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Sustainable Utilization Of Livestock Waste

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

The term sustainable development is defined as development to achieve the needs of present generation without compromising future generation's needs. Future generations are mainly related to the environmental problems of resource consumption and pollution and their distribution over long time horizons (Chaturvedi, B.K. 2011). Human population increases geometrically (1, 2, 4, 16, 32, 64, 128, 256, etc.). However, food supply, at most, can only increase arithmetically (1, 2, 3, 4, 5, 6, 7, 8, etc.). Therefore, since food is an essential component to human life, population growth in any area or on the planet, if unchecked, would lead to starvation. The traditional method of disposing animal wastes has been to spread them on the land because of their excellent fertilizing properties. Due to intensified production of livestock, livestock waste also increasing in tonnes, which has to be disposed off in suitable methods to minimise the environmental hazards.

ENVIRONMENTAL HAZARDS

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

LIVESTOCK WASTE IN THE WORLD

Wastage occurs at all points along food manufacture and in final consumption of food by people. Ledward, *et al* (1983**)** predicted that the wastes coming from different sectors (meat, dairy, poultry) of the livestock processing industries reaches 4.38 million lbs. daily, Biochemical Oxygen Demand (BOD) discharge. Muller (1980) estimated that the global volume of fecal wastes from broilers, laying hens and breeding chickens (excluding turkeys) is to be over 46 billion tons; turkeys about 2.6 billion tons; cattle almost 932 billion tons; buffalos almost 100 billion tons; and from pigs nearly 109 billion tons for a total of 1, 188 billion tons of animal wastes.

Low acceptability or palatability are limiting factors for those waste products of the livestock and poultry industry and also manure as a feed. However, in most cases, it is considered advisable to explore the potential for an upgraded waste product in the animal feed market first.

MANURE CHARACTERISTICS

As a result of rapid growth of the livestock industry, not only feedlot operators but also poultry and dairy operators are faced with the problem of disposing of vast quantities of animal waste and litter. There are obvious variations in the characteristics of wastes from livestock feeding operations. Animal feces frequently contains different feed additives to

Table 1. Feed additives in faeces of livestock and Poultry (Hasimoglu,S.& Aksoy,A. 1998)

Compound	Animal	Use level**	Claims***	Withdrawal
Antibiotics				48 hr at 350 mg /head/day before slaughter
Bacitracin	Feedlot cattle	35 mg./h./d	GP	
Chlortetracyclin	Beef cattle	70 – 75 mg./hd./d	GP, FE, LA	
Chlortetracyclin	Chicken, Turkey	10 – 500 g./T	GP, FE, RD	
Chlortetracyclin	Swine	10 -100 g./T	GP, FE, BE	
Antimicrobials				15 days before slaughter
Arsanilic acid	Chicken, Turkey	45-90 gl/T	GP,FE,EP,CC	
Monensin	Broilers	90-110 g./T	CC	
Sulfamethazine	Swine	0.0025%	GP, FI	
Hormones				
Thyroprotein	Dairy cows	0.1 – 1.5g/100lb BW	MP	
Thyroprotein	Growing Ducks	100 – 200 g/T	GP	
Special Additives				
Amprolium	Calves	5mg/kg BW for 21d	CC	24 hrs
Phenothiazine	Chicken, turkeys	0.2 – 0.6 % in feed	Cecal worms	
Levamisole	Swine	0.08%	GW, Lungworm	72 hrs before slaughter

** Quantities are given in grams (g) per ton (T) of feed or % in feed in most instances.

*** Abbreviations used: GP, growth promotion; FE, feed efficiency; LA, lactation; RD, respiratory disease; BE, bacterial enteritis;; EP, egg production; CC, coccidiosis, MP, milk production; GW, gastro intestinal worm control.

increase weight gains (Church, 1986). Some of the additives are inhibitory to microorganisms or pathogens and considered pollutant (Dove and Hayden 1992) and thus may affect the performance of biological treatment units for animal wastes. Summary of animal waste characteristics are presented in Table 2.

NEED FOR UPGRADING ANIMAL WASTE

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

1. CONVERTING ANIMAL WASTE TO FOOD

Animal wastes and crop residues can all be converted to food by some form of bioconversion. Chemical and physical treatments of animal wastes may not be suitable for direct food production because it may be difficult to monitor the safety for health. Higher fungi-mushrooms have been used as human food for centuries. Mushrooms can transform nutritionally valueless wastes (manure and crop resides) into highly acceptable nutritious, valuable food. Kurtzman (1979) indicated that *Agaricus bisporus* (common mushroom) and *Agaricus bitorquis* can be grown on composted horse manure or rice straw. After using for mushroom growing, the compost can be returned to the field as fertilizer. Under a controlled environment, mushroom shelters can be productive units yielding up to 120 kg/m^2 each season. Microbial conversion of wastes, including manure, offers the opportunity to convert a large fraction of their nutritional need into an effective demand by helping the undernourished in the Third World to supply their own food and feed.

2. FEED FROM ANIMAL WASTE

Nutrients from waste are, either directly

Table 2. Animal waste characteristics (Hasimoglu, S. and Aksoy,A. 1998)

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

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

Ensilage is effective in making animal wastes safe for refeeding (N.R.C. 1981). When properly treated, ensiled wastes undergo lactic acid fermentation, and if the product is held for 10 days in a silo prior to feeding, pathogenic bacteria such as Salmonella, parasidic nematodes, and coccidia are practically eliminated. Spore forming bacteria, while not destroyed, do not proliferate; these bacteria are usually not harmful. Moreover, ensiled animal wastes look and smell better than untreated excreta. In this system, a workable formula is 60 parts swine or cattle waste, 20 parts air dried poultry litter, and 20 parts ground grain, hay or crop residue. This type of formula is generally known as "wastlage" (N.R.C. 1981). Wastlage may constitute the entire ration for breeding cattle; enriched with higher energy feed, it can be fed to growing and lactating animals (Muller, 1980). In some commodities, the chemical nature of the waste material for example, the high ash content of chicken manure and high silica content of rice hulls and straw may be unsuitable (N.R.C. 1981). Cooke and Fontenot (1990) showed that even though swine waste and broiler litter are high in ash, sheep and steers absorb phosporous from poultry manure effectively.

The controlled discharge of animal and human wastes may cause environmental pollution and threaten public health. Research in different countries have shown that algae is one of the cheapest ways to treat animal waste waters which is excellent substrate. Algae, the microscopic planktonic plants, are capable of photosynthesis in the presence of sunlight and release of oxygen. The oxygen supports bacterial population that breaks down the organic matter in wastewater. This symbiotic action renders the organic matter in nocuous and at the same time converts the waste into nutrients for algae (Muller 1980). The water then has a much reduced organic matter with biochemical oxygen demand (BOD) ranging from 30 to 80 mg/L and can be discharged with minimal environmental impact. The algae containing 45-65 % crude protein can be harvested and processed for animal feed (N.R.C. 1981). Although algae production from human and

animal waste seems promising, the technology is not fully developed. The main concern is the possible contamination of manures by pathogens, antibodies, pesticides, hormones or other chemicals.

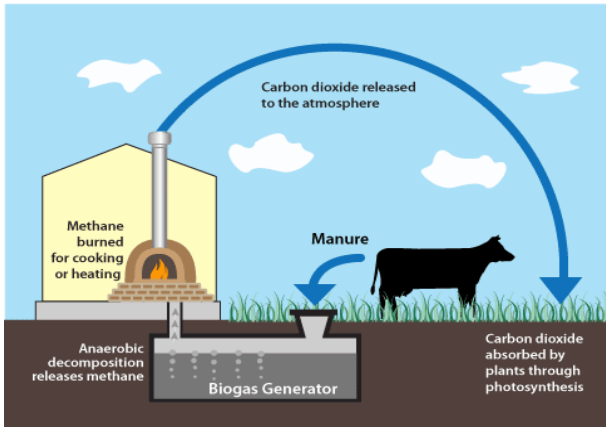
It should be noted here that for any food or feed materials, proper handling of the raw material and products is needed to assure animal and human safety. The feasibility of waste to feed projects depends on the characteristics, availability and cost of collection and transport of the raw material and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

3. FUELS FROM ANIMAL WASTE

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

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

- Produces an energy source that can be stored and used more efficiently.
- Creates a stabilized residue that retains the fertilizer value of the original material.
- Reduces fecal pathogens (Enteric viruses, Salmonella, Shigellae, E. Coli, Cholera, Hookworm ova, etc. and improves public health.
- Reduces transfer of plant pathogens from one year's crop residue to the next year's crop.



For any of the waste-to-fuel processes, availability of capital is always a limitation (N.R.C. 1981), especially for developing countries. However, centrally produced components could be an advantage. Different systems capable of handling different wastes form agro-industrial processing plant are discussed by different scientists (Middlebrooks, 1979; N.R.C. 1987). Integrated farming systems requires farmers to make changes in their traditional social patterns and farming practices (Augustburger, 1988).

4. FERTILIZER FROM ANIMAL WASTE

During the history of human beings, almost all nutrients and organic wastes were returned to the soil. N.R.C. (1981) claims that recent human activities have altered this cycle and organic wastes have been diverted into waterways. Fly control and destruction of disease vectors occurs in the process. On-site composting of poultry manure within the poultry house resulted in an odorless, fly-free environment and was relatively inexpensive. Whatever the form of nitrogen applied, it is normally quickly converted to the nitrate form by biological process. Nitrate is highly soluble rendering it highly mobile so that it moves with the soil water (Gardner and Watson 1986). Schilfgaarde (1986) indicated that in Iowa in the Big Spring Basin there is a close direct relation between the increase in fertilizer-N-use and the NO3-N recorded in the ground water since 1958. As Chemical fertilizer use goes up and the amount of manure used goes down, NO3 in the drain water also goes up (EPA's maximum nitrate (as N) contaminant level is 10 ppm.

CONCLUSION

- We should get ready to remove those chemicals from our food, feed, and fertilizer and most importantly from our environment which are the most harmful. As in the case of nutritional evaluation, two options are open for assuring acceptable safety aspects: analytical and biological testing which must be investigated thoroughly.
- Most of the residues, chemicals and pesticides in livestock waste feeding apparently represent no serious threat to humans, and different processing methods of animal wastes eliminate the danger of the pathogenic microorganisms.
- The need for cooperative action between the different disciplines of livestock industry and farm operations toward reducing the pollution coming from animal waste is necessary.
- Strict regulatory measures have to be implemented to control the environmental pollution to cater the conducive atmosphere in all spheres of development to the future generations.

REFERENCES

Augustburger, F. 1988. Utilization of biomanure produced from biogas technology in the Andean area. P. 225, In: P. Allen and D. Van Dusen Editors. 1988. Global Perspectives on Agroecology and Sustainable Agricultural Systems, Vol. 2. Agroecology Program, Univ. of California, Santa Cruz.

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

Church, D.C. 1986. Livestock feeds and feedings. A Reston Book Prentice-Hall, Englewood Cliffs, N.J. 07632.

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

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

Dove, C.R. and K. D. Hayden 1992. The effect of copper and fat addition to the diets of weaning swine on growth performance and serum fatty acids. Journal of Animal Science, (70) 3: 805.

Gardner, W.R. and J.E. Watson, 1986. Best management practices for control of nitrogen pollution by farm and feedlot. In: Summer, B.J. and S.S. Anderson Eds. 1986. Toxic Substances in Agricultural Water

Supply and Drainage. Defining the Problems. Proceedings from the 1986 Regional Meetings, U.S. Committee on Irrigation and Drainage, Denver, Colorado.

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

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

Middlebrooks, E.J. 1979. Industrial Pollution Control, Vol. 1: Agro-industries. John Wiley and Sons, New York.

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

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

N.R.C. 1987. Agricultural Biotechnology. National Academy Press, Washington, D.C.

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

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

Heat Stress In Dairy Animals: Implications And Mitigation Strategies

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Summer months are approaching, which are always stressful to both human beings and animals. Elevated environmental temperature along with high relative humidity are very detrimental both to the health and production parameters in dairy animals. Body metabolic systems are always in damage controlling adaptation mode to counteract the ill effects of scorching heat as a result the mechanisms working behind productive systems of animals become less efficient. This is the primary reason why high yielding temperate dairy cattle breeds are unable to cope up with the usual tropical environment of our country. Even the crossbred animals face problems in adjusting to the climate as a result drop in milk production from them during hot and humid seasons is a common problem in our conditions. Usually, animals gain heat from two sources: metabolic heat production within the body and environmental heat production from solar radiations and elevated ambient temperature. Increased body temperature disturbs the thermal balance of the body and heat related illnesses start to manifest, which range from heat edema (most common, but less severe) to heat stroke (least common, but more severe). On the other hand, crossbred dairy animals are almost unavoidable for a profitable dairy farm from their production potential and feed conversion efficiency point of view. In such a scenario, strategies aimed at reducing heat stress in dairy animals during summer months remain the only viable option for dairy farmers.

HEAT STRESS

Usually the term 'stress' indicates to the state of the body system which has been shifted from its normal state under influences of some extraneous factors. Therefore, the term 'heat stress' is used to describe the effects of elevated environmental temperature on body physiological mechanisms. Both human beings and animals have got compensatory and adaptive mechanisms to restore their homeothermy or thermal balance when they are exposed to extreme weathers, but performances begin to be negatively affected beyond a certain limit. Heat stress

is therefore primarily due to the imbalance between heat gain and heat dissipation processes in an individual. In simpler terms when heat load of an animal becomes greater than its capacity to lose heat, the animal is said to be under heat stress. Elevated ambient temperature is the primary reason behind heat stress that is why summer months are important from dairy management point of view. Apart from this high relative humidity, lack of air movement and poor night cooling are some of the additional factors that contribute to heat stress. There are basically four types of seasons in a year in our conditions (Table 1) basing on similar environmental variables (temperature, humidity, day length etc.). Cold seasons are also stressful, but discussions are limited to hot seasons only. Hot and humid season is particularly stressful to animals because air around the body is fully saturated (relative humidity may reach up to 100%), so heat exchange between body and environment is not efficient. Body starts to accumulate heat as a result animals start panting in an attempt to lose heat, which requires huge energy. Sweating is the most energy efficient method of heat loss in animals. But in hot and humid months though sweating occurs, vapourization does not occur due to high relative humidity. That is why hot and dry months are not so stressful as heat exchange mechanisms work efficiently.

Table 1: Major seasons in Indian conditions

Seasons	Months	Temperature	Humidity
Cold and humid	January-March	Low (< 35-36° C)	High (> 40%)
Hot and dry	March-June	High (> 35-36° C)	Low (< 40%)
Hot and humid	July-September	High (> 35-36° C)	High (> 40%)
Cold and dry	October-December	Low (< 35-36° C)	Low (< 40%)

MEASUREMENT OF LEVEL OF HEAT STRESS IN ANIMALS

Body vital parameters can give sufficient indications about the level of heat stress on the animal. When rectal temperature exceeds 39.4° C (103° F) and respiratory frequency reaches to about 100/minute, it is most likely to be due to heat stress. Along with these if feed dry matter intake (DMI) decreases to 10%, then the animal is under high stress and when DMI decreases to 20%, then it is a sign of severe stress. As previously discussed, both ambient temperature and relative humidity add to the severity of heat stress. So efforts have been made to arrive at a single value correlating above factors, which can measure the level of heat stress. One such scale developed by Johansen *et al.* (1963) is very frequently referred as temperature-humidity index (THI) or discomfort index (DI).

$$THI = 0.72 (T_{db} + T_{wb}) + 40.6,$$

Where T_{db} = Dry bulb temperature (° C) and T_{wb} = Wet bulb temperature (° C) THI values of 72 or less are considered comfortable, while values between 75 and

78 indicate discomfort to the animals. When THI exceeds 78 (80-85), animals more particularly lactating cows are under severe distress.

Another such formula for THI was developed by Thom (1988) basing on dry bulb temperature and dew point.

$$THI = 0.55\ T_{db} + 0.2\ dp + 17.5,$$

Where T_{db} = Dry bulb temperature (° F) and dp = dew point (° F)

THI values of 70 or less indicate that about 10% of the population is under stress, while values of 79 and above correspond to 100% of population under stress.

IMPLICATIONS OF HEAT STRESS

Heat stress implications are directly proportional to the severity of heat stress (Table 2). Symptoms of heat stress are rather clear and diagnosis can be made basing on such symptoms. Animals do adapt easily to minor or low level stress without any significant change in their productive and reproductive performances while the opposite is observed in case of severe stress. Even death of the animal is not unusual. The most usual visible sign is drastic reduction in DMI along with increased water intake by animals. Other signs are standing position by animal rather than lie down posture, increased body temperature and respiration rate, increased saliva production, panting, seeking of shade etc. Reduced feed intake creates energy deficit in dairy animals and symptoms related to negative energy balance start to manifest. At the same time, some metabolic and biochemical changes occur during heat exposure in order to adapt to the stress. So basically implications due to heat stress can be categorized into two parts.

A. Biological consequences due to reduced feed intake and other factors.

B. Metabolic and biochemical changes.

Biological consequences

The negative impact of heat stress on production, reproduction and health status in dairy animals is long thought to be due to reduced feed intake, but researches have also included factors like poor ruminal function, altered endocrine functions, reduced nutrient absorption and increased requirements. Major biological effects due to heat stress are listed below.

- Due to increase in core body temperature and inefficient heat dissipation processes, feed intake drastically reduces and energy requirements for maintenance increases. It directly affects milk production by lactating animals. Milk volume decreases along with decrease in fat content and increase in somatic cell count, which is the major economic loss to dairy farmers because of heat stress.
- Respiration rate increases in at attempt for heat loss which is manifested by panting progressing to open mouth breathing. A rapid loss of carbon dioxide in this process leads to respiratory alkalosis.
- To compensate the heavy loss of carbon dioxide via panting, animals increase the output of bicarbonate through kidney in an attempt to stabilize the bicarbonate to carbon dioxide ratio to 20:1. This adversely affects the buffering capacity of rumen as a result

normal ruminal activities are depressed. The drooling of saliva during panting also reduces the amount of saliva entering into rumen affecting ruminal health status.

- Because of reduced buffering action in rumen, heat stressed cows are more susceptible to sub-clinical and acute acidosis. Reduced feed intake followed by slug feeding during cooler parts of the day can cause acidosis. Sequel of acidosis such as laminitis, lameness, sole ulcers, white line disease etc. start to appear within few days to few months after occurrence of heat stress.
- Low fertility in dairy cows inseminated during summer months can be attributed to heat stress. Researches have indicated lower conception rates in cows due to lower estrous activity, reduced follicular activity and early embryonic death during summer months.
- It has also been observed that dry cows whose last trimester of gestation falls during hot months gave birth to calves with lower body weight and were more affected with metabolic disorders after calving.
- Growth rate in growing calves reduces due to lower energy availability and poor metabolism. Appreciable body weight loss in mature animals is also due to same reasons.
- Heat stress can result in sick cows which require additional care and management. The heath conditions commonly associated are dystokia, heat exhaustion, fatty liver in fresh cows, mastitis, adverse reactions to vaccinations leading to abortion and death etc.

Table 2: Heat stress implications in relation to THI.

THI	Stress level	Implications
≤ 72	None	
75-78	Mild	Animals seek shade. Respiration rate increases. Minimal effect on milk production.
80-89	Moderate	Drooling of saliva. Feed intake decreases and water intake increases. Milk production and reproduction are reduced. Body core temperature start to increase.
90-98	Severe	Discomfort to animals is at the peak. Marked decrease in milk production. Rapid respiration (panting) and open mouth breathing.
> 98	Danger	Death may occur due to hyperthermia.

Metabolic and biochemical changes

It is well understood that heat stress alters the body homeostasis to such an extent that the normal body functions are adversely affected. Animals try to counteract this situation with some well defined behavioral changes within a

certain limit. These changes are usually mediated by certain metabolic and biochemical changes in the body system, which are summarized below.

- Due to significant reduction in feed intake, animals usually enter to a state of negative energy balance, just similar to that of transition cows or cows in early lactation. The basic difference which is to be noted that while transition cows are in thermo-neutral state, heat stress cows are always in a state of hyperthermia.
- Transition dairy cows initiate body fat reserve lipolysis leading to mobilization of non-esterified fatty acids (NEFAs), which are a major source of energy during transition or early lactation period. But surprisingly increased NEFAs response is not seen in cows exposed to heat stress though they are also in a state similar to transition cows.
- The absence of NEFAs response in heat stressed cows may be attributed to their altered endocrine status. Acute heat stress causes a marked increase in circulating cortisol, norepinephrine and epinephrine levels just as that in case of transition cows. These hormones are known to induce lipolysis. But the major endocrine change usullay noticed in heat stressed cows is significant increase in circulating insulin level, just opposite to that of transition cows characterized by hypoinsulinemia. Insulin is a potent lipogenic and antilipolytic hormone, which is the primary reason why cows under heat stress do not show elevated NEFAs response.
- The state of hyperinsulinemia as exhibited by heat stressed cows is similar to that of lactating cows with a stimulated immune system, despite reduced feed intake. Cause of hyperinsulinemia is still unclear, but scientists have indicated lipopolysaccharide (LPS – an edotoxin produced by gram negative bacteria) to be a factor behind it. All experimental heat stressed animals have shown to have increased levels of LPS.
- There is significant shift in carbohydrate metabolism. As heat stressed animals do not use NEFAs as a source of energy, they rely on glucose as a fuel. This is the reason despite hyperinsulinemia, there is increased glycogenolysis and gluconeogenesis leading to increased hepatic glucose output.
- The effect of hyperinsulinemia on lipid metabolism is direct i.e. despite reduced nutrient intake during heat stress; animals usually show lipid accretion rather than protein deposition (carcass lipid to protein ratio increases). While the situation is just opposite in thermoneutral environment. Animals under restricted feed intake usually show protein deposition at the expense of lipid accretion (carcass lipid to protein ratio decreases).
- Heat stress adversely affects protein metabolism. Both muscle and mammary protein synthesis are reduced despite the fact that increased insulin level promotes tissue protein synthesis and reduces proteolysis. Due to inadequate feed intake (both in thermoneutral and heat stress conditions), skeletal muscle

is mobilized as a result plasma urea nitrogen level increases. A better indicator of muscle protein catabolism is either 3-methyl histidine or creatin, both of which are increased in heat stressed lactating cows and other animals.

