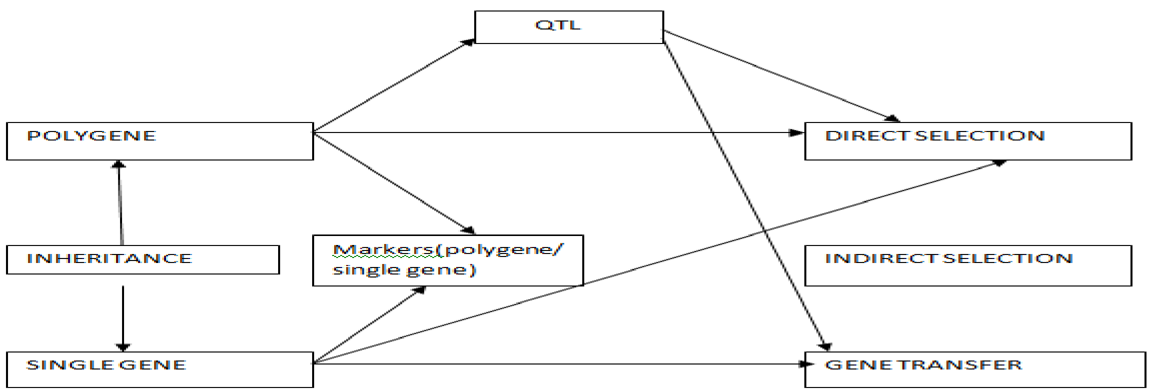

Fig. 2. A strategy for selection for disease resistance

Challenges in genetics of disease rsistance

Identification of phenotype Identifying the phenotype for disease resistance is difficult. It is a false assumption that in a population of sick and healthy animals all healthy animals are disease resistant. Some susceptible animals may not have been sufficiently exposed to the disease organism to get sick. Animals that appear healthy may have sub-clinical infections and represent pathogen reservoirs. Often the clinical expression of a disease can be confounded with a similar disease; for example pneumonia can be confused with bronchitis, emphysema, pleuritis, pulmonary adenomatosis, upper respiratory infection, and pleural fibrosis. Accurate disease diagnosis is costly and time consuming. Selection for disease resistance is much more complicated than selecting for production traits which can be measured directly or indirectly on each animal. In regards to selecting for disease resistance in livestock, it may not be ethical or cost efficient to challenge each animal with a pathogen to determine its level of disease resistance.

Indirect selection of more than one disease Before breeding schemes for disease resistance can be developed, consideration of many different scientific areas such as microbiology, epidemiology, immunology, host-pathogen interaction, host biology, livestock production systems, etc., must be understood. For example, selection for animals resistant to a particular pathogen may result in indirect selection for a more virulent pathogen or, development of highly resistant animals to one specific pathogen may make the animals more susceptible to another pathogen.

Cost benefit ratio Justification for including disease resistance in breeding programs can be challenging to establish. Most importantly, the economical cost of the disease must be sufficiently high to rationalize selecting for resistance. If antibiotics and other drugs have become inefficient because of microbial resistance, selection for disease resistance may be logical. Genetic selection for disease resistance may be useful against diseases for which neither vaccines nor therapeutics have been found. Selection may also be of interest for diseases due to a variety of pathogens infecting the host in a similar manner or pathway. Organic meat production systems that cannot use vaccines or therapeutics may also find it economically important to select for disease resistance.

Disease resistant traits antagonistic to production trait Selection for disease resistance may be unfavorable for animal production. If the genetic factors that improve disease resistance reduce production traits such as growth or feed efficiency then selection for disease resistance will decrease production. There is sufficient evidence that such negative genetic correlations do exist. Milk yield in dairy cattle has a positive correlation with many disease traits (van Dorp et al., 1998). Selection for growth rate in turkeys increased their susceptibility to Newcastle disease (Sacco et al., 1994). In beef cattle, the genetic correlations of disease resistance with growth and feed efficiency traits are unknown. If these genetic correlations are unfavorable, then a selection index for total merit may be feasible to maintain production levels while selecting for disease resistance.

Conclusions

A approach of genetic resistance to disease should be ranked in terms of their economic importance and also in terms of their amenability to genetic selection. Benefit cost ratio should be assessed for the sustainability and desirability and need to genetically improved resistance has to be established. However, genomic exploration with phenotypic recording offers new opportunities in genetic progress. New techniques and sources could be used to generate new data for best selection in livestock

Table 1.

Disease	Buffalo	Cattle	Goat
Trypanosomiasis		17	4
Tick infestation	1	17	
Anaplasmosis		2	
Piroplasmosis		4	
Heart water/		1	
Internal parasite	1	2	1
Fasciolosis	2		
Bovine leukosis		9	
Foot rot		1	
Total	4	59	5

Table.2.