- The adaptive response to those altered mechanisms due to heat load includes activation of heat shock factors (HSFs) and expression of heat shock proteins (HSPs). HSPs (also known as molecular chaperones) are particularly important from cell survival point of view. They bind to unfolded or misfolded proteins and restore their original conformation. Of these, HSP70 is most important and expression levels of HSP70 are most closely indicative of magnitude and duration of thermal stress. In addition to functions of cell protection, HSPs may stimulate insulin function.
- Heat stress most likely induces oxidative stress leading to mitochondrial damage, which is the primary source of reactive oxygen species (ROS) like superoxides. These when get accumulated in cells beyond cellular defense can damage proteins, DNA and lipids and decrease mitochondrial function. In response to increased ROS production, the antioxidant levels in cells increase quickly. Non enzymatic antioxidants include ascorbic acid and glutathione, while enzymatic antioxidants are superoxide dismutase, catalase, glutathione peroxidase and peroxiredoxin. These antioxidants detoxify the ROS and protect the cells from damage.

MITIGATION STRATEGIES

Basically three mitigation strategies can be considered for heat stress, which are listed below.

- Development of genetically heat tolerant dairy breeds.
- Physical modification of the microenvironment of the animals.
- Manipulation of existing feeding practices of the animals.

Heat tolerant dairy breeds can be developed through selection and breeding, but it is a long term process and beyond the scope of this article.

PHYSICAL MODIFICATION OF THE MICROENVIRONMENT

In order to prevent the effects of heat stress, keeping cows comfortable and as cool as possible are key managemental practices. Primary methods for altering the environment can be classified into two categories; first is the provision of shade with feed and water under the shade and the other is evaporative cooling strategies with water.

A. Shade

Provision of shade protects the cows from the primary sources of heat gain from the environment, which can be either natural shade or artificial shade. Trees are an excellent source of shade and cows also preferentially seek for tree shade over artificial man made structures. They are effective blockers of solar radiation as well as leaves help in cooling the air by the process of moisture evaporation from their surfaces. However, most trees don't survive under intensive use. As cows

congregate near the trees during intense heat periods of summer, they develop mud holes near the tree base and this leads to death of trees. But getting natural shade for cows is not always feasible in urban areas. In such a situation, artificial shade structure is the only solution. Some desirable features of artificial shade structure for effective heat abatement are listed below.

- When cows are to be confined inside the structure, then east-west long axis orientation is most preferred for getting maximum amount of shade. On the other hand if cows are free to move inside the structure, then a north-south orientation is better.
- Usually under stall barn system of housing, about 20 square feet of floor space per cow is optimum. But for hot and humid environment, floor space of 60 square feet per cow is recommended. Additional floor space is essential to provide extra open area for improved air movement.
- The floor should be made up of at least 4 inch concrete with 1.5-2% slope for effective drainage facility. It should be grooved to provide firm footing for cows. Earthen floors are not preferred as mud holes can develop quickly. The concrete slab needs to be larger than the area of the shade roof as the shadow of the structure is not limited to the area directly under the shade.
- Gable roofs with at least a 4:12 slope and continuous ridge opening are recommended to promote natural ventilation. Ridge caps should have a minimum of 1 foot of clearance between it and the roof peak. Structures without ridge openings can add significant heat load to cows through thermal radiation from the roof. In such conditions, thermal radiation can be reduced by cooling the roof with water, adding insulation, or painting the roof with a reflective type of paint etc.
- Shade structures of 40 feet wide or less should have a minimum eave height of 12 feet, while more than 40 feet wide structures should have eave heights of 16 feet.
- Provision of open side walls maximizes natural air movement. There should not be any wind block within 50 feet of the windward side of the structure.

B. Evaporative cooling strategies

Evaporative cooling strategies are costly, but they pay big dividends during summer months in terms of increased milk production in organized dairy farms. Water and air movement become the media by which the evaporative cooling by the cows is augmented. Some of the commonly used systems are narrated below.

1. Evaporative pads and fans: Mechanical air cooling by refrigeration or air conditioning is somewhat impracticable in dairy farms. The more economical method is the evaporative cooling pad and fan system which uses energy from air to evaporate water. A pump circulates water to the pads (corrugated cardboard type material), as a result air from fans is cooled through evaporation along with increase in its relative humidity. This system has now been replaced by a fine mist injection apparatus which injects water under high

pressure into the stream of air blown downward from above. Coolers are placed every 20 feet in the roof and air is pulled through the cooler at very high rates. These systems are best effective in arid climates, but also work well in humid climates.

2. High pressure foggers: Usually fogger nozzles are fitted to the exhaust side of the fans and they disperse very fine droplet of water into the fans. These water droplets are immediately dispersed into the air stream and quickly evaporate, thus cooling the surrounding air and raising its humidity in the process. Usually foggers are operated in day hours only, but fans operate continuously. Foggers should not be used in barns with side walls that restrict air flow.

3. Misters: Misters cool the air in the same principle as that of foggers, but the mist droplets are larger than fog droplets. Animas are primarily cooled by inspiration of cooler air. But misters don't work well in windy conditions or in combination of fans in humid climates as the big droplets are not fully evaporated before settling to the ground resulting in wet bedding and feed. Further an insulating layer may be formed between skin of animals and water droplets on hair, which can increase the heat load on animals. Thus misters are not generally advised for most of the dairy farms.

4. Sprinklers: These are different from foggers and misters in working principle. Sprinklers don't cool the air rather the large water droplet from them wet the hair coat and skin of the cow and then water evaporates to cool the hair and skin. This system is best effective in combination with air movement, so sprinkler-fan system is gaining popularity. Fans are usually tilted downward at 20-30^0 angles to provide an air flow of about 11000 cubic feet per minute (cfm). At least one 36 inch fan is necessary for each 40 animals at 30 feet interval. Nozzles are placed approximately every 8 feet interval above the cows. Sprinklers are fitted immediately below the fans so that water is thrown just under the fans which run continuously. Cows are sprinkled for 1-2 minutes at 15 minute intervals.

5. Cooling ponds: Cows can be affected by infectious diseases like leptospirosis and mastitis if they have access to natural ponds and streams. Therefore, cooling ponds may be a controversial method of heat stress management in dairy cows. However, artificial ponds (approx. dimensions of 50 x 80 feet and 4-6 feet deep) inside the dairy farm with inlet-outlet water facility represent a great option for relieving the heat load in dairy cows without any adverse effect on udder health or other diseases. The primary mode of heat loss in cooling ponds is conduction with a small amount lost by evaporation. The ideal temperature of water inside the cooling pond should be 75-86^0 F.

MANIPULATION OF EXISTING FEEDING PRACTICES

Nutrient requirements of animals are drastically altered during heat stress, so manipulation of feeding practices is one of the most promising options to combat the ill effects of heat stress in animals. Basically ration reformulation as per the

need of the animals is the best method. Along with that feed additives which are known to maintain animal health and productivity in heat stress can also be supplemented in the ration. One of the common nutritional interventions is to increase the energy density of the ration by increasing the amount of concentrates and supplemental fat and reducing the fiber content as feed intake is markedly decreased during heat stress. But a delicate balance has to be maintained between the concentrate and fiber content of the ration as heat stressed cows are highly prone to rumen acidosis. Some promising alternations in feeding strategies which can be attempted for heat abatement in dairy animals are described below.

A. Feeding regimen: Because of high discomfort and stress level during day time of summer months, cows usually consume more feed during comparatively cooler evening hours. So they can be encouraged to take more feed during these periods to maintain their normal dry matter intake. However slug feeding should be avoided and cows may be offered smaller meals at more frequent intervals. So it is recommended that at least 70% of daily feed of the cow should be offered during night.

B. Water: Intake of water by cows should increase during summer months to facilitate heat dissipation through respiration and sweating. Need of water is more by lactating cows as water is the primary nutrient for milk production. Water consumption increases by as much as 50% when THI becomes 80 or above. If adequate water supply is not provided during severe heat stress, then cows tend to divert the water for milk production towards heat dissipation processes. So provision of waterers inside the shade for continuous supply of clean water becomes almost mandatory in organized farms. At least 1 watering station should be there per 20 cows. Cows usually prefer water at $70\text{-}86^0$ F.

C. Fiber: Fiber is essential for proper rumen function. NRC (2001) has recommended minimum 25% neutral detergent fiber (NDF) in ruminant diets (minimum 21% effective NDF) with at least 75% of NDF from roughage sources. However, fibers produce more metabolic heat (acetate metabolism) than concentrates (propionate metabolism). So fiber content of the diet has to be reduced to a certain level during heat stress so as not to disturb rumen functions. Research works have indicated that a roughage NDF value of 60% still supports rumen functions with adequate milk fat from dairy cows during summer months. Another similar work suggests that a decrease in dietary NDF content to 23% and roughage fiber sources to 55% can provide sufficient effective fiber for dairy cows in the tropics. Dietary acid detergent fiber (ADF) should not be less than 18% for cows.

D. Protein: There is no concrete recommendation regarding protein supplementation during heat stress periods. Previously, it was thought to increase the protein level in diet because of reduced feed intake by cows. But recent evidences suggest that over feeding of protein, more particularly rumen

degradable protein is deleterious for animals. The excess protein undergoes heavy ruminal degaradation producing higher amount of ammonia beyond the utilization capacity of rumen microbes, which is eliminated from body in a energy consuming (7.2 Kcal/g of nitrogen) metabolic pathway. This further increases heat load on animals. Feeding of good quality low degradable protein has shown to improve milk production in heat stressed cows. So both quantity and form of protein play important role while feeding heat stressed cows. A recommendation which can be adopted is that the dietary CP level should not exceed 18% (only for high producing cows) with rumen degradable protein content be limited to 61% of diet CP.

E. Fat: Increasing dietary fat content is a very common practice to increase the energy density of ration and to reduce basal metabolic heat production. Heat increment of fat is less than forages and thus its supplementation could be beneficial during hot weather. However, there are inconsistent research reports regarding the benefits of increased fat supplementation. Some reports indicated higher milk production by cows fed high fat diet while some reports deny the effect of increased fat supplementation during heat stress. Although results are contradictory, but nutritionists still suggest slightly higher fat supplementation (6-7% of dietary fat; normal being 5%) during heat stress.

F. Minerals: Heat stressed cows loose considerable amount of potassium (K) through sweating and urination during heat stress, so dietary K concentration should be increased to 1.4-1.6%. Increase in dietary K concentration have resulted in 3-5% more milk production and increased DMI. Along with K, the concentrations of sodium (Na) and magnesium (Mg) have to be increased to 0.45% and 0.35%, respectively. Mineral formulations with higher levels of K and Na should be offered to lactating cows only as extra salt or K supplementation can cause udder edema in dry cows. If extra fat supplementation is to be provided, then the concentration of calcium (Ca) has to be increased to 0.9%.

G. Vitamins: Raising dietary vitamin levels have been suggested by some workers. If cows are getting 1,00,000 international units (IU) of vitamin A, 50,000 IU of vitamin D and 500 IU of vitamin E per day through their rations, then there seems no need of extra supplementation to cows during hot weathers. Fresh forages supply adequate vitamin E and cows synthesize vitamin D in sufficient amount on exposure to sunlight.

H. Dietary cation-anion difference (DCAD): DCAD of ruminant diets represenst the difference between concentrations of major cations and anions [DCAD = $(Na^+ + K^+) - (Cl^- + SO_4^{2-})$ meq/100 g DM]. Increasing DCAD has resulted in increased DMI in heat stressed lactating cows. This is probably due to the fact that a positive DCAD diet helps to overcome the acidosis problems in cows along with increase in blood buffering capacity. Using Na and K sources devoid of Cl and S will increase the diet DCAD. A positive DCAD of about +20 to +30 meq/100 g DM is found

to be a good option during hot summer months for dairy cows.

I. Buffers: Na bicarbonate is the most used ruminal buffer used to combat the effects of acidosis in heat stressed cows. Alkaline diets containing Na bicarbonate and Mg oxide are very effective for correcting low milk fat content during intense summer months. Rumen pH increases which is favourable for fiber digestion. Diet having more chloride content decreases blood pH and DMI, so dietary chloride content should not exceed 0.35% of DM for lactating cows under heat load.

J. Ionophores: As discussed earlier, heat stressed cows increase the process of gluconeogenesis to meet the glucose demand. Monensin is a well described rumen modifier which increases the production of propionate, the predominant gluconeogenic precursor. In ruminants. So ultilizing monensin may be a key strategy during heat stress to improve the glucose status of lactating cows.

K. Antioxidants: Oxidative stress is one of the deleterious effects of heat stress through generation of ROS. These are detoxified by antioxidants of the body system naturally. Dietary supplementation of antioxidants certainly helps in maintaining the oxidative balance and production potential in dairy cows. Supplementation of vitamin C and E has shown to relieve heat stress in goats with a reduction in cortisol level. Buffaloes when supplemented with synthetic antioxidant (viteselen) before and during heat stress have shown increased pregnancy and fertility rate. Herbal preparations have also enhanced the working efficiency of body antioxidants (enzymatic and non enzymatic) during heat stress.

L. Niacin: Niacin may be helpful in reducing body temperature during summer months due to its vasodilation action. It gives relief from heat stress by increasing evaporative heat loss from the body and reducing the ill effects of heat at cellular level. Thus supplementation of rumen protected niacin during heat stress is beneficial.

M. Fungal culture: Supplementation of yeast culture (*Saccharomyces cerevisiae*) has shown to increase DMI in transition cows during thermal load. Rumen health status is maintained, rumen pH is enhanced, acidosis risk is reduced and fiber digestion is improved.

N. Supplementations with insulin mimetic action: As discussed earlier, proper insulin action is a key component of successful adaptation of animals to heat load. So supplementations that enhance insulin action may be an effective way of survival during heat stress. Lipoic acid and its reduced form, dihydrolipoic acid act as scavenger of ROS and enhance cellular glucose uptake, thus may improve heat tolerance and animal performance during heat stress by enhancing insulin action. Chromium is a micromineral which facilitates insulin action on glucose, lipid and protein metabolism, more particularly glucose metabolism. Because use of glucose is predominant during heat stress, chromium supplementation may improve thermal tolerance and production level in animals. Similarly, thiazolidinediones (TZDs) are a group of drugs which can

improve insulin sensitivity. So TZDs could be very useful for improving glucose use during heat stress.

CONCLUSION

Due to continuous climatic change over the years, ambient temperature is on the increase resulting in global warming. This is bound to negatively affect performances by animals, more particularly milk production by lactating cows. Implementing heat stress abatement strategies is very important to maintain the productivity of animal along with reduction in fiscal losses. In addition to usual housing management and other heat amelioration efforts, nutritional strategies can prove to be the cost effective option to minimize summer induced losses. Primary focus of all feeding strategies is to keep the rumen healthy for improved feed intake and digestion. Diets or nutritional supplements improving insulin sensitivity and promoting glucose use may be crucial in terms of adaptation to heat load. Provision of shade and cool water to dairy animals is the simplest way of reducing heat load. Along with this, slight modification in feeding practices of the animals during summer months could go a long way in keeping the animals healthy and maintaining their productive and reproductive performances.

Hydroponics Fodder: Nutritious Livestock Feed

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Feeding of livestock constitute more than 60% cost. Feeding includes both the concentrate as well as the green feed. Feeding of livestock especially the dairy animals is incomplete without green fodder in their diets. There are various factors which govern production of green fodder. The major constraints in green fodder production is decreasing land size, water scarcity, more labour requirement, same quality green fodder availability round the year, manure/ fertilizer requirement and natural calamities. Therefore, it is need of time to have some alternative method to produce green feed throughout the year. So, in this context hydroponics fodder production system seems to be the most useful method for fodder production for livestock production sustainability.

What is hydroponics?

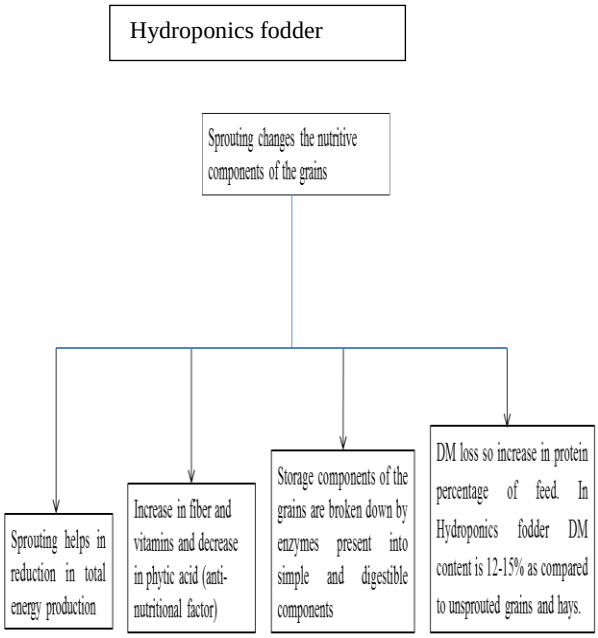
Hydroponic is derived from Greek word 'water working'. Hydro means water and Ponics means working. This technology is a part of hydroculture which involves growing plant without soil, but in water or nutrient rich solution for a short duration (Naik, 2013). Today, hydroponics is an established branch of horticulture. Rapid progress has proved it to be thoroughly practical making it more advantageous over conventional methods of horticulture. There are mainly two merits of this technology. First, hydroponics may potentially produce much higher crop yields. Also, hydroponics can be used in places where in-ground agriculture or gardening are not possible.

Hydroponics fodder system:

Although the methods of fodder production by hydroponics technology date back to the 1930's there is renewed interest in hydroponic fodder as a feedstuff for sheep, goat and other livestock. Hydroponics fodder growing system produce a greater yield over a shorter period of time in a smaller area than conventional method for growing fodder. Different types of fodder like maize, wheat, cowpea etc. can be grown

by hydroponics technology. Hydroponics fodder system are usually used to sprout cereal grains such as barley, oats, wheat, sorghum and corn or legumes such as alfalfa, clover or cowpea (Schoenian, 2014). Among above barley is the most commonly grown forage as it usually gives the best yield of nutrients. Hydroponics green fodder production unit consist of green house and control unit. Green house is ideal to grow hydroponic fodder because in this temperature, humidity and light is maintained. Temperature of approximately 70ºF, humidity 60% and light of 16 hours required for better result.

How Hydroponics fodder is beneficial?



Advantages of Hydroponics fodder:

1. ***Efficient use of water***- In this technology water recirculates to be used in feed for animal consumption. It uses as little as 1/20 the amount as a regular farm to produce the same amount of food. This technology requires 2-3 litre of water to produce 1 kg of green grass whereas conventional methods require an average of 80 litre of water for same quantity.
2. ***Less land requirement***- In limited area one can go for hydroponics fodder technology. In small area large yield of fodder can be obtained. No need for long term feed storage as there is daily production and no nutrient losses that can be associated with feed storage. On an average it uses 1/5th of total area needed by conventional system for agriculture.

Land required for production of 240 kg green feed/day for one year

Hydroponics	**218 sq.ft**
Conventional system	37673 sq.ft
Saving	37455 sq.ft

3. ***No environmental pollution***- It is well suited to organic producers as in this no chemicals, fertilizer is used which is unhealthy for livestock. So, fodder is free of diseases, pesticides residue.
4. ***Animal performance***- Best suited to non-ruminants (horses, rabbits, pigs and poultry) who would be more

benefitted when changes in the feed due to sprouting (eg: less starch, more sugars) as compared to ruminants (sheep, goat and cows) who are less efficient at digesting high quality feed. Better body weight gain, improved fertility, earlier heat cycles, improved fleece quality, improved immunity, better behaviour and temperament, less manure etc. (Schoenian, 2014).

Table 1: Effect of feeding Hydroponics on growth and reproduction

S.no.	Particulars	Control feed	Hydroponics fodder
1.	Initial Average B.wt (kg)	155	153
2.	Final Average B.wt (kg)	231	244.5
3.	Average weight gain/day (gm)	461	555
4.	Heifer conceived	11	17

In one study it was found that there was increase in milk yield by 0.5-2.5 litres per animal per day with increase in fat and SNF content. The Surat District Milk Producers Union Limited (SUMUL) conducted an experiment on heifers (20 no.) using Ayurvet hydroponics machine and found higher reproductive efficiencies by 55% and body weight 20% as compared to control group. In male, found to increase semen volume and semen concentration.

5. ***Cost effective***- As competition for land and water increases and feed prices continue to rise, hydroponic fodder could become a viable option for more livestock producers as it reduces the requirement for concentrated feed products.
6. ***Suited to dry and drought prone regions***- Best suited to semi-arid, arid and drought prone regions of world. As fodders are gown indoor so no problem for crop failure and hence good quality forage can be produced year around.
7. ***Nutritional value enhancement***- Hydroponic fodder is highly nutritious as compare to conventional feed in terms of protein, energy and vitamins. It has 3 times more protein and rich in vitamins A and E. Conversion ratio of seed to green feed is 7-10 times. Hydroponic fodder is nutritious as this involves whole plant (leaves, stems, roots).

Table 2: Protein % of some conventional fodder and hydroponics

Fodder	% Protein	
	Conventional fodder	Hydroponics
Maize	8.5	19-20

Barley	12	29
Oat	11.5	19

CONCLUSION

Although the methods of fodder production by hydroponics technology date back, it has various recent utility. This technology definitely proves to be better source of fodder production system, both in quality and quantity. Hydroponics technique is completely organic along with this helps to conserve various natural resources like land and water. It reduces dependency of livestock producers on weather and rainfall which can further helps in increasing production. Only the initial cost of installation is high but the profitability obtained by this technology nullifies this. Along with this if the government provides incentives and subsidies on fertilizer, seeds hydroponics can prove to be the most successful fodder production system in future.

REFERENCES

Naik, P.K., (2013). Hydroponics fodder as livestock feed. The Hindu daily newspaper.

Schoenian, S., (2014). Small Ruminant Info Sheet.

http://www.sheepandgoat.com/articles/hydrofodder.htm

http://www.bltrobotics.com/wiki/Hydroponics

http://www.liveotgrid.com/hydroponics.html

Dry Cow Management

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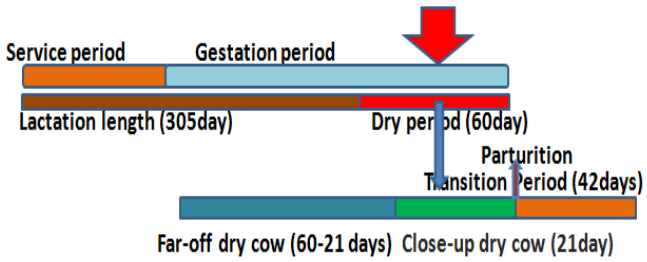
Dry cow management is critical for obtaining maximum dry matter intake, good health, increase reproductive efficiency and optimum milk production in the following lactation. These can be achieved by feeding balanced diets which will aid in avoiding metabolic disorders and maintaining improved disease resistance. Dry period is important for the rest and regeneration of tissues in the udder, when short or absent dry period reduces the number of secretary cell in the udder, and therefore, subsequent reduce the milk production. Dry cow is fed a high-fiber roughage diet, which helps restore the muscle tone of the rumen and allows time for any lesions in the liver to shrink.

DRY COW

A cow that is not lactating or secreting milk after it has completed a lactation period following calving.



Calving interval = Service period + Gestation period

Calving interval = Lactation length + Dry Period

Dry period = Far-off dry period + Close-up dry period

Transition period = Close- up dry period +21day after parturient

Why necessary for a cow to dry off:-

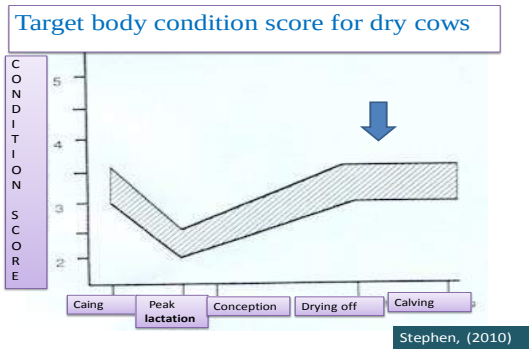
1. The mammary gland functions incessantly (without interruption) during the entire lactation period which results in wear and tear in the secretary cell of the udder.
2. Cow loose body condition during lactation.
3. Proper care, feeding and management of the dairy cow can help improve milk production and health of the dairy cow during the next lactation

Importance of the dry period;-

1. Prepare the mammary gland for the next lactation
2. Prepare the digestive tract for next lactation
3. To properly nourish the developing calf
4. To maintain optimum body condition

5. To minimize digestive, metabolic and infectious diseases

HOW TO DRY OFF



Abrupt cessation of milking:-

- Abrupt cessation of milking causes built up of pressure in the udder which no immediate permanent effect on the rate of secretion so drying off for few day
- Abrupt cessation method is the better one for low yielders, especially not for high yielders

Incomplete milking:-

- Emptying smaller and smaller quantities of milk from the udder spread over a week
- Incomplete milking is the best method of drying for high yielder cow otherwise may cause swelling and pen in the udder

Intermittent milking:-

- Milking once every second or third day
- This method is preferred for cows already having mastitis

A cow producing more than 40 pounds of milk daily dry- off by reducing feed intake by 50 to70 % will drastically reduce the supply of nutrient available to the udder causing milk synthesis to decrease and milking less frequently. Ideally, concentrate should be eliminated about 1-2 weeks before the dry off days. Separate dry cows from the milking herd, and allow them to get plenty of exercise.

DRY PERIOD LENGTH

The cow should be dry for 45-60 days. The date to begin the dry period is calculated back from the projected date of calving. Dry period length of cow is less than 40 day, the cow produce less milk in the next lactation compared to cow given a 45-60-days dry period. Dry period length of cow 70-days or longer dry period may have a slightly higher milk production, but it can not be economically justified. Dry period depends on the parity status: cow, 45-60 days and first calf heifer-60-70 days. If a cow is not dry off at all, the next lactation may be lower Production by as much as 25-30%.

BODY CONDITION SCORE

Body condition score is an indication of the amount of stored energy reserves held by the cow. It changes with stage of lactation. Body condition is a method of evaluating fatness or thinness in cows according to a five-point scale, a scale of 0 denotes a very thin cow while 5 denotes an excessively fat cow. Condition score 3, is the most desirable for the cow at drying off and calving.

Over conditioning or fatness, (BCS > 3.5), may cause the dry cow to have difficulty at calving, be more susceptible to metabolic disorders and infections. When milk production decreased and prolonged dry period. In contrast, under condition, or

thinness (BCS < 2.5), in the dry cow can frequently lower milk production; reduce the persistency of the cow's lactation. Thin cows often do not show heat or conceive until they start to regain or maintain bodyweight.

DRY PERIOD NUTRITION

Dry matter intake (DMI) tends to decrease during the latter part of the dry period due to increase in the calf size on reduction in rumen size. Due to this change in DMI, the diet nutrient density must be adjusted in the last 2 weeks to maintain nutrient intake. If this is not done, then actual quantities of nutrient intake will be decrease

Dry matter intake

Ingredient	**Far-off dry cow**	**Close-up dry cow**	**Milking cow**
Dry matter intake (%body weight)	**1.9-2.0**	1.6-1.8	2.5-4.0
NE(Mcal/lb DM)	0.57-0.62	0.63-0.72	0.75-0.78
Crude protein (%)	2	14-15	16-19

Source-: Pre-calving care equals post calving profitability (Amaral, 2007)

CONTROLLING ENERGY INTAKE DURING DRY PERIOD

Controlling energy intake during dry period might lead to better transition success (Dann *et al*., 2006; Douglas *et al*., 2006; Loor *et al.,* 2006). Controlling energy intake during the dry period is desirable (Holcomb *et al*., 2001; Agenas *et al*., 2003). Dry matter intakes remain more constant as cows approach calving when fed the high-straw, low energy diets than in cow fed high-energy close-up diets (Dann *et a*l., 2006; Janovick Guretzky *et al*., 2006). Common practices to feed ration of higher energy and nutrient density during the close-up period. This approach was designed in an effort to adopt the rumen microbial population and rumen papillae to higher nutrient diets fed after calving

A survey data collection in 277 herds (over 27000 Cow) in the United Kingdom, Ireland France and Sweden, changing to the high-straw, low energy TMR system decreased (Beever D.E, Richard Keenan and Co., Borris).

Complication	**Decreased by**
Assisted calving	53
Milk fever	76
Retained placenta	57
Displaced abomasums	85
Ketosis	75

PROTEIN REQUIREMENTS DURING DRY PERIOD

The protein requirement of the developing calf increases in the last 60 days of gestation. The optimum CP requirement for early dry period should be 12-13 CP%. Protein excess must be avoided which is associated with downer cow syndrome (Rick, 2008). Incidence of metabolic disorders in cows fed different level of CP during dry period.

Incidence	CP -8%	CP-15%
Number of cows	27	26
Downer cows	0	8
Abortions	0	3
Parturient paresis (milk fever)	2	4
Displaced Abomasum	0	3
Deaths	1	6

(Kjulien *et al*., 1997)

VACCINATION

Advantages of Vaccines at drying off:-

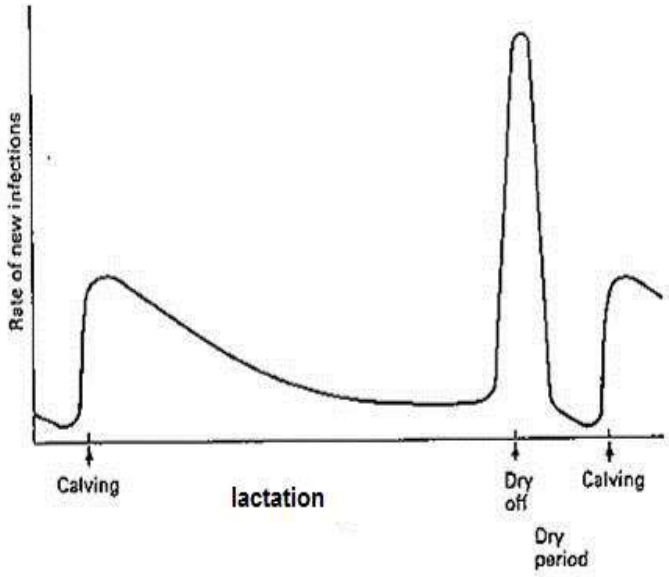
1. It should produce protective antibodies for calving time and early lactation.
2. Vaccination during the dry period results in protective antibodies in colostrum for passive protection of the calf.
3. Vaccine boosters for calf protection should be given three weeks prior to calving for maximum colostral antibodies.

DRY COW THERAPY

The risk of new intramammary infection is greatest during the early and latter portions of the dry period. The most effective time to treat udder infections is at drying off.

- The cure rate is higher than that achieved by treatment during lactation.
- A much higher dose of antibiotic can be used safely.
- Retention time of the antibiotic in the udder is longer.
- Tissue damaged by mastitis may be regenerated before freshening.

Timing of infection in udder



(Williamson et al., 1995)

CONCLUSION

Ensure sufficient body condition to provide reserve energy to meet requirements for milk production and reproduction in early lactation. Strengthen the cows' immune systems and body defences by ration balancing and supplementation of vitamins and minerals. Dry cow therapy is recommended for all cows that have had contagious mastitis and herds with high infection rate during lactation

REFERENCES

Amaral Donna M and Mazon Gustav, 2015, Why Should I Have Two Groups of Dry Dairy Cows philips

Bhalaru, S.S., Dhillon, J.S. and Tiwana, M. S. 1980. Body weight changes during early lactation and milk production in buffaloes. Progress Rep. V. Workshop

AICRP Buffalo, Udaipur, 13-14 Oct, 1980, pp. 16-17.

Williamson, G and Payne, W.J.A. 1978. An Introduction to animal Husbandry in tropics. The ELBS and Longmans, London. P.285.

Colic: Its Causes and Management in Equines

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The horse most commonly suffers from abdominal colic among the species of domestic livestock. Colic is an important cause of mortality and morbidity in domesticated horses. It is the leading cause of death and the number one health concern of horse owners. Term colic is derived from symptoms shown by animal suffering from abdominal pain. Precisely it indicates pain in colon. Horses are more susceptible to colic because horse's digestion involves fermentation of which a by-product is gas, which can easily distend the gut causing problems. Secondly, horses cannot vomit to get rid of toxins or indigestible food. Moreover, the gut has a large absorptive area which leaves the horse susceptible to toxins being absorbed quickly.

CLASSIFICATION OF COLIC

Origin of colic may be anatomical or clinical. Anatomical colic may be called True colic when it originates from the gastrointestinal tract (e.g. small or large intestine, stomach) and False colic when it originates from the organs other than gastrointestinal tract like liver (hepatic colic), bile duct (biliary colic), kidneys (renal colic) etc. Types of clinical colic are: Simple or spasmodic colic, Tympanic or windy, Impactive or obstructive and Extraluminal.

- Simple colic- sudden excessively increased peristalsis. Characterized by sudden intense but intermittent pain.
- Tympanic colic- also known as "Flatulence". Excessive accumulation of gas in GIT lumen. Characterized by intense but continuous pain with dyspnoea.
- Impactive colic- slow in onset, pain increases in intensity and lastly becomes continuous.
- Extraluminal colic- due to obstruction of lumen from outside of the bowel like volvulus invagination, torsion, strangulation, different type of hernias.

CAUSES OF COLIC

The causes of colic are numerous, but generally they are related to the anatomy and the microflora of the horse's gastrointestinal tract. Some more common causes of colic include:

Figure 1 Parasite infestation

- High grain based diets/Low forage diets
- Mouldy/Tainted feed
- Abrupt change in feed
- Sand ingestion

- Long term use of NSAIDS
- Stress
- Dental problems- like horse is unable to chew the food sufficiently
- Parasite infestation mainly *Strongylus vulgaris*
- Lack of water consumption leading to impaction colic
- Antibiotics- change the microbial population in the gut, which in turn affects starch digestion.

Figure 2: Faulty teeth arrangement

SYMPTOMS OF COLIC

- Pain
- Pawing
- Rolling
- Bloating
- Sweating
- Distress
- Uneasiness
- Looking at belly
- Kicking at belly
- Loss of interest in food and water
- Peculiar postures (sitting, stretching)
- Absence of gut sounds

GENERAL CLINICAL SIGNS OF COLIC

- Elevated body temperature
- Elevated heart rate
- Increased respiration rate
- Increased capillary refill time
- Change in mucous membrane colour

DIAGNOSIS OF COLIC

- History- like recent change in diet, change in activity, deworming etc.
- Physical examination- like colour of mucous membranes, capillary refill time, skin tenting time etc.
- Rectal examination- for diagnosing displacements, torsions, strangulation, impaction etc.
- Nasogastric intubation- useful

Figure 3 Rolling on ground

Figure 4 Sweating

Figure 5 Kicking at belly

Figure 6 Looking at belly

both as diagnostically and therapeutically
- Auscultation- for examining gut sounds
- Abdominal ultrasound- can diagnose presence of sand, strangulation, intussusceptions, wall thickening of intestine etc.
- Faecal examination- shows parasitic load

TREATMENT OF COLIC

It is important to know the cause of colic for its proper treatment. The severity of signs of colic is not always indicative of severity of colic. Sometimes it is very difficult to determine the cause of colic and hence its treatment. Many cases of colic can be successfully treated with medication, while the cases involving severe twist or impaction may requires surgical intervention. Basic treatment of colic is as follows:

- If pain is peracute or acute then there is danger of death. First step is to relieve the pain. For this potent analgesics are used like:

Inj. Xylazine @0.5-1.1 mg/kg body weight (IV)

Inj. Fortwin @ 0.5-1 mg/kg body weight (IV)

Inj. Megludyne @ 1.1-2.2 mg/kg body weight (IV)

- Correction of fluid, electrolyte and acid base abnormalities. A balanced, isotonic, polyionic fluid such as lactated Ringer's solution is preferred.
- In case of spasmodic colic; spasmolytics (like Atropine), Tranquilizers, Sedatives and easily digestible laxative feed is provided.
- In tympanic colic; anti-histaminic and anti-zymotics are used to treat the animal after relieving the pain. No feed and water is given to the animal up to 24 hours. Avoid easily fermentable feed and proper exercise of the animal is necessary in case of tympanic colic.
- In case of obstructive colic; relieve pain and then administer oily purgatives or perform enema with hot soapy water. Specific anthelmintics like Fenbendazole for *Strongylus vulgaris* are given to the animal. Correction of dehydration of animal is important. Antibiotics are administered to combat the bacteria.

Most of the colic cases can be treated on the farm with medication and use of a nasogastric (stomach) tube to alleviate gases and administer medication. However, cases related to displacement of organs or impaction requires surgical intervention.

DIFFERENTIAL DIAGNOSIS OF COLIC

Colic should be differentially diagnosed from diseases like Lactation tetany, Tetanus, Rabies, Laminitis, Uterine torsion, Peritonitis, Oesophageal pain, Testicular torsion, Obstructive urolithiasis etc.

PREVENTION OF COLIC

- A clean fresh water supply should always be available except immediately after work.
- Provide adequate regular exercise.
- Feed horse on a regular schedule even on the weekends.
- Do not make sudden changes to the horse's diet.
- Keep feed boxes and hay racks as well as the feedstuffs clean and free of mould and dust.
- Check teeth frequently for dental problems that may cause chewing issues.

- Feed the appropriate amount of high quality digestible forage (fewer stems, more leaves)
- Keep feed off the ground to avoid sand ingestion.
- Practice an effective parasite control program that fits the farms needs.

Figure 7 Avoid sand feeding

CONCLUSION

Colic is probably the most feared disease for the horse owing community. Many small and marginal farmers keep equine species like donkey, mule etc. for draft purposes. These animals are the main source of income to the small and marginal farmers. So, if their animals suffer from colic it is a great loss to the farmer. Horse owner needs to be able to recognize the symptoms of colic and early veterinary intervention should be sought. Majority of colic cases have a good outcome with appropriate treatment and care. Hence, by following a few simple guidelines and good horse management practices colic can be prevented in horses.

Artificial Insemination Technique in Cattle: Its Pros and Cons

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Artificial Insemination (A.I.) is process of collecting sperm cells from a male animal and manually depositing them into the female reproductive tract during oestrus period. A.I. is commonly used in many species instead of natural mating because of increased safety of animal and producer, increased production efficiency and better genetics. Natural mating is a stressful process and has a much higher tendency to cause injuries in both animal as well as producer. In cattle, males are quite large and sometimes aggressive also which increases the risks associated with natural mating. A.I. removes all the risks associated with keeping male.

HISTORY OF A.I.

- In around 1322 A.D. Arab chief wanted to mate his mare to a stallion owned by his rival. They used to steal semen of stallion.
- In 1780, Spallanzani successfully bred two dogs with the use of Artificial Insemination. He is called as inventor of A.I.
- In 1931, mass breeding of cattle by an A.I. corporation in Denmark.

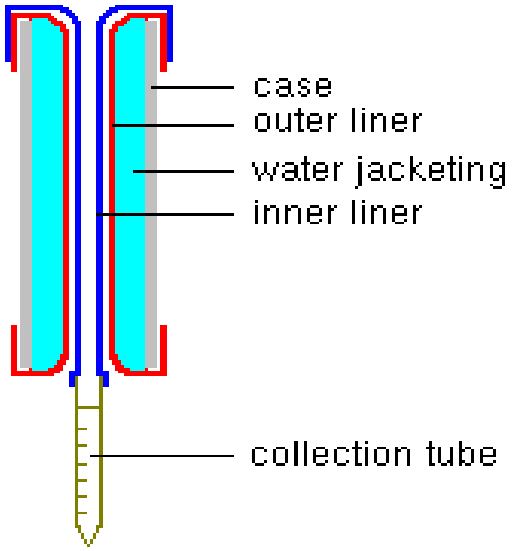
OBJECTIVES OF A.I.

- Genetic improvement of livestock
- Disease control mechanism
- Possible to increase fertility
- Decrease breeding expense

VARIOUS STEPS INVOLVED IN SEMEN STRAW PREPARATION

1. **Collection of semen**

The most commonly used method of semen collection in bull is through *artificial vagina*. Artificial vagina has following parts as shown in figure:



- A strong outer rubber cylinder having an inner diameter of 6 cm with a length between 30 cm for young bulls and 40 cm for adult bulls. A valve is fixed at about 5 cm from one end to admit water and air in preparation of artificial vagina.
- Inner sleeve of rubber or rubber liner.
- Semen collection tube made of glass or plastic having 10 ml capacity.
- Insulating bag

Before using for semen collection all the parts are washed thoroughly and sterilized properly, and assembled as artificial vagina. Warm water between 45-50°C is filled through the filling aperture into the space between outer cylinder and inner sleeve to provide an inner temperature between 42-46°C. An inside temperature above 47°C may kill sperms in the ejaculate. For collection, the cow or dummy is secured in service crate. The artificial vagina assembled is held at 45° angle from the direction of penis. The artificial vagina is held with the left hand by a right handed person; and when the bull mounts the cow, the sheath of the bull will be grasped by the operator, directing the glans penis into the artificial vagina, and then the bull gives a thrust to ejaculate. The operator should take care so as not to touch the exposed part of the penis. After the bull dismounts, the artificial vagina is taken off from penis and the air vent is opened to release the pressure from the jacket. The water from the jacket is also drained by opening the nozzle. This allows the ejaculate to flow from the cone to the

Figure 1: Artificial Vagina

semen collection tube. The semen collection tube is detached from the cone, plugged with cotton wool and taken to the laboratory for examination. Apart from this method, *Electro-ejaculation* method is also used in bulls. This technique was first adopted in 1922 by Battelli for collection of semen from guinea pigs. The salient points of the method are as follows:

- At the beginning the rectum is washed with 6 % sodium chloride solution.
- The probe is then inserted up to about 12 inches and held in a position of rectal floor.
- Alternate current increasing in voltage gradually from zero to 5 volts and returning again to zero within every 5 to 10 seconds is initially passed.
- The subsequent stimulations made progressively higher so that at about fifth stimulus a maximum of 10-15 volts is reached. Erection and ejaculation occur at 10-15 volts when 0.5-1 ampere current is flowed.