Disease	Resistant breed	Compare	Exp.Cond.	Result	References
H. controtus	N'Dama	Zebu	Village herd	Fewer abomasal worm, lower FEC	Claxton & leaperre, 1991
Ticks (amblyomma, hyalomma)	N'Dama	N'Dama x Zebu	Field condition	Fewer ticks	Marttioli et al.,1993
Ticks (anaplasma marginale)	N'Dama	Gobra zebu	Field condition	Lower serological Prevalence &fewer ticks	Marttioli et al.,1995
Theileria Annulata	Sahiwal	Holstein-Friesian	Artificial infection	Less sever clinical symptoms	Glass et al., (2005)

REFERENCES

Axford, R.F.E., Bishop, S.C., Nicholas, F.W. and Owen, J.B.(2000). *Breeding for disease resistance in farm animals. 2nd Edition, CABI Publishing.*

Behl, J.D., Verma, N.K., Tyagi,N., Mishra,P., Behl, R. and Josh, B.K.(2012). The Major Histocompatibility Complex in

Bovines: A Review . *ISRN Veterinary Science*. 2012 : 1-13

Bishop, S.C. and Woolliams, A.J. (2014). Genomics and disease resistance studies in livestock. *Livestock Science* 166 : 190-198.

Casas, E., and R. T. Stone. 2006. Quantitative trait loci for infectious bovine keratoconjunctivitis. *Anim. Genetics* (submitted).

Claxton, J. & Leperre, P. 1991. Parasite burdens and host susceptibility of Zebu and N'Dama cattle in village herds in the Gambia. Veterinary Parasitology, 40(3–4): 293–304.

Glass, E.J., Preston, P.M., Springbett, A., Craigmile, S., Kirvar, E., Wilkie, G. & Brown, C.G.D. 2005. Bos taurus and Bos indicus (Sahiwal) calves respond differently to infection with Theileria annulata and produce markedly different levels of acute phase proteins. International Journal for Parasitology, 35(3): 337–347

Harmon, B. G., L. G. Adams, J. W. Templeton, and R. Smith III. 1989. Macrophage function in mammary glands of Brucella abortus-infected cows and cows that resisted infection after inoculation of Brucella abortus. *Am. J. Vet. Res*. 50:459-465.

Lamont, S. J. 1989. The chicken major histocompatibility complex in disease resistance and poultry breeding. *J. Dairy Sci*. 72:1328-1333

Lund, T., Miglior, F., Dekkers, J.C.M. and Burnside, E.B. (1994) Genetic relationships between clinical mastitis, somatic cell count and udder confermation in Danish Holsteins. *Livestock Production Science* 39(3), 243-251.

Mattioli, R.C., Bah, M., Faye, J., Kora, S. & Cassama, M. 1993. A comparison of field tick infestation on N'Dama, Zebu and N'Dama × Zebu crossbred cattle. Veterinary Parasitology, 47(1–2): 139–148.

Mattioli, R.C., Bah, M., Kora, S., Cassama, M. & Clifford, D.J. 1995. Susceptibility to different tick genera in Gambian N'Dama and Gobra zebu cattle exposed to naturally occurring tick infection. Tropical Animal Health and Production, 27(2): 995–1005.

Morris, C. A (1998) Responses to selection for disease resistance in sheep and cattle in NewZealand and Australia. *Proceedings of the 6th world congress on genetics applied to livestock production*. 27:295-302.

Mrode,R.A. and Swanson,G.J.T.(1996). Genetical and statistical properties of somatic cellcount and its suitability as an indirect means of reducing the incidence of mastitis in dairy cattle. *Animal Breeding Abstract* 64(11): 847-857.

Nicholsan, F.W.(1987). *Veterinary Genetics*. Oxford University Press, Oxford.

Philipsson, J., Ral, G. and Berglund, B.(1995) Somatic cell count as a selection criterion for mastitis resistance in dairy cattle. *Livestock Production Sciences* 41(3): 195-200.

Qureshi, T. J. W. Templeton, and L. G. Adams. 1996. Intracellular survival of Brucella abortus, Mycobacterium bovis

(BCG), Salmonnella dublin and Salmonella typhimurium in macrophages from cattle genetically resistant to Brucella abortus. *Vet. Immunol. Immunopathol.* 50:55-66.

Rogers, G.W., Hargrove, G.L. and Cooper, J.B. (1995). Correlation among somatic – cell scores of milk within and across lactations and linear type traits of Jerseys. *Journal of Dairy Science* 78(4):914-920.

Rothschild M. F. 1998. Selection for disease resistance in the pig. Proceedings of the National Swine Improvement Federation, Raleigh, North Carolina.

Sacco, R. E., K. E. Nestor, Y. M. Saif, H. J. Tsai, and R. A. Patterson. 1994. Effects of genetic selection for increased body weight and sex of poults on antibody response of turkeys to Newcastle virus and Pasturella multocida vaccines. *Avian Dis*. 38:33-36.

Templeton, J. W., D. M. Estes, R. E. Price, R. Smith III, and L. G. Adams. 1990. Immunogenetics of natural resistance to bovine brucellosis. *In Proc. 4th World Congr. Gene. Appl. Lvstk. Prod.* 396- 399.

van Dorp, T. E., J. C. M. Dekkers, S. W. Martin, and J. P. M. Noordhuizen. 1998. Genetic parameters of health disorders, and relationships with 305-day milk and conformation traits of registered Holstein cows. J. Dairy Sci. 81:2264- 2270.