2. **Examination of semen**

It involves following tests:

- Macroscopic and physical tests- Volume, Colour, Consistency and cloudiness, Osmotic pressure, Specific gravity, Electro conductivity
- Microscopic tests- Counting of sperms, Motility of spermatozoa, Live and dead count, Morphological abnormalities
- Chemical tests- Fructolysis, Respiration co-efficient, Methylene blue reduction, Hydrogen ion concentration, Catalase test
- Bacteriological tests

3. **Dilution of semen**

Various milk or skim milk based, egg yolk based, coconut milk based and commercial dilutors are used for increasing the volume of the semen i.e. extension of semen. The main purpose of extending semen is to increase the volume of the ejaculate obtained from quality adult males so that a large number of females may be mated from a single dose of his ejaculate. Moreover, ejaculated sperm do not survive for long period and thus to preserve fertilizing capacity of the spermatozoa for a long period various agents are added.

4. Liquid semen Storage, Freezing and Thawing

For freezing, temperature is lowered down slowly and slowly. Storage of semen in liquid nitrogen is the most convenient and accepted method all over the world. Thawing of frozen semen should be done immediately before use and as quick as possible to prevent recrystallisation of water into bigger crystals. The most widely practised temperature of thawing is 37-40˚ C for 30 seconds to get optimum survival of spermatozoa.

Timing of Insemination for Maximum Conception

Success in insemination timing is dependent upon a good heat detection program. In large herds, this means assigning individual responsibility for heat detection and a continued education program for labour. A successful heat detection program and subsequent proper timing of insemination will pay dividends in increasing reproductive efficiency of the animal. The various symptoms of heat are:

- The animal will be in excited condition, restless and nervous.
- Frequent bellowing
- Reduced feed intake
- Peculiar movement of lumbosacral region
- The animals which are in heat will lick and smell other animals.
- The animals will try to mount other

animals.

- The animals will standstill when other animal try to mount. This period is known as standing heat.

This exists for 14-16 hours.

- Frequent urination
- Clear mucous discharge from the vulva
- Swelling of the vulva

- Congestion and hyperaemia of vulvar membrane
- Raised tail
- Decreased milk production
- On Palpation uterus will be turgid and the cervix will be opened

Since oestrus may last from 10 to 25 hours there is considerable latitude in possible time of insemination. Maximal conception is obtained when cows are inseminated between mid- oestrus and at the end of standing oestrus.

ARTIFICIAL INSEMINATION TECHNIQUES

Commonly used insemination techniques in cattle are: Speculum method and Recto-vaginal technique

RECTO VAGINAL METHOD

In cattle the safe and best method of insemination is Recto- vaginal method of insemination. Cow which is in heat is well controlled placing it in a Travis. The inseminator will get ready by wearing a plastic apron, gumboots and gloves. The semen straw after thawing is loaded in a sterilized A.I. gun and is covered with a plastic sheath. The inseminator will insert the gloved left hand into the rectum after applying the soft soap or other lubricant on the glove and back racked the animal and the hand is further inserted and will catch hold the cervix through rectal wall. The A.I gun loaded with semen straw is passed. Through the vulva to vagina and cervix and observed with the hand in rectum that the A.I. gun reaches the cervix, then the semen is deposited by injecting the gun and after depositing the semen the gun is removed. The empty straw and sheath are discarded.

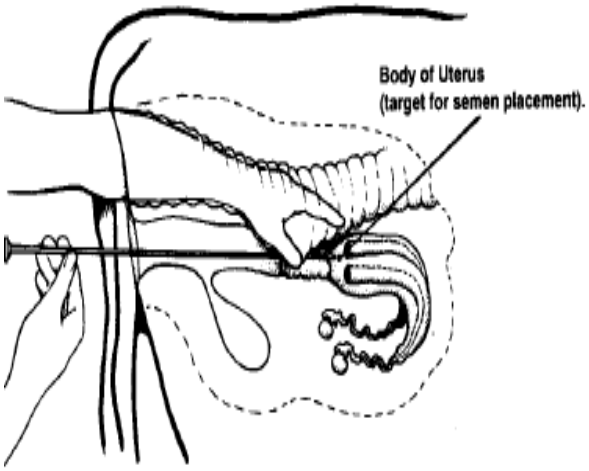
SPECULUM METHOD

In this method speculum is placed in the vagina of the cow which provides passage outside to the site of insemination. Inseminating pipette containing diluted semen is then introduced through the vaginal passage and inserted half way into the cervix where semen is syringed.

PROS OF A.I. IN CATTLE

Various advantages of A.I. over natural mating are:

- The cost of maintenance of breeding bull is saved as there is no need to maintain breeding bull.



- It prevents the spread of certain diseases and sterility due to genital diseases like Contagious abortion, Vibriosis etc.
- The progeny testing can be done at an early age.
- The semen of a desired sire can be used even after the death of that particular sire.
- The semen collected can be taken to the distant places for insemination.
- It makes possible the mating of animals with great differences in size without injury to either of the animal.
- It is helpful to inseminate the animals which refuse to stands or accept the

male at the time of oestrus. It helps in maintaining the accurate breeding and calving records.

- It increases the rate of conception.
- It helps in better record keeping.
- Old, heavy and injured sires can be used.

CONS OF A.I. IN CATTLE

- Requires well trained operations and special equipments.
- Oestrus detection must be good.
- Requires more time than natural services.
- Necessitates the knowledge of the structure and function of reproduction on the part of operator.
- Improper cleaning of instruments and insanitary conditions may lead to lower fertility.
- If the bull is not properly tested, the spreading of genital diseases will be increased.
- Market for bulls will be reduced, while that for superior bull is increased.
- Technology to store cooled and frozen semen is difficult to maintain.

CONCLUSION

Artificial insemination is used as a tool for the rapid improvement of quality of genes in future generations by maximum possible use of best sires. Artificial insemination is advantageous over natural mating as it increases the safety for the farmer as well as animal, reduces the cost of maintenance of bulls, reduces disease transmission and increases potential for genetic selection. Thus, artificial insemination is an economical measure in that fewer bulls are required and maximum use can be made of the best sires to increase the productive as well as reproductive efficiency of the female animal.

Understanding Stereotypic Behaviour And Their Management In Farm Animals

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Animal behaviour refers to how animals react to other animals of the same species, other beings and the environment. It also concerns the overall reactions to adapt or to adjust to various internal and external conditions.

"Stereotypies"- what does it mean?

'Stereotypies' or 'stereotypic behaviours' are kind of abnormal behaviour and have long been inter-changeably defined as repetitive, unvarying and apparently functionless behaviour patterns. A stereotypy is also defined as a repetitive behaviour that repeats itself in a pattern that seldom changes and it serves no obvious purpose (Mason et al., 2007; Price, 2008). Stereotypies occur in all types of animals who live in the care of people. Because stereotypies become increasingly fixed the behaviour sequences all begin to look exactly alike and because they take up more and more of an animal's time, they can interfere with other aspects of an animal's life. Abnormal Repetitive Behaviour (ARB) may be subdivided into two basic categories based on the unvarying manner in which the behaviours are repeated:

(1) **Stereotypies-** It involves unvarying inappropriate repetition of a particular set of movements and/or body postures that lack any goal or function. (2) **Impulsive/compulsive behaviours-** It involve the repetition of an inappropriate goal with variable flexible goal-directed behaviour (Garner, 2005). When animals are observed in confinement captivity, some of these stereotypical and displacement behaviours are often seen: a chicken performing dust-bathing behaviours with no dust; a sow in a gestation crate bar biting; a chained-up dog licking its paw repetitively; a zoo jaguar pacing the perimeter of its cage. An animal's need to express certain behaviours (e.g. dust bathing, nesting, foraging, locomotion, social interaction, seeking, etc.) is blocked in some confinement livestock production systems. This causes potential problems with animal welfare. The agricultural industry has created some housing systems in which animals are not able to behave naturally. Their drive to perform natural behaviours is dissatisfied and as a result they develop a higher level of frustration in their housing, manifested in various ways but particularly in their expression of

behaviour. Producers can economically raise livestock and poultry in intensive confinement systems. The question is: should we raise them this way? The animals are never going to be able to 'tell' us how they feel and therefore we must try to understand them in a different manner (i.e. through their behaviour). Some people may still fear making assumptions about an animal's well-being through its actions (even though they most likely do this on a daily basis with fellow humans). But, as one researcher profoundly stated, it is important to be 'roughly right on something important than to be accurate but wrong or irrelevant'. Animal well-being is that 'something important.'

What causes Stereotypies?

Understanding the basic causes of the behaviours is important, not only to advance fundamental scientific knowledge of how behaviour is organized, but also because the appropriate use of stereotypic behaviours to assess animal welfare requires that we understand why animals perform them.

Motivational explanations for stereotypies:

Motivational explanations of stereotypies seek to understand how they arise via an animal's internal states and responses to external stimuli. These internal and external factors are considered the same as those underlying the initiation and termination of adaptive, species- typical behaviour patterns. Motivation is thus an ethological construct used to describe why normal animals do what they do, in terms of their choice of behaviour pattern at any moment, and the time and effort they devote to performing it (Mason et al., 2001; Toates, 2001).

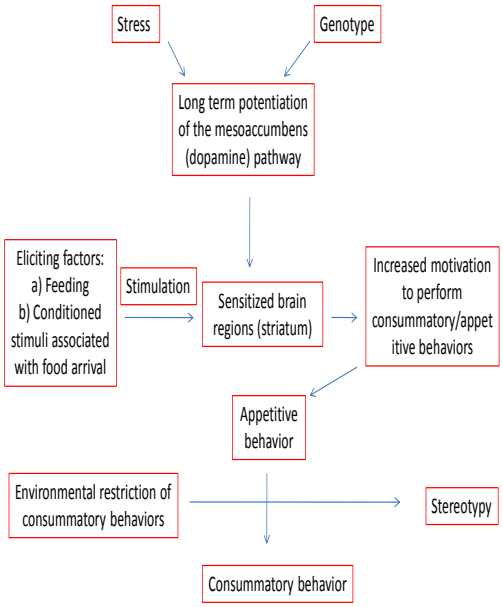

Fig. Considered causal factors of stereotypic behaviour (McBride and Hemming., 2009)

Motivation used to be thought of in terms of drives; thus a high hunger drive would lead to increased foraging and feeding. However, drive theories have been replaced by more complex models based on motivational states (McFarland, 1993) that are determined by an array of internal and external factors. Thus, an animal's likelihood to feed is affected by internal factors (such as an energy deficit), but also the availability and palatability of different foods, and the presence of factors eliciting competing behaviours, such as the presence of predators. Motivated behaviour often has an appetitive preparatory phase (such as searching), which culminates in a more stereotyped, species-typical consummatory phase

such as eating, mating or fighting (McFarland, 1981).

Approaches to prevent or reduce abnormal behaviour

Abnormal behaviours observed in farm animals include locomotor stereotypies such as weaving, pacing, and route-tracing and mouth-based stereotypies such as wool-eating by sheep, feather pecking and cannibalism by poultry, bar biting by pigs, tongue rolling by cattle, and wind-sucking by horses (Price, 2008). These behaviours can cause injury to the animal performing them or to other animals in the social group and are most commonly observed in situations in which the quality or quantity of space provided to the animal is inadequate.

Environmental enrichment may reduce the frequency or severity of these behaviours, or even prevent them from developing in the first place (Mason et al., 2007). Newberry (1995) suggested a useful concept: the endpoint of enrichment should be to improve the biological functioning of the animal. Therefore, goals of enrichment programs include- (1) Increasing the number and range of normal behaviours shown by the animal. (2) Preventing the development of abnormal behaviours or reducing their frequency or severity. (3) Increasing positive utilization of the environment (e.g. the use of space) and (4) Increasing the animal's ability to cope with behavioural and physiological challenges such as exposure to humans, experimental manipulation, or environmental variation. Various kinds of useful enrichment types are briefly described here:

1. Social enrichment, which can involve either direct or indirect (visual, olfactory, auditory) contact with conspecifics (other individuals of the same species) or humans.
2. Occupational enrichment, which encompasses both psychological enrichment (e.g. devices that provide animals with control or challenges) and enrichment that encourages exercise.
3. Physical enrichment, which can involve altering the size or complexity of the animal's enclosure or adding accessories to the enclosure such as objects, substrate, or permanent structures (e.g. nest boxes).
4. Sensory enrichment, or stimuli that are visual (e.g. television), auditory (music, vocalizations), or in other modalities (e.g. olfactory, tactile, taste).
5. Nutritional enrichment, which can involve either presenting varied or novel food types or changing the method of food delivery.

1. *Social Enrichment*

If the experimental protocol dictates individual housing for cattle, visual and auditory contact with conspecifics is desirable. Research on cattle–human interactions indicates that humans may serve as a substitute for conspecific contact if social contact is not possible. Gentle and confident handlers benefit animals and may result in improved milk production. For example, when humans stroke body parts commonly groomed by other cattle such as the neck, cattle are more likely to approach humans, indicating that appropriate and gentle contact with

humans can improve human–animal interactions (Schmied et al., 2008). Conversely, rough handing is stressful for cattle. Cattle recognize individual people and become frightened of those who handle them aggressively (Rushen et al., 1999). Shouting, hitting and use of the cattle prod (a handheld device commonly used to make cattle or other livestock move by striking or poking them) are frightening and cattle should not be handled in this way (Pajor et al., 2003). Indeed, cattle will show more vigilance behaviour when exposed to a human who has handled them roughly compared with a gentle or unfamiliar handler (Welp et al., 2004).

2. *Occupational Enrichment*

Tied dairy cattle should have daily exercise in a yard. Exercise provides numerous health benefits; for example, cattle given daily exercise had fewer illnesses requiring veterinary attention and fewer hock injuries (Gustafson, 1993). Cattle provided with such exercise use this time to groom parts of the body that they can not reach while tied (Loberg et al., 2004). Indeed, loose-housed cattle increase grooming when provided a mechanical brush and will use these brushes to groom hard-to-reach areas, such as the hindquarters (Wilson et al., 2002; DeVries et al., 2007). Scratching/ribbing devices were used more frequently and for longer by cattle compared with other types of enrichment devices tested (Wilson et al., 2002).

3. *Nutritional Enrichment*

Access to well-managed pasture is beneficial and recommended for all cattle. Dairy cows with access to pasture have fewer health problems such as mastitis (e.g. Washburn et al., 2002). Cattle also do not exhibit stereotypic tongue rolling while at pasture (Redbo, 1990). Indeed, provision of exercise (Redbo, 1992), adequate roughage (Redbo and Nordblad, 1997), and group housing calves (Seo et al., 1998) have all been found to reduce stereotypic tongue rolling in cattle.

4. *Sensory Enrichment*

Noise is a possible stressor within cattle housing environments and during routine management practices such as handling, milking, and transport. Beef cattle exposed to either human shouting or noise of metal clanging move more while restrained in the chute; thus, quiet environments facilitate animal handling and well being (Waynert et al., 1999). Quiet environments may be even more important for dairy cattle, as they are more reactive to sound than beef cattle (Lanier et al., 2000). Although music and noise can serve as a cue that will synchronize attendance at an automatic milking machine (Uetake et al., 1997), cows will avoid noise, such as a radio or sounds of a milking machine, associated with milking when given the choice (Arnold et al., 2008). Olfactory enrichment may also be important for cattle; feedlot cattle are reported to be more attracted to scented (milk or lavender) enrichment devices than to unscented devices (Wilson et al., 2002). As mentioned above feedlot cattle will spend time scratching their skin against brushes (Wilson et al., 2002), which may act as a form of tactile enrichment.

Some considerations to prevent the development of abnormal behaviour in cattle and buffaloes:

If possible one should follow loose housing system and house the animals as per their age, body wt., physiological status and social hierarchy in the herd. In case the farmers are bound to opt for conventional housing system then they should provide ample space to animal for walking and exercise. If calves are weaned immediately after birth or at very early age then milk feeding to the calves should be done by artificial teats or a bottle with a screw nipple and immediately after milk feeding they should be fed ground grain mixture/wheat bran so as to distract them from indulging in inter-sucking.

REFERENCES

Arnold, N. A., Jongman, E. C. and Hemsworth, P. H. (2008) Avoidance of tape-recorded milking facility noise by dairy heifers in a Y maze choice task. *Appl. Anim. Behav*. *Sci.*109:201–210

DeVries, T. J., Vankova, M., Veira, D. M. and VonKeyserlingk, M. A. G. (2007) Short communication: Usage of mechanical brushes by lactating dairy cows. *J. Dairy Sci*. 90:2241–2245.

Garner, J. P. (2005) Perseveration and stereotypy-systems-level insights from clinical psychology. In: J Rushen, G Mason, eds. Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare. 2nd ed.Wallingford UK: CAB International.

Gustafson, G. M. (1993) Effects of daily exercise on the health of tied dairy-cows. *Prev. Vet. Med.*17:209–223.

Lanier, J. L., Grandin T., Green, R. D., Avery, D. and McGee, K. (2000) The relationship between reaction to sudden, intermittent movements and sounds and temperament. *J. Anim*. *Sci.*78:1467–1474.

Loberg, J., Telezhenko, E., Bergsten, C. and Lidfors, L. (2004) Behaviour and claw health in tied dairy cows with varying access to exercise in an outdoor paddock. *Appl. Anim. Behav. Sci*.89:1–16.

Mason, G., Cooper, J. and Clarebrough, C. (2001) The welfare of fur-farmed mink. Nature 410, 35–36.

Mason, G., Clubb, R., Latham, L. and Vickery, S. (2007) Why and how should we use environmental enrichment to tackle stereotyped behaviour? *Appl. Anim. Behav. Sci.* 102:163–188.

McFarland, D. (1993) Animal Behaviour. Oxford University Press, Oxford,UK.

McFarland, D. (1981) The Oxford Companion to Animal Behaviour. Oxford University Press, Oxford, UK.

McBride S. D., Hemmings, A. (2009) A Neurologic Perspective of Equine Stereotypy. *Journal of Equine Veterinary Science*. Vol.29

Newberry, R. C. (1995) Environmental enrichment: Increasing the biological relevance of captive environments. *Appl. Anim. Behav. Sci*. 44:229–243.

Pajor, E. A., Rushen, J. and de Passille A. M. B. (2003) Dairy cattle's choice of handling treatments in a Y-maze. *Appl. Anim. Behav. Sci*. 80:93–107.

Price, E. O. (2008) Principles and applications of domestic animal behaviour. CABI, Wallingford, UK.

Redbo, I. (1990) Changes in duration and frequency of stereotypies and their adjoining behaviours in heifers, before, during and after the grazing period. *Appl. Anim. Behav. Sci.* 26: 57-67.

Redbo, I. (1992) The influence of restraint on the occurrence of oral stereotypies in dairy cows. *Appl. Anim. Behav. Sci.* 35: 115-123.

Redbo, I., and Nordblad, A. (1997) Stereotypies in heifers are affected by feeding regime. *Appl. Anim. Behav. Sci.* 53:193–204.

Rushen, J., Boissy, A., Terlouw, E. M. C. and de Passille, A. M. B. (1999) Opioid peptides and behavioral and physiological responses of dairy cows to social isolation in unfamiliar surroundings. *J. Anim. Sci.* 77:2918–2924.

Seo, T., Sato, S., Kosaka, K., Sakamoto, N., Tokumoto, K. and Katoh, K. (1998) Development of tongue-playing in artificially reared calves: Effects of offering a dummy-teat, feeding of short cut hay and housing system. *Appl. Anim. Behav. Sci.* 56:1–12.

Schmied, C., Boivin, X. and Waiblinger, S. (2008) Stroking different body regions of dairy cows: Effects on avoidance and approach behaviour toward humans. *J. Dairy Sci*. 91:596–605.

Toates, F. (2001) Biological Psychology. Pearson Education Limited, Harlow, UK

Uetake, K., Hurnik, J.F. and Johnson, L. (1997) Effect of music on voluntary approach of dairy cows to an automatic milking system. *Appl. Anim. Behav. Sci.* 53:175–182.

Washburn, S. P., White, S. L., Green, J.T. and Benson, G. A. (2002) Reproduction, mastitis, and body condition of seasonally calved Holstein and Jersey cows in confinement or pasture systems*. J. Dairy Sci.* 85:105–111.

Welp, T., Rushen, J., Kramer, D. L., Festa-Bianchet, M. and de Passille, A. M. (2004) Vigilance as a measure of fear in dairy cattle. *Appl. Anim. Behav. Sci.* 87:1–13.

Waynert, D. F., Stookey, J. M., Schwartzkopf-Genswein, K. S., Watts, J. M. and Waltz, C. S. (1999) The response of beef cattle to noise during handling. *Appl. Anim. Behav. Sci.* 62:27-42.

Wilson, S. C., Mitlöhner, F. M., Morrow-Tesch, J., Dailey, J. W. and McGlone, J. J. (2002) An assessment of several potential enrichment devices for feedlot cattle. *Appl. Anim. Behav. Sci.*76:259–265.

Role of Molecular Markers in Fruit Crops

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The markers have been used over the years for the classification of plants. Markers are any trait of an organism that can be identified with confidence and relative ease, and can be followed in a mapping population with other words; they can be defined as heritable entities associated with the economically important trait under the control of polygenes (Beckman and Soller, 1986). Morphological markers can be detected with naked eye (naked eye polymorphism) or as difference in physical or chemical properties of the macromolecules. Therefore, there are two types of genetic markers, respectively: morphological markers or naked eye polymorphism and non-morphological markers or molecular markers.

Morphological markers

Morphological markers are those traits that are scored visually, or morphological markers are those genetic markers whose inheritance can be followed with the naked eye. The traits included in this group are plant height, disease response, photoperiod, sensitivity, shape or color of flowers, fruits or seeds etc. Although they are generally scored quickly, simply and without laboratory equipments, such markers are not put too much use because of the following reasons: genotypes can be ascertained generally at whole plant or plant organ level and frequently the mature plant is used. Such markers frequently cause major alternations in the phenotype which is undesirable in breeding programs. Dominant, recessive interactions frequently prevent distinguishing all genotypes associated with morphological traits. Morphological markers masks the effect of linked minor gene, making it nearly impossible to identify desirable linkages for select and are limited in number, influenced by environment and also specific stage of the analysis.

Non-morphological markers or molecular markers

Recently all progress in both breeding and modern genetics has relied on the phenotypic or morphological assay. But with the advent of molecular markers a new generation of markers was introduced over the last two decades that have become an important tool in the genetic improvement of crop species and has changed the entire scenario of biological sciences. Molecular markers are any kind of molecule indicating the existence of a chemical or a physical process. Molecular

markers include biochemical constituents (e.g. secondary metabolites in plants) and macromolecules (e.g. proteins and deoxyribonucleic acid) (Joshi *et al,* 1999). These macromolecules show easily detectable differences among different strains of a species or among different species. Strauss *et al.* (1992) distinguished the molecular markers into two classes. Bio-chemical molecular markers derived from the chemical products of gene expression i.e. protein based markers and molecular genetic markers derived from direct analysis of polymorphism in DNA sequences.

Biochemical molecular markers

The first biochemical molecular markers used were the protein based markers. Proteins are attractive for direct genetic study because they are the primary products of structural genes. Changes in coding base sequence will under many circumstances, resulting in corresponding changes in the primary structure of proteins. Even single amino acid substitutions, deletions or additions can have marked effects on the migration of proteins under an electric field during electrophoresis. One of the earliest protein based markers to be used was isozyme. Market and Moller (1959) coined the term to describe the multiple molecular forms of the same enzyme with the same substrate specificity. Isozymes are different forms of an enzyme exhibiting the same catalytic activity but differing in charge and electrophoretic mobility. In isozyme analysis, crude plant extracts are subjected to electrophoresis using starch or polyacrylamide gels. Following electrophoresis, the enzymes of interest are detected by treating the gels with specific activity stains. Variation in bending patterns obtained between individual samples can be used to sort out genetically the varieties tested.

DNA based markers

DNA contains individual genetic blue print. The sequence of nucleotides in DNA of an individual is unique and thus determines its identity. The ultimate difference between individuals lies in the nucleotide sequence of their DNA. The detection of such differences employing different molecular biological techniques led to the development of DNA markers. On plants DNA markers were first developed in 1985-86 by first developed in 1985-86 by two groups of researchers working independently at native plants incorporated, USA and Cornell University Ithaca USA. DNA markers should not be considered as normal genes, as they usually do not have any biological effect and instead can be thought of as constant landmark in the genome. DNA markers are the identifiable DNA sequences found at specific locations on the chromosomes and transmitted by the standard laws of inheritance from one generation to the next one. They rely on DNA assay in contrast to morphological markers based on visible traits and biochemical molecular markers based on protein products by gene. So DNA is an ideal molecule for studying polymorphism.

Properties for ideal DNA Markers

Highly polymorphic in nature; co-dominant expression; selectively neutral behaviour; easy access and assay; easy exchange of

data between laboratories; follow Mendelian inheritance; genetically linked to trait in question, not affected by pleiotropism and epistatic interactions. The different molecular marker technologies that are available today can be classified into two broad categories: based on molecular hybridisation and based on Polymerase Chain Reaction (DNA amplification).

Restriction Fragment Length Polymorphism (RFLP)

This is the first marker system that was conceived and developed by Botstein *et al.* (1993) and is based on southern blotting hybridization technique. If genomic DNA's are digested with restriction enzyme, electrophoresis, blotted on nitrocellulose membrane and detected with labelled probe, then polymorphism in the hybridization pattern is revealed due to the change in restriction cleavage site. Such variation is termed as Restriction Fragment Length Polymorphism. To use this technique a set of chromosomal DNA fragments are prepared as probes, such a set of probe is called library. DNA isolated from the species of interest is digested with restriction enzyme and relatively small fragments are legated in bacterial plasmid, afterwards the plasmid is transferred into bacterial cell. By growing the transferred bacteria one obtains a large supply of a single plant DNA restriction fragments which is suitable for use as hybridization probe.

Random Amplified Polymorphic DNA (RAPD)

PCR based markers developed by William et al. (1990). Primers (usually a decamer) with arbitrary sequences (random primers) are used for amplification, DNA segments to be amplified will be selected at randomly and this provides a truly random samples of DNA markers and so is described as RAPD. In this technique primers are designed. A single primer is a short oligonucleotide of random chosen DNA sequence with at least 50% GC content. This process starts by extracting the genomic double stranded DNA which is made single stranded by heating at 920°C for a minute. At this stage primer hybridizes with the homologous genomic DNA and then a new strand is synthesized using enzyme taq polymerase. Separation of reaction products is achieved on standard agarose gel which is then visualized with ethedium bromide staining.

Simple Sequence Repeats (microsatellites)

Simple sequence repeats (SSRs), also known as microsatellites, are present in the genomes of all eukaryotes. These are ideal DNA markers for genetic mapping and population studies because of their abundance. These are tandemly arranged repeats of mono-, di-, tri-, tetra- and pentanucleotides with different lengths of repeat motifs (e.g. A, T, AT, GA, AGG, AAC, etc.). These repeats are widely distributed throughout plant and animal genomes that display high levels of genetic variation based on differences in the number of tandemly repeating units at a locus. These SSR length polymorphisms at individual loci are detected by PCR, using locus-specific flanking region primers where the sequence is known. Thus, STMs require precise DNA sequence information for each

marker locus from which a pair of identifying flanking markers are designed. This is impractical for many plant and animal species that are not well-characterized genetic systems. Some of these SSR-based methods have been collectively termed mocrosatellite-primed PCR (MP-PCR).

Amplified Restriction Fragment Length Polymorphism (AFLP)

Amplified restriction fragment length polymorphism is a powerful DNA fingerprinting technology developed by Vos et al. (1995) based on PCR amplification of a set of restriction fragments, selected from a pool of fragments that are generated due to digestion with a pair of specific restriction enzymes, one of them being a frequent cutter and the other a rare cutter.

This technique involves three steps; firs, restriction of DNA and ligation of oligonucleotide adapters, second, selective amplification of sites of restriction fragments and last, gel analysis of the amplified fragments.

Applications of molecular markers

1. **Assessment of genetic diversity**

A number of reports are available on the use for DNA markers to assess genetic diversity among species of several horticultural crops, as well as validation of genetic relatedness among them. This has significant application, especially for difficult to breed woody perennials. Using RAPD markers the wide variability was observed in the mandarin germplasm present in N. E. Himalayas. In China using SSR markers, genetic diversity in mandarin landraces and wild races of mandarins, sweet orange, mandarins, grapefruit, lemon and citranges was resolved. DNA markers have also been utilized to find out the phylogenetic relationships in 30 accessions of true Citrus fruits ('Fortunella', 'Eremocitrus', 'Microcitrus', 'Clymenia' and 'Citrus'). The different types of markers that have been used for assessment of genetic diversity are presented as folow in Tab. 4.

Identification of QTLs

Many important heritable characters are a consequence of the joint action of several genes. Such characters are often referred to as polygenic or quantitative. Several characters of plant species, among which are traits of agronomic importance, are inherited quantitatively. Yield, maturity date and drought tolerance are examples of such characters. The genetic loci for such characters have been referred to as quantitative trait loci (QTLs). The essential feature which makes feasible the finding and characterization of a QTL is its linkage with a known marker locus segregating with Mendelian ratios. DNA markers provide this opportunity by making it feasible to identify, map and measure the effects of genes underlying quantitative trait .In grape QTLs were use for features such as like Critical Photoperiod, growth cessation, or dormancy, bud break (BB) and winter hardiness (Tab. 5).

Varietal identification

Varietal identification is nothing but DNA fingerprinting. Singly or in groups, molecular markers are capable of producing patterns that are unique for each individual genotype. Their patterns, whether they are generated by PCR or by

hybridization with single copy, multicopy, or repeated sequences are referred to as genetic fingerprintings. Few examples of DNA markers used for varietal identification are mentioned in Tab. 6.

Disease diagnostics

Molecular markers have made it possible to develop diagnostic techniques to identify pathogen with an unprecedented accuracy and speed and to tap genes from as diverse sources as microbes, plants and animals to enable the researchers to develop plants resistant to diseases (Tab. 7).

REFERENCES

Shiv, L., A. K. Singh, M. Srivastav, A. K. Dubey and N. K.Singh (2008). Genetic diversity assessment in Indian grape by Simple Sequence Repeats (SSR) markers. *India J. of Horti.* **65:** 4

Adato, A. D., V. Sharon, V. S. Lavi, J. Hillel and S. Gazit (1999). Application of DNA fingerprinting for identification and genetic analysis of mango (M. indica) genotypes. *J. Amer.*

Soc. Hort. Sci. **120:**259-64. Antonius, K. (1999). Molecular markers in Rubus (Rosaceae) research and breeding. *J. of Horti. Sci. and Biotech*. **74 :**149-160.

Ashworth, V. E. and M. T. Clegg (2003). Microsatellite Markers in Avocado (Persea mericana Mill.): Genealogical Relationships Among Cultivated Avocado Genotypes. *Journal of Heredity* **94:**407-415.

Bartolozzi, F., M. L. Warburton, S. Arulsekar and T. M. Gradziel (1998). Genetic characterization and relatedness among California almond cultivars and breeding lines detected by randomly amplified polymorphic DNA (RAPD) analysis. *J. Am. Soc. Hort. Sci.* **123:**381-87.

Bastianel, M., L. Cristofani-Yaly, A. C. M. Oliveira, J. Freitas-Astua, A. Antonio, G. M. Franco, D. V. Resende, V. Rodrigues and M. A. Machado (2009). Quantitative trait loci analysis of citrus leprosis resistance in an interspecific backcross family of (Citrus reticulata Blanco x C. sinensis L. Osbeck) x C. sinensis L. Osb. Euphytica 169:101-111.

Beckman, J. S. and M. Soller (1986). Restriction fragment length polymorphism and genetic improvement of agricultural species. Euphytica 3:111-24.

Bhat, K. V. and R. L. Jarret (1995). Random amplified polymorphic DNA and genetic diversity in Indian. Musa gemplasm GRACO. 42:107-18.

Botstein, J. O., A. Sonko, L. Otten and B. Walter (1993). RFLP molecular taxonomy in Vitis vinifera L. *Theor. Appl. Genet*. **87:**431-38.

Botez, C., R. Sestras, M. Ardelean, D. Pamfil, B. Patrascu and A. Sestras (2009). Phenotypic Selection Assisted by Molecular Markers for Scab Resistance in Apple. *Acta Hort.* **814:**771¬776.

Bourquin, J. C., A. Sonko, L. Otten and B. Walter (1993). RFLP molecular taxonomy in Vitis vinifera. Theor. and Appl Genet. 87:431-38.

Table 1. Successful examples of RFLP techniques in fruit crops

Sr. No.	Plant Species	Work Done	References
1.	Peach	Genetic linkage and mapping	Rajapakse *et al.* (1995)
2.	Sour Cherry	QTL analysis of flower and fruits	Wang *et al.* (2010)

Table 2. Successful examples of RAPD techniques in fruit crops

Sr. No.	Plant Species	Work Done	References
1.	Peach	Identification of peach cultivars	Lu Zx *et al.* (1996)
2.	Peach	Comparison of peach cultivars	Warburton *et al.* (1996)
3.	Almond	Genetic relatedness among cultivars and breeding lines	Bartolozzi *et al.* (1998)

Tab. 3. Supporting institutes on DNA projects

Institute	Crop	Work
IIHR	Mango, Citrus, Pomegranate	i) Identification of Mango varieties and genetic relatedness through RAPDS ii) Identification of markers linked to bacterial canker resistance in Lemon iii) Development of markers to test clonal fidelity of pomegranate plants raised through tissue culture.
CPCRI-Kasargod	Coconut	i) DNA fingerprinting of all major coconut accessions,hybrids and high yielding palms using RFLP,RAPD markers ii) Development of molecular markers linked with imprtant traits especially root wilt disease resistance/tolerance and drought tolerance.
NRC-Trichy	Banana	i) Marker aided selection for important traits ii) DNA finger printing of new Musa clones
CISH-Lucknow	Mango	i) DNA fingerprinting for identification and analysis of existing genotypes, promising new hybrids and clones of mango

Tab.4. DNA Markers for Genetic Diversity Assessment in Fruit Crops

Sr. No.	Fruit	Marker Type	References
1.	Apple	AFLP and RAPDs	Coart *et al.* (2003)
2.	Avocado	Mini satellite DNA	Ashworth *et al.* (2003)
3.	Banana	RAPDs	Brown *et al.* (2009)
4.	Citrus	RFLP	Durham *et al.* (1992)
5.	Grapes	RFLP and SSRs	Bourquin *et al.* (1993)
6.	Mango	cpISSR and RAPDs	He *et* al. (2007)
7.	Pistachio	Mini satellite marker	Riaz Ahmad *et al.* (2003)
8.	Cashew	RAPD and ISSR	Thimmappaiah *et al.* (2009)
9.	Pear	SSRs and AFLP	Sisko *et al.* (2009)

Tab 5. Markers associated to main polygenic traits in fruit crops

Fruit	Trait	Marker Type	References
Apple	Fire blight resistance	SCAR, SSR	Sylwia *et al.* (2009)
Citrus	Citrus leprosis virus resistance	AFLP and RAPD	Bastianel *et al.* (2009)
Pear	Incompatibility	AFLP and SSR	Sun *et al.* (2009)
Banana	Sugar content Seedlessness,	RFLP AFLP, SSR,	Ming *et al.* (2001) Mejia *et al.* (2007)
Grapes	Berry Size, and Ripening Date	RAPDs, ISSRs and SCARs	
Strawberry	Day-neutrality	AFLP	Weebadde *et al.* (2008)
Apricot	Plum Pox Virus	SSR	Soriano *et al.* (2007)

Tab. 6. DNA Markers for Varietal Identification

Crop	Marker Type	References
Raspberry	RAPD	Parent *et al.* (1993)
Apple	RAPD	Koller *et* al. (1993)
Grape Cultivar	SSR	Thomas *et al.* (1995)
Grape Roostock	RAPD	Hong Xu *et* al. (1995)
Lemon	RAPD	Deng *et* al. (1995)
Mango	RAPD	Schnell *et al.* (1995)
Blackberry	RFLP	Antonius *et* al. (1997)

Tab. 7. DNA Markers for disease diagnostics

Character	Fruit crops with population	Major gene (symbol)	Markers linked	Reference
Grey mold *(Botrytis cinerea)*	Strawberry		RAPDs	Rigotti *et al,* 2002
Downy mildew	*Vitis vinifera* cv. 'Mocato Binaco' x *V. riparia*			Marino *et al.,* 2003
Brown spot disease *(Alternaria alternata)*	'Clementine' x 'LB-8-10' ('Clementine' x 'Minneola')	Aa M1/aaM1	P12 (15.3 cM) and AL3 (36.7 cM) (RAPDs)	Dalkilic *et al.,* 2005
Eastern filbert blight *(Anisogramma anomala)*	Hazelnut OSU 245.098 x OSU 408.040		5 AFLP markers B2-125 at 4.1 cm	Chen *et al.,* 2005
Citrus tristeza virus Sharka disease	Different citrus hybrids Apricot (Padre x 54P455)	Ctv-R Y	RAPDs	Cristofani *et al.,* 2000 Bliss *et al.,* 2002
Citrus nematodes resistance	LB 26 (Clementine mandarin x Hamlin sweet orange) x Swingle citrumelo (C. paradisi		Markers linked with Ctv were evaluated	Ling *et al.,* 2000
Plum root nematode resistance	Bulked segregate analysis of clones P 2175, P. 1079 and P. 2980	Ma1, Ma2 and Ma3	SCAL 16 & SCAL 19 (Practically applied)	Lecoules *et al.,* 1999
Peach root knot nematodes resistance	Peach cv. 'Juseitou'	Mj	STS-834b	Yamamoto and Hayashi, 2002

Factors Affecting Immunobiology Of Cow Udder

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Mastitis is the most common disease affecting adult dairy cows and this disease associated with economic losses that cause serious burden to producers. The current practices of mastitis control are based on proper milking hygiene, reduced exposure to environmental pathogens and dry cow antibiotic therapy. These practices have reduced occurrence of the disease. The prevention and treatment of mastitis are primary concerns of the dairy industry. To decreasing the impact of mastitis on the dairy industry is to increase the natural ability of the cow to resist infections. The defense of the mammary gland against mastitis-causing pathogens is affect by several factors like anatomical, cellular, and soluble protective factors. Once causative agent successfully penetrate the teat end opening then it depend upon the immune status of the animal either prevent it or not. The specific and innate immune factors associated with mammary gland tissues and secretion also play a vital role in protecting the gland from infectious disease. Dairy cattle are more susceptible to mastitis during the periparturient period. It is well noticed that the incidence of mastitis with respect to lactation stage are directly related to changes in the composition, magnitude, and efficiency of the mammary gland defense system. There are numerous genetic, physiological, and environmental factors that can compromise host defense mechanisms during the functional transitions of the mammary gland (Sordillo, 2005).

1. Mammary defense mechanisms

The mammary gland (MG) is protected by a variety of defense mechanisms that can be separated into two distinct categories that is innate immunity and specific immunity. The mammary gland is protected by two form of immune defense mechanism:

- Innate immunity
- Acquired immunity

Innate immunity is also known as nonspecific immunity that is the mainly occur during the early stages of infection. The nonspecific or innate responses of the mammary gland are mediated by the physical barrier of the teat end, macrophages, neutrophils, natural killer cells and by certain soluble factors. This defense is mediated by macrophages, cytokines, neutrophils, natural killer cells

and physical barrier of the teat. The immune system is characterized by its capacity to recognize and discriminate between foreign invading agents and molecules produced by the organism (Janeway and Medzhitov, 2002).The mammary gland perform a variety of immunological function provide protection even in peripartum and produced antibodies in colostrum to protect newborn against infectious agents. (Sordillo and Sshafer –Weaver , 1997).

Acquired immunity also called specific immunity. This is the basis of vaccination. This immune response uses many innate immune effector mechanisms to eliminate microorganisms. It is based on memory and is increased by repeated exposure to the same pathogen.

Anatomical factors

Mastitis occur when causative agent gain entry from the teat orifices so teat end is considered as the first line of defense against invading pathogens. The teat canal is the first line of defence because pathogen must penetrate through it to cause an IMI. Teat sphincter muscle is to keep the orifice closed that isolate the interior of the mammary gland as shown in diagram 1(A). It means that any damage lead to an increase in the incidence of mastitis (Myllys and Buzalski,1994). The teat canal is lined with keratin which provides an additional physical barrier preventing bacterial migration towards the MG cistern (Sordillo and Streicher,2002).The esterified and non-esterified fatty acid (myristic, palmitoleic and linoleic) function as bacteriostatic and associated with keratin and some protein associated with keratin bind to pathogenic microorganism to cause osmolarity changes.

Cellular factors

It inflammatory cells include like neutrophil, lymphocyte and phagocyte. These cells considered as second line of defense. These cells regulate both innate and acquired immune response.

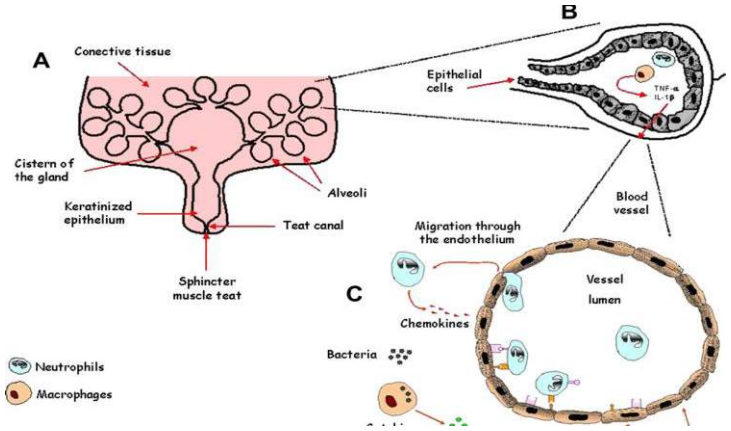

Diagram1. (A, B, C): **A**. Schematic diagram of the bovine mammary gland showing the most important anatomic factors that act as defense barriers. The teat sphincter muscle represents the first line of defense, whereas the keratinized epithelium of the teat cistern is considered the second line. **B**. Cellular and soluble factors that participate in the innate immune response of the mammary gland. Macrophages located in the alveoli phagocytize bacteria that enter the mammary gland cistern. Activated macrophages release cytokines such as TNF-α and IL-1β. **C**. Endothelial cells from blood vessels adjacent to alveoli express adhesion molecules in response to pro-inflammatory cytokines that facilitates neutrophil recruitment from the bloodstream to the site of infection in order to eliminate the invading bacteria.

The macrophage recognizes the invading pathogen and initiates the inflammatory

responses. Adhesions of bacteria to epithelial cell as well as bacterial toxin with them induce synthesis of TNF-α, IL-6, Chemokine, IL-8 as shown in diagram 1(B).

Soluble factors

The soluble factors which are important for mammary gland defense are following:

- Immunoglobulin
- Lactoferrin
- Complements
- Lysosome

Immunoglobulin functions as the soluble effector of specific or humoral immune responses. The four classes of immunoglobulin are known to influence mammary gland defense against bacteria causing mastitis: IgG1, IgG2, IgA and IgM. In healthy glands, the concentration of Ig is low during lactation but slowly increases during the non-lactating periods and reaches peak concentrations during colostrogenesis. A study shown that shown that IgG1, IgG2, and IgM can
act as bacterial opsonins that enhance phagocytosis of neutrophils and macrophages.

Lactoferrin is an iron-binding protein produced by epithelial cells and leukocytes and, in the presence of bicarbonate, sequesters free ferric ions present in milk. It have bacteriostatic ability to prevent growth of bacteria, such as staphylococci and coliforms which have iron requirement. In the healthy mammary gland, the concentration of lactoferrin is low but increases during involution and inflammation.

Complement is a collection of proteins that is present in serum and milk which cause the lysis of invading bacteria. The concentrations of complement are highest in colostrum, inflamed mammary glands and during involution. Complement concentration are lowest during lactation. Therefore, because of its intermittent presence in milk complement is thought to play only a minor bactericidal role in the mammary gland.

Lysozyme is a bactericidal protein that is present in milk and that functions by cleaving peptidoglycans from the cell wall of Gram-positive bacteria as well as the outer membrane of Gram-negative bacteria (76). Lysozyme may enhance the binding of lactoferrin to bacterial cell walls.

Periparturient immunosuppression

The increase in incidence of mastitis with respect to lactation stage is related directly to compromised host defenses during the functional transitions of the mammary gland. Dairy cow experienced reduce immune function from about 3 week before and 3 week after calving so immunosuppression result in an increased incidence and severity of infection after peripartum period. The animal have high demand for energy during the periparturient period, feeding stress may be one of the reason for immunosuppression.

Hormonal factors

Stresses due to pregnancy and parturition stimulate the production of a variety of stress hormones that have important effects on the immune response. One group of these stress hormones known as corticosteroids that cause immunosuppression. Dexamethasone is a synthetic glucocorticoid that can decrease the total number, distribution and function

of leukocytes in bovine blood (Burton and Erskine, 2003). The studies of neutrophils during parturition revealed a down-regulation of adhesion molecules which correlates to neutrophil dysfunction and disease development in cattle.

Nutrition factors

The antioxidants and trace minerals play important roles in immune function which influence the health in transition dairy cows. Vitamin A, Zinc, Copper, Selenium, and Zinc are play important role to maintain immunity .Some research shown if the shortage of these element have negative impact on the activity on the inflammatory cells as shown in (Table 2). The lymphocyte activity can be influenced by energy, protein, Zn, and vitamin A and antibody production is influenced by energy, protein, Cu, Zn, Se, and vitamins A, D, and E. The killing ability of immune cells is increased by nutritional supplementation with Vitamin E (Politis et al., 2004).

CONCLUSION

The different anatomical barriers help to prevent entrance of the infection to udder. The innate and acquired immunity both are important to defend mammary gland from infection. Animals are more prone to infection during and just after parturition. The Transition cow management is necessary to keep the cow away from postpartum metabolic disorder and the peripartum care is essentially required for udder health of animal.

Cytokines associated with immune response to mammary gland (Table: 1)

Cytokine	Source	Function
IL-1	Macrophages and epithelial cells	Neutrophil recruitment to the MG
IL-2	CD4+ lymphocytes	Activate NK cells and CD8+ lymphocyte
IL-6	Macrophages	Influx of monocyte to the MG
IL-8	Monocytes, T lymphocytes ,macrophages and epithelial cells	Chemokine induce neutrophil recruitment to the MG
IL-2	T lymphocyte	Regulates differentiation of T lymphocytes
TNF-α	Macrophages, neutrophil and epithelial cells	Induce expression of adhesion molecules in endothelial cells
IFN-γ	CD4+, CD8+ and NK cells	Activates T lymphocytes induces production of IL-12 and neutrophil activation

Micronutrient effects on MG immunity (Table 2)

Micronutrient	Observation	References
Se	Decreased efficiency neutrophil function	(Erskine,R.J.1993)
	Improved bactericidal activity of neutrophil	(Hogan *et al*.1993)
	Decreased severity and duration of mastitis	(Erskin *et al*.,1989)
Vitamin E	Increased neutrophil bactericidal activity	(Smith *et al*.,1985)
	In combination with Se decrease prevalence of IMI at calving	(Sears *et al*.,1990)
	Decrease incidence of clinical mastitis	(Hogan *et al*.,1993)
Vitamin A	Decrease SCC	(Reddy *et al*.,1990)
	Moderated glucocorticoide levels	(Scherf *et al*.,1994)
Cu	Deficiency decrease N killing capability	(Jones,1981)
	Deficiency increase susceptibility to bacterial infection	(Harmon *et l*.,1994)
Zn	Deficiency decrease leucocyte function Deficiency increase susceptibility to bacterial infection	(Reddy *et al*.,1990)

Plant Variety Protection And Farmers Right (PVPFR)

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In order to provide for the establishment of an effective system for the protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants it has been considered necessary to recognize and to protect the rights of the farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties. The provisions of the TRIPS Agreement have widened the scope of protection of intellectual property rights relating to agriculture through plant variety protection. Indian patent act (1970) does not permit the patenting of plant varieties and animal breeds which are existing in nature. To protect the rights of the breeders and farmers, Govt. of India has enacted the Plant Varieties Protection and Farmers Rights (PVPFR ACT, 2001) and effective from January, 2006. It has become imperative on the part of the Government of India to develop our own *sui-generis* (a Latin phrase meaning 'of their own kind') system to provide a frame work for Plant Variety Protection and Farmers Right. Protection of the plant varieties under the Act accelerates agricultural development and stimulates investment for research and development for the development of new plant varieties which in turn facilities the growth of the seed industry and ensures the availability of high quality seeds and plant in material to the farmers.

Main aim of the PPV & FR Act

- To encourage scientists, farmers, communities for the development of new plant varieties having quality and production potential
- To recognize and protect the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.
- Facilitate the growth of seed industry in the country which will ensure the availability of high quality seeds and planting material to the farmers.
- Registration of varieties for legal protection
- Characterization and documentation of registered varieties
- Ensuring the availability of quality seeds of registered varieties under this Act
- Establishing Gene Funds for rewards and compensation

RIGHTS UNDER THIS ACT

Farmers' Rights

The Act recognizes the farmer not just as a cultivator but also as a conserver of the

agricultural gene pool and a breeder who has bred several successful varieties. There are provisions for such farmers' varieties to be registered with the help of NGOs or institutions so that they are protected against being scavenged by formal sector breeders.

The main provisions are:

- Farmer who bred variety are equated with plant breeder for registration, royalty sharing, recognition and rewards
- Farmers variety can also be registered as an extant variety;
- Will be entitled to save, reuse, exchange, share the seed of all varieties
- Farmers or group of farmers will not be liable to pay any fee in any proceeding before the authority.
- Farmers are eligible for recognition and rewards for the conservation of Plant Genetic Resources of land races and wild relatives of economic plants.

The Act provides following rights to the farmers: (Anonymous. 2012-13)

- **Right on seed:** To save their own seed from their crop and use it for sowing, re-sowing, exchanging, sharing with and selling to other farmers provided that farmer will not be entitled to sell branded seed of a protected variety.
- **Right to register their varieties:** Traditional varieties developed or conserved by farmers and new varieties developed by them are eligible for recognition.
- **Right for reward and recognition:** Farmers engaged in the conservation of genetic resource of landraces and wild relatives of economic plants and their improvement through selection and preservation of plant genetic resources.
- **Right for Benefit Sharing:** In case of important role of Farmers' varieties for breeding new plant varieties.
- Protection of innocent infringement.
- Exemption from fees.

Breeders' Rights

The Act provides exclusive right to breeder or his successor, agent or licensee to produce, market, sell, distribute, import and export of seed of his registered variety.

Researchers' Rights

Researcher can use any of the registered variety under the Act for conducting experiment or research. This includes the use of a variety as an initial source of variety for the purpose of developing another variety but repeated use needs prior permission of the registered breeder

REGISTERABLE PLANT VARIETIES IN INDIA

- **New Varieties:** A Variety which is not in public domain in India earlier than one year before the date of filing or outside India, in the case of trees or vines earlier than six years or in any other case earlier than four years.
- **Extant Variety**: A Variety which is notified under Seed Act, 1966 or a variety about which there is common knowledge or a farmer's variety or any other variety which is in public domain is considers as an Extant Variety.
- **Farmer's Variety:** A Variety which has been traditionally cultivated and evolved by the farmers in their fields or a variety which is a wild relative

or land race of a variety about which farmers possess common knowledge.

- **Essentially Derived Variety (EDV):** Predominantly derived from such initial variety, or from a variety that itself is predominantly derived from such initial variety, while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of such initial variety.

CRITERIA FOR PROTECTING A PLANT VARIETY

The plant variety must be:

- **Distinct**: A variety should be clearly distinguishable by at least one essential characteristic from existing or commonly known varieties in any country at the time of filing of the application.
- **Uniform:** A Variety must be sufficiently uniform in its essential characteristics.
- **Stable:** Essential characteristics of a variety must be stable after repeated propagation or in the case of a particular cycle of propagation at the end of each cycle.

WHO CAN APPLY FOR THE REGISTRATION OF A PLANT VARIETY?

- Any person claiming to be the breeder of the variety;
- Any successor of the breeder of the variety;
- Any person being the Assignee or the breeder of the variety in respect of the right to make such application;
- Any farmer or group of farmers or community of farmers claiming to the breeder of the variety;
- Any person authorized to make application on behalf of farmers; and
- Any university or publicly funded agricultural institution claiming to the breeder of the variety.

COST OF REGISTERING A PLANT VARIETY

Application for registration of plant varieties should be accompanied with the fee of registration prescribed by the Authority. Fee for registration for different types of variety is as under:

No.	Action	Official fee
1	Extant Variety notified under section 5 of the Seeds Act,1966	Rs. 1000/-
2	New Variety/Essentially Derived Variety (EDV)	Individual Rs. 5000/- Educational Rs. 7000/- Commercial Rs.10000/-
3	Extant Variety about which there is common knowledge (VCK)	Individual Rs. 2000/- Educational Rs. 3000/- Commercial Rs. 5000/-

PREREQUISITES FOR FILING AN APPLICATION FORM FOR REGISTERATION OF PLANT VARIETY

- Denomination assigned to such variety
- An affidavit that variety does not contain any gene or gene sequence involving terminator technology
- Complete passport data of parental lines with its geographical location in India and all such information relating to the contribution if any, of any farmer(s) village, community, institution etc in breeding and developing the variety

- Characteristics of variety with description of Novelty, Distinctiveness, Uniformity and Stability
- A declaration that the genetic material used for breeding of such variety has been lawfully acquired
- A breeder or other person making application for registration shall disclose the use of genetic material conserved by any tribal or rural families for improvement of such variety

DEPOSITION OF SEED OR PROPAGATING MATERIAL BEFORE REGISTRATION

Deposition of seeds is necessary for DUS test conducted by PPV & FR authority. The applicant needs to deposit the fixed amount of seed or propagating material with prescribed germination percentage and physical purity along with the seed quality test report to the authority.

DURATION OF PROTECTION FOR A REGISTERED PLANT VARIETY

- Trees and Vines: 18 Years
- Other crops: 15 Years.
- Extant Varieties: 15 Years from the date of notification of that variety by the Central Government under Seed Act, 1966.

CONCLUSION

In India the seed production program is in the hands of organized and unorganized sector (farmers). In fact most of the farmers are resource poor and do not have experts hand in their command. They need technical and financial support to produce quality seeds. The liberal farmer's right provided on the use of seed of protected varieties and Researcher's right provide in the Act may restrict the increased research investment from the private sector. The registration of new plant varieties by PVP authority will be based on the criteria of novelty, distinctiveness, uniformity and stability. This test will be conducted very precisely with much technical knowledge to avoid confusion. Varieties and hybrids which are unscrupulously released without being subject to DUS test will lead to considerable reduction in the targeted production causing insufficiency.

REFERENCES

Anonymous. 2013. Annual report of Protection of Plant Varieties and Farmers' Rights Authority.

Automation In Feeding– A Precision Dairy Farm Management

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Individual animal management is an emerging concept in precision dairy farming, where individual monitoring is the key to success. Feeding management is one of the critical and labour intensive components in dairying and needs automation to provide individualized care. Automation can provide feeding based on production level, reduces feed cost, labour cost and wastage of feed. It increases feed efficiency and optimize productivity. Overall automation in feeding dairy farms may improve dairy cow's health and welfare.

AUTOMATION IN DAIRY FARMS

Mechanization in dairy industry started a way back in the era of 1830 (Shahhosseini, 2013) however, several advances in dairy farm mechanization have taken place only recently due to increased number of heads per farm. In modernized dairy farming, automation has a great place; it has helped the world over dairymen to incorporate several new and innovative technologies to maximize yield and profit in the farm (Jacobs and Siegford, 2012). Raising labour cost and increasing herd sizes have led to significant interest in the use of automation. Automation changes many aspects of farm management as it alters both the nature and organization of the work. Recently the concept of Precision dairy farming has been introduced for monitoring of individual animals through sensor-based management tools and robotic equipment that automatically delivers individual cow management applications (Bewley, 2010). One of the main objectives of automation is individual animal management. An important problem in dairying today is the efficiency of labor and his utilization. Several technological developments have improved the efficiency of the milking

process greatly but in feeding automation has not improved much. If the feeding operations were mechanized and automated completely, the labor productivity would be improved by the way of reduction of labor and labor costs and more time would be available for other farm activities (Svennersten-Sjaunja and Pettersson, 2008; de Koning, 2010).

In dairy farm, feeding concentrate without a fully automated system accounts for approximately 25% of the total working time requirement (Schick, 2006). After milking, this corresponds to the most working time in the dairy farming. In dairies, automatic milking systems have been available commercially since 90s and

have gained a large popularity across the developed countries (de Koning, 2010). However, automation in feeding dairy cows has been limited to the delivery of some components of the ration such as concentrates or forages. Automatic feeding systems (AFS) for total or partial mixed rations (TMR or PMR) have been developed since the beginning of 2000 (Hollander *et al.*, 2005), but commercial farms have shown interest in the technology during 5-6 years only. The first commercial use of Automatic feeding system was introduced in 2004, Netherland but the technology was adapted in 2010 (Bisaglia *et al*., 2013).

Automatic Feeding System

Conventional to automatic feeding system with railed or self-propelled feeders has become popular over the last 5-20 years (Barmore, 2002). More recently, different types of AFS have been developed by the research centers (Kazumoto, 1999; Tamaki, 2002) and by manufacturers (Hollander *et al*., 2005) that are usually based on either existing technologies for single feedstuff automated distribution of concentrates, silages and forages or on complete new concepts like TMR or PMR. Feeding totally or partially mixed rations are expected to stimulate cows' activity promoting visits to both the feeding devices and the automatic milking system to reduce labour demand in farms (Bisaglia *et al*., 2010; 2013).

Guidelines for the purchase and use of computerized concentrate feeders were already available (Prichard and Estridge, 1988). However, research trials to document the nutritional and economic advantages of the individual approaches are scanty, and results often have been contradictory (Cassel, 1982, Leaver, 1989). During in last 3-5 years, technologies for automatic feeding system have grown in popularity. Some of the most important ways to explain these systems include the possibility of a variable frequency to modulate the ration, to control the feeding times, to stimulate the cow activity and to manage the composition of the total daily ration with the objective to control the feed

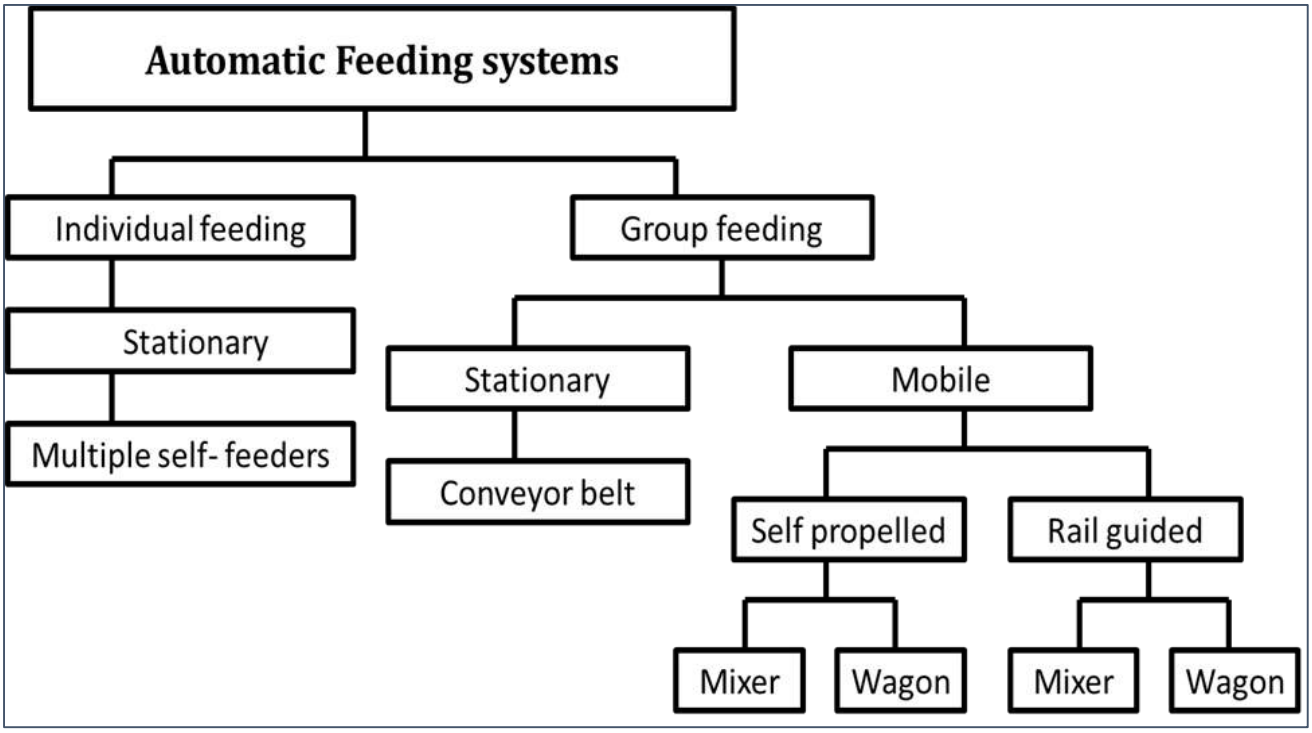

Fig.1: Classification of feeding systems (Bisagila et al., 2010; Grothmann et al., 2010)

intake (Bisagila *et al*., 2010). Nydegger and Grothmann (2009) has reported that more than 16 manufacturers have developed different automatic operating feeding designs for TMR/PMR with an estimated 300-400 farms have adopted this technology, mostly located in Northern Europe, Canada and Japan.

Classification of feeding system

The basic categorization of feeding system was based on the type of feeding, whether it is Individual or in group feeding. Individual feeding provides the chance to feed cows with different components and balanced ration for the specific requirements of each animal. The latest version of feeding system has been developed as group automatic TMR feeding in which, cows are fed with balanced diets for the average requirements of the group and not by individual requirement. In group feeding, automatic concentrate feed dispensers are placed either in the milking parlor or in the barn. The classification of different Automatic Feeding systems is given below:

Features of Automatic Feeding System

A. Feeding frequency

One of the salient features of an AFS for TMR includes the possibility to increase the daily frequency of feeding from 1 upto 15 cycles per day but with conventional mixer wagon based feeding technique has 1-2 cycles per day. This provides potential to stimulate cow feeding activity and dry matter intake and to promote the natural feeding behaviour of more meals per day (Bisagila *et al*., 2010). Azizi *et al*. (2009) found AFS dispense feed meal frequencies of 7-9 meals per day, meal durations of 36-38 minutes/meal and meal sizes of 2-3.5 kg per meal for cows. De Vries *et al*. (2005) investigated the influence of the frequency

of daily feed delivery on cow behaviour and concluded that frequent delivery of feed improves access to feed for all cows, particularly during peak feeding periods when fresh feed is provided, and reduces the amount of feed sorting. De Vries and von Keyserlingk (2005) found that delivery of the feed 6 hours after milking increased the total daily feeding times of the cows with 12.5% compared to the situation of feed delivery at the time of milking in conventional system. Mantysaari *et al.* (2006) and Pompe *et al.* (2007) found that frequent supply of fresh roughage decreased the peaks in cow visits to the feeding places that are typical for conventional feeding systems.

Bisaglia *et al*. (2013) reported that 80% of the farms in Netherland with conventional feeding (CF) distributed the feed once per day while the number of feed pushups for those farms were 3.5 ± 1.6 times per day while the farms with Automatic Feeding distributed the feed 7.8 ± 2.0 times per day with intervals between feedings of 3.1 ± 0.9 hours and with automatic pushups of the feed. It is also reported that the farmers using with automatic feeding systems were positive about their overall performance, especially about the management aspects. There was a decrease in labour requirement for feeding from 33.2 per cow per day with conventional feeding to 16.4 s per cow per day with automatic feeding.

B. Working time measurement

Grothmann *et al*. (2010) reported the working time measurements in 18 different farms in European countries using automatic feeding techniques. The working time of AFS in farm with 60 animals was 50.6 manpower minutes (MP min)/day and a farm with 120 animals spent 65.2 MPmin/day. It included ration management, daily storage container filling and daily feed table cleaning. Feeding the same herd with a feeder mixer wagon, including feed distribution and feed pushing three times, would require 71.3 MPmin/day for 60 animals and 202.8 MPmin/day for 120 animals. Bisaglia *et al*. (2010) also arrived with similar results in working time performances with 150 milking cows had saved 100 min in AFS compared to feed mixer wagons. AFS can be a good opportunity for optimizing working time and work load in dairy farms. Working time measurement modeling (Nydegger & Grothmann, 2009) in AFS showed that it had significantly lower time requirement than conventional feeder mixer wagon. Bisaglia *et al*. (2013) reported that the daily time required for the use of the management system differed by approximately 1 s per cow between the two groups of farms ranging from 14.3 s per cow in the conventional feeding system farms to 15.4 s per cow in the AFS ones. Available evidence thus reveals that automated feeding systems enable dairy farmers to manage larger herds with lower labor requirements (de Koning, 2010), which means that the application of automated feeding systems fits with the trend of increasing herd sizes (Rutten *et al*., 2013).

CONCLUSION

Management of dairy cows with automation is the recent trend in commercial and semi-

commercial dairy farms. In dairy farms efficacy of labour is the intensive problem, if the system of animal management with automation may improve the farm efficiency and animal welfare. Feeding of dairy animals with more than 50-100 cows makes more human power and labour cost. Automation in feeding dairy animals with forage or silage or concentrate or TMR may reduce the feeding frequency and working time management with aspects of reduce wastage of feed, labour and labour cost compared to farms with commercial feeding system without automation.

REFERENCES

Azizi, O., Kaufmann O. and Hasselmann, L. 2009. Relationship between feeding behaviour and feed intake of dairy cows depending on their parity and milk yield. *Livestock Sci*. **122**: 156-161

Barmore, J. A. 2002. Fine-tuning the ration mixing and feeding of high production herds. In: Proc. Tri-state dairy nutrition conference, Fort Wayne, IN, USA, 16-17 April

Bewley, J. 2010. Precision dairy farming: advanced analysis solutions for future profitability. 1st North American Conf. on Precision Dairy Management, 2-5 March, Toronto, Canada.

Bisaglia, C., Belle, Z., van den Berg, G. and Pompe, J. C. A. M. 2013. Automatic *vs.* conventional feeding systems in robotic milking dairy farms: a survey in The Netherlands.

Bisaglia, C., Nydegger, F., Grothmann, A. and Pompe, J. C. A. M. 2010. Automatic and frequency-programmable systems for feeding TMR: state of the art and available technologies. XVII World Congress of the CIGR, 13-17 June, Québec City, Canada.

Cassel, E. K., Merrill, W. G., Bui, T. V., Milligan, R. and Guest, R. 1982. Evaluation of systems for feeding supplemental concentrates to group fed cows. *Anim. Sci*., Mimeo Ser. No. 59 rev., Cornell Univ., Ithaca, NY.

De Koning, C. J. A. M. 2010. Automatic milking - Common practice on dairy farms. Proc. of the 1st North American Conf. on Precision Dairy Management, 2-5 March, Toronto, Canada.

De Vries, T. J., von Keyserlingk, M. A. G. and Beauchemin, K. A. 2005. Frequency of feed delivery affects the behaviour of lactating dairy cows. *J. Dairy Sci*., **88**: 3553-3562.

De Vries, T.J. and von Keyserlingk, M. A. G. 2005. Time of feeding delivery affects the feeding and lying patterns of dairy cows. *J. Dairy Sci*., **88**: 625-631.

Grothmann, A., Nydegger, F., Moritz, C. and Bisaglia, C. 2010. Automatic feeding systems for dairy cattle- potential for optimization in dariy farming. Wageningen, The Netherland, pp.1-6.

Hollander, K. C. J., Blanken, K., Gotink, A., van Duinkerken, G., Dijk, G., Lenssinck, F. and de Koning, K.. 2005. Feeding systems on dairy farms. Animal Science Group 73, Lelystad, The Netherlands.

Jacobs, J. A. and Siegford, J. M. 2012 Invited review: The impact of automatic milking systems on dairy cow management, behavior, health, and welfare. *J. Dairy Sci*., **95(5)**: 2227–2247.

Kazumoto, I. 1999. Full-automatic TMR preparation feeding equipment mainly used self-sufficient feed. *Livestock tech.,* **526**: 2-5.

Leaver, D. 1989. The incorporation of new techniques into cattle production systems in developed countries. Proc. 2nd Int. Symp. New Techniques Agriculture. Univ. Call. North Wales, Bangor, England

Mantysaari, P., Khalili, H. and Sariola, J. 2006. Effect of feeding frequency of a Total Mixed Ration on the performance of high-yielding dairy cows. *J. Dairy Sci*., **89**: 4312-4320.

Nydegger, F.and Grothmann, A. 2009. Automatic feeding of cattle. Results of a survey on the state of the art. Ettenhausen. The Netherland.

Pompe, J. C. A. M., Alders, D H. J., Heutinck, L. F. M. and Lokhorst, C. 2007. Automatic individual feeding systems for dairy cows: observations of facility utilization, In: Cox, S. (Ed.), Precision Livestock Farming '07, Wageningen Academic Publishers, Skiathos, Greece, pp. 45-51.

Prichard, D. E., and Estridge, M. L. 1988. Computerized concentrate feeders for dairy cows. Dairy Guide, 00113. Ohio Coop. Ext. Serv., Columbus.

Rutten, C. J., Velthuis, A. G. J., Steeneveld, W. and Hogeveen, H. 2013. *Invited review:* Sensors to support health management on dairy farms. *J. Dairy Sci*., **96(4)**: 1928–1952.

Shahhosseini, Y. 2013 Cow behaviour in AMS: Comparison of two different systems. M.Sc., Thesis, Swedish University of Agricultural Sciences. Sweden

Svennersten-Sjaunja, K. M. and Pettersson, G. 2008. Pros and cons of automatic milking in Europe. *J. Anim Sci*., **86(13)**: 37-46.

Tamaki, K. 2002. Livestock management with 'relaxation' for both humans and domestic animals (4)-III. Development and utilization of full-automatic TMR preparation and feeding equipment. *Animal husbandry,* **56(10)**: 1065-1070.

Brassica Anemia Factor

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Brassica spp. is frequently used to feed farm animals in India. It includes *B. campestris* (Mustard), *B. latifolia* (Mahua), *B. oleracea capitata* (Cabbage), *B. oleracea var botrytis* (Cauliflower) and *B. oleracea acephala* (Kale). Kale is a well proven fodder crop providing high yields of green fodder and a flexible utilization period which can stretch from August right through to the following March. The crop has high crude protein content (15.06%), metabolizable energy (2.40 Mcal/kg DM), good winter hardiness and can be fed to both cattle and sheep. It can also be harvested and ensiled. However, it is not recommended to use them without restriction, because of their typical anti-nutritional sulfur compounds: glucosinolates, which are goitrogenic, and S-methylcysteine sulfoxide (SMCO), which is responsible for anaemia.

SMCO is a toxic non protein amino acid which contains nitrogen and sulfur. It is also known as "brassica anemia factor" or "kale anaemia" or "red water". SMCO is a metabolic product of forage brassicas, generally not found in toxic amounts in seeds of *Brassica spp*. The toxicity can occur with all brassica crops, but more common with kale crops. Most susceptible species is roe deer, however affects all species (Arnold, 2014). This is more severe in cows than sheep.

MECHANISM OF TOXICITY

SMCO which is found in forage and can be considered as primary hemolysin, is converted to dimethyl disulfide (secondary hemolysin) in the rumen by the microbes (dethiolmethylation). The dimethyl disulfide (DMDS) absorbed into the bloodstream and oxidizes hemoglobin. There is formation of disulfide bonds between chains of hemoglobin, resulting from the oxidation of thiol groups, making structure of hemoglobin unstable. Spleen removes the damaged RBCs from circulation resulting in anemia. Hemolysis also occurs due to oxidative damage to RBC membrane resulting in hemoglobinuria. The conversion rate of SMCO to DMDS depends on the dietary composition and probably on the composition of the rumen flora. The toxicity is increased by rumen microbial fermentation. A genetically increased susceptibility (low reduced glutathione levels or deficiency in glucose-6-phosphate dehydrogenase) may also occur. Other factors related to toxicity include that flowering plants generally having higher concentrations of SMCO than

vegetative plants. Highest SMCO levels are found in young leaves and growing shoots. The condition tends to be worse when soil nitrogen and sulphur levels are high because NO_3^- also interferes with oxygen binding to hemoglobin in the blood and, in severe cases, causes rapid animal death. SMCO is a heritable character (0.24) (Barry, 2013), therefore, individual animal itself may also be the reason of high susceptibility to the toxicity.

LEVEL OF TOXICITY

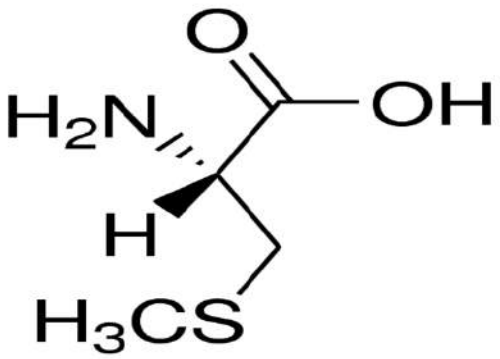
SMCO concentrations generally vary between 0.6 and 2.0% DMB in forage. When concentrations exceed 1.5% SMCO, the performance of grazing animals may be reduced (Fletcher *et al.,* 2010; Smith, 1980). In case of steers, daily SMCO intakes of 18-35 g/100 kg live weight may lead to acute condition showing hemolytic response with growth inhibition while 10-15 g/100 kg live weight daily dose result into low grade anemia (sub-acute). In Goats, daily intakes of 15 to 19 g/100 kg live weight SMCO, whether given as kale or the pure synthetic compound, elicit hemolytic responses. However, animals with 10 g/100 kg live weight SMCO show mild disturbances in blood picture or may even be beneficial due to anti-carcinogenic, anti-diabetic and cardiovascular effects. The possible prophylactic action of the S-alkylcysteine sulphoxides has been studied in coronary heart disease in man. It also has strong antimicrobial activity (phytoalexin) that helps in preventing pathogenesis in growing plants**.**

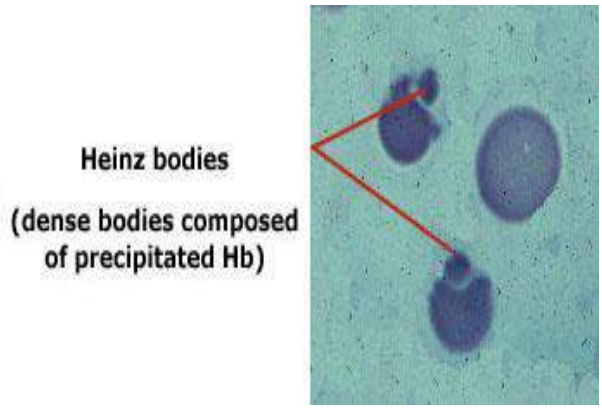
SIGN AND SYMPTOMS OF TOXICITY

The affected animal show weakness, fall in performance, liver and kidney damage, elevation in heart and respiration rates to compensate the reduced number of RBCs. Hematocrit may drop by 75% of the normal range. Hemoglobinuria also occurs resulting in red coloured urine, hence the name "red water" is given. There is massive icterus in severe case which may be fatal. In case of roe deer, hypoxia may be the probable reason for lesions of the CNS. In less severe cases, a subclinical icterus may lead to fat discolouration resulting in down grading of carcass. Heinz-Ehrlich bodies are visible a few days to 3 weeks after the beginning of feeding of kale. These stainable granules are deposits of denatured hemoglobin inside RBCs, results from the irreversible oxidation of hemoglobin by dimethyl disulfide.The ultimate cause of destruction of red blood cells after oxidative damage with Heinz-Ehrlich body formation is not yet well understood. Several hypotheses have been put forward like-

- Vulnerability of the membrane is increased to further damage
- Alteration in the RBC membrane permeability
- Splenic entrapment due to an alteration in red blood cell deformability
- Recognition by macrophages of the membrane areas with attached Heinz bodies

Some animals may collapse and suddenly die due to heavy blood loss.





TREATMENT AND CONTROL

There is no method found to detoxify SMCO in forage, however, sundrying may help to some extent (Ayres, 2002). Hematinics (sub-acute cases) and blood transfusion (severe cases) should be provided.

Important managemental methods to control the toxicity are as follows-

- It is not advisable to graze the animals on brassica crops that have started flowering i. e. mature brassica as SMCO content increases with age of plants.
- Slow introduction and access to an alternative feed source may be an important method to use kale fodder.
- These crops should be used for late winter pasture in temperate areas.
- The excess use of nitrogen and sulphur in fertilizer should be avoided.
- Selenium supplementation helps to protect animals against erythrocyte damage.
- If kale anaemia is suspected, remove animals from the crop and keep under close watch until health is regained.
- Manipulation of rumen flora by dietary manipulation can be done to exclude organisms with SMCO-lyase activity.
- The search for varieties with a low SMCO content in the forage (maximum: 4-6 g/kg DM) seems to be the most promising way of reducing pathological risks.
- Single trait selection is suggested for future research i.e. selection for animals with a high level of GSH and/or glutathione reductase

REFERENCES

Arnold, M. 2014.Forage-Related Cattle Disorders Brassicas: Be Aware of

the Animal Health Risks. Kentucky Cooperative Extension.

Ayres, L. 2002. Forage brassicas - quality crops for livestock production. Agfact P2.1.13, first edition.

Barry, T.N. 2013. The feeding value of forage brassica plants for grazing ruminant livestock. *J. Anim. Feed Sci.*, 01-12

Fletcher, A. L., Wilson, D. R., Maley, S., McCallum, J. and Shaw, M. 2010. The effect of sulphur and nitrogen fertiliser on levels of antinutritional compounds in kale. Proceedings of the New Zealand Grassland Association, 72: 79-84.

Smith, R. H. 1980. Kale poisoning: the brassica anaemia factor. *Vet Rec*, 107:12-15.

Fish Nutrition: Facts and Information

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Good nutrition in animal production systems is essential for economically producing a healthy, high quality product. In fish farming, nutrition is critical because feed represents 40-50% of the production costs. Interest in fish and shellfish nutrition has increased markedly over the past two decades, largely due to the global increase in aquaculture production. Nutritional status is considered one of the important factors that determine the ability of fish to resist diseases. Outbreaks of fish diseases commonly occur when fish are stressed due to a variety of factors including poor nutrition. The need for proper diets to improve health and prevent diseases of farmed aquatic animals is widely recognized. In the past two decades significant advances have been made in establishing the quantitative requirements of more than 40 essential nutrients for optimum growth and better feed utilization, as well as to prevent deficiency diseases of single or multiple nutrients (NRC, 1993). The production of nutritionally balanced diets for fish requires efforts in research, quality control, and biological evaluation. Faulty nutrition obviously impairs fish productivity and results in a deterioration of health until recognisable diseases ensue. The borderlines between reduced

growth and diminished health, on the one hand, and overt disease, on the other, are very difficult to define. There is no doubt that as our knowledge advances, the nature of the departures from normality will be more easily explained and corrected. However, the problem of recognizing a deterioration of performance in its initial stages and taking corrective action will remain an essential part of the skill of the fish culturist.

NUTRIENT REQUIREMENTS AND DEFICIENCIES

Protein

Because protein is the most expensive part of fish feed, it is important to accurately determine the protein requirements for each species and size of cultured fish. Proteins are formed by linkages of individual amino acids. Although over 200 amino acids occur in nature, only about 20 amino acids are common. Of these, 10 are essential

(indispensable) amino acids that cannot be synthesized by fish. The 10 essential amino acids that must be supplied by the diet are: methionine, arginine, threonine, tryptophan, histidine, isoleucine, lysine, leucine, valine and phenylalanine. Of these, lysine and methionine are often the first limiting amino acids. Fish feeds prepared with plant (soybean meal) protein typically are low in methionine; therefore, extra methionine must be added to soybean-meal based diets in order to promote optimal growth and health. It is important to know and match the protein requirements and the amino acid requirements of each fish species reared.Protein levels in aquaculture feeds generally average 18-20% for marine shrimp, 28-32% for catfish, 32-38% for tilapia, 38-42% for hybrid striped bass. Protein requirements usually are lower for herbivorous fish (plant eating) and omnivorous fish (plant-animal eaters) than they are for carnivorous (flesh-eating) fish, and are higher for fish reared in high density (recirculating aquaculture) than low density (pond aquaculture) systems. Protein requirements generally are higher for smaller fish. As fish grow larger, their protein requirements usually decrease. Protein requirements also vary with rearing environment, water temperature and water quality, as well as the genetic composition and feeding rates of the fish. Protein is used for fish growth if adequate levels of fats and carbohydrates are present in the diet. If not, protein may be used for energy and life support rather than growth. Proteins are composed of carbon (50%), nitrogen (16%), oxygen (21.5%), and hydrogen (6.5%). Fish are capable of using a high protein diet, but as much as 65% of the

protein may be lost to the environment. Most nitrogen is excreted as ammonia (NH_3) by the gills of fish, and only 10% is lost as solid wastes. Accelerated eutrophication (nutrient enrichment) of surface waters due to excess nitrogen from fish farm effluents is a major water quality concern of fish farmers. Effective feeding and waste management practices are essential to protect downstream water quality

Lipids (Fats)

Lipids (fats) encompass a large variety of compounds. Lipids have many roles: energy supply, structure, precursors to many reactive substances, etc. In the diet or carcass of fish, lipids are most commonly found as triglycerides, phospholipids and, sometimes, wax esters. Triglycerides are composed of a glycerol molecule to which three fatty acids are attached. Phospholipids are also

composed of a glycerol molecule but with only two fatty acids. Instead of a third fatty acid a phosphoric acid and another type of molecule (choline, inositol, etc.) are attached. Wax esters are made of a fatty acid and a long chain alcohol and are a common form of lipid storage in certain species zooplankton . The main role of triglycerides is in the storage of lipids (fatty acids). Phospholipids are responsible for the structure of cell membranes (lipid bilayer). Fatty acids are the main active components of dietary lipids. Fish are unable to synthesize fatty acids with unsaturation in the n-3 or n-6 positions yet these types of fatty acids are essential for many functions. These two types of fatty acids are, therefore, essential for the animal and must be supplied in the diet. Deficiency in essential fatty acid result in general, in reduction of growth and a number of deficiency signs, including depigmentation, fin erosion, cardiac myopathy, fatty infiltration of liver, and "shock syndrome" (loss of consciousness for a few seconds following an acute stress). Salmonids require about 0.5 to 1% long chain polyunsaturated n-3 fatty acids (EPA (20:5 n-3) and DHA (22:6 n-3)) in their diet. This amount is easily covered by ingredients of marine origins, such as fish meal and fish oil, which are always present in significant amounts in salmonid feeds.

Carbohydrates

Carbohydrates represent a very large variety of molecules. The carbohydrate most commonly found in fish feed is starch, a polymer of glucose. Salmonid and many other fish have a poor ability to utilize carbohydrates. Raw starch in grain and other plant products is generally poorly digested by fish. Cooking of the starch during pelleting or extrusion, however, greatly improves its digestibility for fish. However, even if the starch is digestible, fish only appear to be able to utilize a small amount effectively. Carbohydrates only represent a minor source of energy for fish. A certain amount of starch or other carbohydrates (e.g. lactose, hemicellulose) is, nevertheless, required to achieve proper physical characteristic of the feed.

Vitamins

Vitamins are organic compounds necessary in the diet for normal fish growth and health. They often are not synthesized by fish, and must be supplied in the diet. The two groups of vitamins are water-soluble and fat-soluble. Water-soluble vitamins include: the B vitamins, choline, inositol, folic acid, pantothenic acid, biotin and ascorbic acid (vitamin C). Of these, vitamin C probably is the most important because it is a powerful antioxidant and helps the immune system in fish. The fat-soluble vitamins include A vitamins, retinols (responsible for vision); the D vitamins, cholecaciferols (bone integrity); E vitamins, the tocopherols (antioxidants); and K vitamins such as menadione (blood clotting, skin integrity). Of these, vitamin E receives the most attention for its important role as an antioxidant. Deficiency of each vitamin has certain specific symptoms, but reduced growth is the most common symptom of any vitamin deficiency. Scoliosis (bent backbone symptom) and dark coloration may result from deficiencies of ascorbic acid and folic acid vitamins, respectively.

Minerals

Inorganic elements (minerals) are required by fish for various functions in

metabolism and osmoregulation. Fish obtain minerals from their diet but also from their environment. Many minerals are required in trace amounts and are present in sufficient quantity in the surrounding water for the fish to absorb through their gills. In freshwater, there is generally sufficient concentration of calcium, sodium, potassium and chloride for the fish to absorb and cover its requirements. The totality of the requirement for other minerals must, in general, be covered by the diet. Dietary minerals play many roles. There generally have a structural (e.g. bone formation) or catalytic (e.g. metalloenzyme) role. Minerals required by fish included calcium, phosphorus, sodium, potassium, magnesium, iron, copper, zinc, cobalt, selenium, iodine, and fluorine. The recommended levels of minerals in the diet are shown in Table 1. Reduced growth, feed efficiency and skeletal deformities is the most common signs of mineral deficiencies.

Table 1. Mineral requirement of salmonid fish in freshwater

Minerals	**Requirement (mg/kg feed)***
Calcium (Ca)	**10,000**
Chlorine (Cl)	**9,000**
Potassium (K)	**7,000**
Sodium (Na)	**6,000**
Phosphorus (P)	**6,000**
Magnesium (Mg)	**500**
Iron (Fe)	**60**
Zinc (ZN)	**30**
Manganese (MN)	**13**
Copper (Cu)	**3**
Iodine (I)	**1.1**
Selenium (Se)	**0.3**

**Requirement in the absence of significant amounts of the specific mineral in the water.*

CONCLUSION

All nutrients required for the well-being and normal growth of the fish must be supplied in formulated diets as available (digestible) nutrients. Otherwise, the fish cannot utilize the nutrients present in the feed ingredients. The formulated diets also must be pelleted and processed in such a manner that they are durable and water stable with a minimum amount of fines. Proper feeding of a quality diet should be considered as a high priority in the daily routine on fish culture stations. Wasted feed depletes oxygen levels, causes gill damage, and supports fungal and bacterial growth, all of which can lead to disease problems. Because it is necessary to transfer dietary nutrients into the fish through a water medium, problems occur which are unknown in terrestrial animal feeding practices. Most of the feeding charts available today are based on meat-meal diets of the past. One must be cautious in applying these tables to modem diets which have higher nutrient densities and availabilities. The main factors influencing feed intake of fish are water temperature, the energy content of the diet, and expected growth. Therefore, an estimation of feed intake needed must be based on these fundamental factors. If a group of fish is not feeding actively or growing as expected, diagnostic work is needed to determine the cause. Lack of appetite or retarded growth are often early signs of stress and disease.

REFERENCES

Azevedo, P.A., Cho, C.Y. and Bureau, D.P. (1998). Effects of feeding level and water temperature on growth, nutrient and energy utilization and

waste outputs of rainbow trout (*Oncorhynchus mykiss*). Aquat Living Resour. 11: 227-238.

Cho, C.Y. and Bureau, D.P. (1998). Development of bioenergetic models and the *Fish-PrFEQ* software to estimate production, feeding ration and waste output in aquaculture. Aquat. Living Resour. 11:199-210.

Cho, C.Y. and Bureau, D.P. (1997).Reduction of waste output from salmonid aquaculture through feeds and feeding. Progress. Fish. Cult. 59 155-160.

Cho, C.Y., Cowey, C.B. and Watanabe, T. (1985). Finfish nutrition in Asia, Methodological approaches to research and development. International Development Research Centre, Ottawa. Publication No. IDRC-233e 154 p.

Cho, C.Y. (1992) Feeding systems for rainbow trout and other salmonids with reference to current estimates of energy and protein requirements. Aquaculture 100:107-123.

Cho, C.Y. (1990). Fish nutrition, feeds, and feeding with special emphasis on salmonid aquaculture. Food Rev. Int. 6:333-357.

Cho, C.Y., Hynes, J.D., Wood, K.R. and Yoshida, H.K. (1994). Development of high nutrient-dense, low pollution diets and prediction of aquaculture wastes using biological approaches, Aquaculture 124: 293-305.

Cho, C.Y. and Kaushik, S.J. (1990). Nutritional energetics in fish: energy and protein utilization in rainbow trout (*Salmo gairdneri*), World Rev. Nutr. Diet. 61:132-172.

Cho, C.Y., Slinger, S.J. and Bayley H.S. (1982). Bioenergetics of salmonid fishes: Energy intake, expenditure and productivity, Comp. Biochem. Physiol. 73B: 25-41.

Iwama, G.K. and Tautz, A.F. (1981). A simple growth model for salmonids in hatcheries, Can. J. Fish. Aquat. Sci., 38: 649-656.

Shearer, K.D. (1994). Factors affecting the proximate composition of cultured fishes with emphasis on salmonids, Aquaculture 11: 63-88.

Availability of Green Fodder in India and Their Importance in Livestock

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India has one of the largest livestock populations in the world, and one of its notable characteristics is that almost its entire feed requirement is met from crop residues and byproducts; grasses, weeds and tree leaves gathered from cultivated and uncultivated lands and grazing on common lands and harvested fields.The Main concern in developing dairy industry in India is to feed the high yielding animals economically on green fodder.Feeding of green fodder improves both productivity and reproductivity in dairy animals.

PRESENT SOURCES OF FEED

Types of Fodder, Their Requirement and Their Yield per Acre

For Buffalo, green fodder requirement is 10% of its body weight is 50 kg, Dry fodder requirement is 8-10 kgs and concentrate requirement is 2 kgs for maintenance (daily activities) and per 2.5 kgs of milk additional 1 kgs of concentrate is required. Legume fodder varieties are RLS-88 of Lucern,Vardan or Mescavi for Cowpea & nonlegumes fodder varieties are RBN-13 for Hybrid napier and African tall for maize and Maldandi, Ruchira are for Sorghum.

In 50 kgs green fodder for buffalo, 40 kgs of nonlegume fodder as above mentioned

crops should be given and leguminous fodder of 10-12 kgs like Lucern,Cowpea, Berseem is given to maintain requirements of animal.

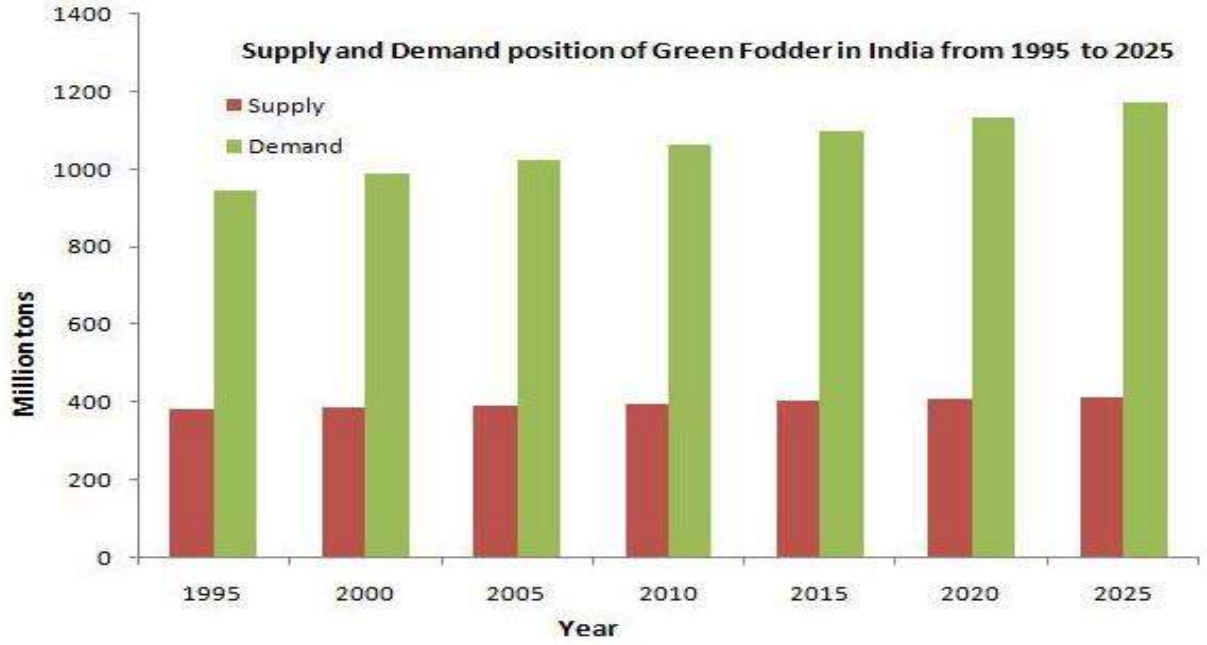
In five acres (200R area), 100R area should be under perennnial fodder varieties like under RBN-13 (50R) and remaining 50R under Lucern (RLS-88). Remaining 100 R land should be under seasonal fodder varieties like maize, Sorghum, maize pattern with cowpea as mixed crop. Dry fodder like sorghum kadbi, maize kadbi, wheat straw, rice straw are suited to buffalo but straws require additional treatment as they are inferior in fodder quality. In milk 98% part is water and 2% part is solid so the quantity of milk is depends on what type and quality of feed is given to animal and what amount of water is consumed by animals. Fat per cent is depends on dry matter of feed so majority of concentrate, dry foder and minerals like calcium constitute formation of fat droplets in milk. Dry rice grass considered as dry fodder but its nutritive quality is low, so it requires treatemt of urea, Jaggary, minerals and salt.

Requirement vs Availabiblity

It is understood that there is a huge gap between demand and supply of all kinds of feeds and fodders. If we examine the land resources available in the country for growing fodder and forage crops, it is estimated that the average cultivated area devoted to fodder production is only 2.5 % of the total area and the pasture and grazing land comprises only 3.6% of the total area.

- These resources are able to meet partly the forage requirements of the grazing animals only during the monsoon season. But for the remaining period of the year, the animals have straws of jowar (sorghum), bajra (cumbu), rice, ragi, wheat, barley etc., either in the form of a whole straw supplemented with some green fodder or a sole feed. Apart from this, the natural grasslands and the cultivable waste and fallow lands provide some grazing during the favourable growth periods in the monsoon season. With regard to the demand and supply of green fodder, dry fodder and concentrates in the Country, there exist varying reports. This is beacuase of the complex nature of the feed resources which are mutually interdependent and highly dynamic and unorganized. Also there is no specific methodology available to predict the demand and supply. National Institute of Animal Nutrition and Physiology (NIANP), Bangalore reports that the deficit is 38%, 45% and 44 % with regard to green fodder, dry fodder and concentrates, respectively.

Supply and Demand of Green and Dry Fodder (Estimates in million tonnes)



The projected balance between demand and supply of fodder presents a challenge in coming years. While the deficits are anticipated to increase as a proportion of the requirements, the situation appears all the more grim in case of green fodder. Focused strategies and concerted efforts are the need of the hour to face up to this challenge.

Constraints in Availability of Green Fodder

The major constraints in the availability of green fodder may be broadly categorized as follows.

1. **Small land holding size of the dairy farmers**

The 'no land'or 'small land holding size' factor of the dairy farmers is the major cause of less fodder production. Majority of the dairy farmers of the state are landless or have small piece of land for rice or vegetable or other horticultural production and they just can not afford that piece of land specifically for fodder cultivation.

2. **Unawareness for fodder cultivation**

In most of the cases, the dairy farmers are not aware of the package of practices for fodder cultivation and its effective utilization as per the farming conditions for round the year fodder availability for their dairy unit.

3. **Land utilization pattern and crop production system**

The availability of feed resources of a state is dependent on the land utilization pattern and crop production system. The green forages can be contributed from the cultivated fodder, grazing land, miscellaneous tree crops and cultivated waste land and forest area.

4. **Seasonal variation**

The seasonal variation in weather or climate is mainly responsible for the inadequate fodder accessibility round the year.

Kharif (June - September)	**Rabi (October - Dec/Jan)**	**Summer (April - June)**
Eg. Cowpea, Cluster bean, Field bean, Bajra, Sorghum, Maize 	Eg. Berseem, Lucerne, Oats, Barley 	Eg. Cowpea, Cluster bean, Field bean, Bajra, Sorghum, Maize 

Feeding Green Forage

Although forage based feeding systems help lower feed costs, the scope for such systems is limited in India because of the need to give priority to food crops. The

average cultivated area under fodder crops is estimated as 4.4%. In areas with better irrigation facilities, intensive fodder production is practised and in the Northern Region, particularly Punjab and Haryana, 10% of the irrigated land is allocated to fodder cultivation. The major part of the ration of dairy animals in this region consists of lucerne, berseem, maize, oat, sorghum, etc. In other parts of the country, although the area under fodder crops has not increased, the technique of a mixed cropping system of forages with other cash crops like vegetables and sugarcane is widely adopted by farmers.

Importance of Feeding Green Fodder

(i) fulfills bulk of the animal easily and quickly.

(ii) Good palatability and digestibility.

(iii) Good source of water as they contain 75-85% water depending upon the type of fodder and stage of harvesting.

(iv) Main sources of fibrous carbohydrate, which are well utilized by the animals (the non-legume fodders are rich in carbohydrate).

(v) Major sources of vegetable protein (legume fodders are rich in protein content).

(vi) Good sources of important minerals like calcium and iron.

(vii) Rich source of carotene (vitamin A) and vitamin E, required to maintain optimum fertility of the animals.

(viii) The milk and milk products of the dairy animals fed on green fodders are rich conjugated linoleic acid (CLA), which has major health benefits in humanbeings.

Ways and Means to Increase Fodder Production

To meet current level of livestock production and their annual population growth, strategies are needed to include measures that improve availability of

quality fodder as well as for designing suitable models for fodder-based economic milk production. Better genetic resources of fodder crops, including grasses, have to be collected and conserved. And at a large-scale, food-fodder cropping systems need to be encouraged to provide balanced nutrition to livestock in the mixed farming situations. To diversify basket of feed resources, non-conventional/underutilized feed resources like azolla (humid and sub humid conditions), turnip, fodder beets, and cactus need to be evaluated for their inclusion and effective utilization in livestock diets. Concerted efforts by plant breeders' concomitant with animal nutritionists are vital to recalibrate plant composition for traits like higher nutrition concordance and digestibility for meeting requirement of animals with moderate production level. Popularization and adoption of fodder- and feed-enrichment technologies to increase nutritive value of fodders at the farmers' doorstep is another option for increasing livestock production. There is impelling exigency to promote 'fodder bank' concept for preserving surplus from range lands during rainy season to be used during lean periods in post-monsoon and summer months.

Some imporatnt points to increase the fodder production are as under:

- Maximising forage production in space and time.
- Identifying new forage resources and increasing fodder seed production.
- Increasing the forage production within the existing farming systems.
- Adoption of agro-forestry systems to utilise different tree fodders for livestock rearing.
- Utilising marginal, sub-marginal drylands and problem soils for developing feed and fodder resources. Exploiting the feasibilities of growing fodder along with food and cash crops. Utilising barren and uncultivated lands. Establishment of fodder banks in villages Conservation of fodder into feed blocks.
- Enrichment of straw/stover with urea/fortification.
- **Use of chaff cutters.**
- Comprehensive watershed development programs with inclusion of fodder component.

Requirement of Green Fodder Crop Seeds/hec, Fertilisers, Machinery and Economics

OUTPUTS	
Production/ha	Forage 220 t/ha green fodder
PLANT MATERIAL REQUIRED	
Hybrid napier	3000 slips/ha
Cowpea	40 kg seed/ha
Maize	30 kg seed/ha
Berseem	25 kg seed/ha
Sorghum Mustard	20 kg seed/ha
	1.5 kg seed/ha
FERTILIZER/FYM	
FYM	10 tonnes/ha
FERTILIZER	
Nitrogen	150 kg
Phosphate	150 kg
Potash	60 kg
MACHINERY	
Weeder-cum–mulcher	
ECONOMICS	
(Net profit Rs./ha)	
Rs. 21,000=00/ha/year	

Various types of green fodder crops and their varieties

Crops	**Varieties**
Hybrid napier	IGFRI No. 6/ IGFRI No. 10
Berseem	Wardan Bundel Bersem-2
Mustard	Japanese rape/ Chinease cabbage
Maize	
Cowpea	African tall Bundel Lobia 1/ Bundel Lobia 2
Sorghum	PC-6/HC 136

Intensive Fodder Crop Rotations for Different Agro-climatic Zones of India

ZONES	CROP ROTATION	GREEN FODDER YIELD T/ha/annum
NORTHERN	Hybrid napier intercropped with berseem	211.7
	Hybrid napier + lucerne	176.0
	Berseem + Japan rape - Jowar + cowpea	170.5
	Maize + Cowpea-Maize + Cowpea - Turnip-Oat	190.0
CENTRAL & WESTERN	Hybrid napier + cowpea-berseem + mustard	286.3
	Maize + cowpea-M.P. Chari-berseem + mustard	197.2
	M.P.Chari-turnip-oat	192.3
	M.P.Chari + cowpea-berseem + mustard-Jowar + cowpea	168.6
	Maize + cowpea- maize + cowpea-oat-maize + cowpea	168.5
EASTERN	Maize + cowpea-oat-bajra + cowpea	102.6
	Jowar + cowpea-berseem + mustard-maize + cowpea	96.0
	Maize + ricebean-berseem + mustard	111.5
	Hybrid napier alone	144.2
SOUTHERN	Sorghum + cowpea-maize + cowpea-maize + cowpea	110.7
	Maize + cowpea-maize + cowpea-maize + cowpea	106.0
	Guineagrass round the year	93.5

Waste Management In Relation To House Fly Control In Poultry

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Commercial poultry production in India has undergone tremendous metamorphosis in the last two decades. Unlike backyard chicken, the problem of parasitic diseases is comparatively less in commercial poultry as the birds are being maintained under confined environment. However, the incidence of certain parasitic diseases, which are transmitted through faecal oral contamination, like coccidiosis, *Ascardia galli* and tapeworm infestations had been reported frequently in deep litter system of management. This has prompted the farmers to go for modern housing such as narrow cage and high rise cage systems to contain various diseases. As a result the incidence of infectious diseases has been controlled to a larger extent in cage system of management, but accumulation of litter under the cages for prolonged period provides ideal environment for fly breeding which leads to fly menace in layer production. House flies are closely associated with man and animals as they survive on organic waste such as manure, broken eggs, spills of feedstuff and dead birds. House flies are considered as the major pest species causing many harmful effects to man and animals.

Health and social problems associated with house flies

House flies lack biting mouth parts and hence they are not able to ingest solid food materials. But they eject their crop fluid onto the solid food to liquefy and then eat it. This feeding habit and presence of numerous hairs on their body enable them to act as a mechanical vector and intermediate host for many diseases. House flies are known to transmit salmonellosis; amoebiasis Giardiosis and pin worm in man(Sasaki *et al*., 2000 and Doiz *et al*., 2001) and As for animal diseases, they act as intermediate host for *Choanotaenia infundibulum* in chicken (Ponnudurai *et al*. 2004), *Thelazia* and *Stephanofilaria* in cattle and *Habronema* spp. in horse. Apart from disease transmission, house flies in poultry farms causing great irritation and annoyance to the birds and labours. The vomit drops of flies produce erosion of cages, reduced illumination of lights and dirty eggs. During high fly season they may even enter into the human dwellings located near the farm vicinity and cause great discomfort to people. The people often get aggrieved of this, approach the authorities to direct the farmers to take suitable control measures or close the farm. This problem is

prevailing across the country wherever poultry farms are concentrated more in a small area such as Namakkal in Tamil Nadu and some districts in Haryana.

Factors responsible for fly menace in poultry farms

Climatic condition that prevails in our country coupled with reproductive potentiality of house flies are the major reasons for high fly population (Barth, 1986). Together, accumulation of droppings under the cages attracts the flies for oviposition and provides suitable substrate for larval development. If the litter materials are in dry condition, there will be no fly problem, because dry litter not only discourages fly breeding but also create ideal condition for proliferation of natural enemies of house flies (Fatchurochim *et al*., 1989). Leakage of water due to faulty nipple causes wet litter problem which favours fly breeding. Similarly improper disposal of broken eggs and dead birds, spillage of feed and wet litter causing ingredients in the feed would enhance the fly breeding.

Biology of house flies

Knowledge on biology of house fly is very important for taking effective control measures against it. A single female fly lays around 1000 eggs, which hatch in 24 hours. The larvae undergo three moultings, and become pupa in 5 – 6 days. Adult fly emerges from pupa in 4 – 5 days. Under ideal condition i.e. temperature 30^0 C and Relative humidity 80 %, the whole life cycle is completed in 10 -12 days, whereas in winter season the life cycle is prolonged up to 30 days (Soulsby, 1982). This is why the population is very low during the winter months (Stafford and Collison, 1987). The fly population usually begins to rise following advent of summer rain in the middle of March and then it steadily increases. But high fly intensity could be seen during the months October and November usually following monsoon.

Control of house flies through waste management (cultural method)

Considering the ill effects associated with house flies, it is imperative to keep them at below threshold level if complete control is not possible. As we all know that various classes of chemical insecticides and insect growth regulators are commonly used for control of house flies. Indiscriminate use of these chemicals has resulted in development of resistant population, pollution and residues in meat and eggs. To overcome above shortcomings, cultural method of fly control can be adopted to minimize fly menace in poultry farms. Cultural method consisting of good litter management, proper disposal of dead birds and broken eggs, no feedstuff spillage and replacement of faulty nipples and proper grading which does not allow surface water to run into the house. All these would help to maintain farm in good conditions.

i. Monitoring of house flies in poultry farms

Fly monitoring is cornerstone in the fly control programme. Spot card method is a standard technique for monitoring of house flies in poultry farms (Axtel, 1970). The spot card is a 5 x 3''white paper is fixed to the cardboard or plywood. Approximately 5 -10 spot cards should be placed inside the shed at different

locations for 24 hours. After 24 hours all the cards should be collected and counted the spots that made by the flies (Ponnudurai and Harikrishnan, 2011). In foreign countries the spot cards are interpreted as if fly spots per card exceeds above 50 in a farm, that farm requires fly control measure.

ii. Litter management

Accumulation of litter material under the cages is one of the major reasons for fly problem in commercial poultry farms. So, proper manure management is the key to most fly control programs. The moisture content of the fresh poultry manure is approximately 60 to 80 per cent, which is ideal for fly breeding. Manure below 25% moisture and above 80% moisture will not support housefly breeding. Hence, fly breeding can be discouraged by reducing moisture level to 30% or liquefy the manure by adding the water.

a. Removal of litter

The life cycle of house flies can be interrupted by frequent removal (at least once a week) of litter material accumulated under the cages. Considering the labour cost, frequent removal is not practically feasible and hence it is advisable to remove the litter material at least twice in a year. The first removal during the month of February end or first week of March and second removal should be before arrival monsoon i.e. in the month of August or September. The litter material should not be removed completely instead ½ feet material should be left in the pit. This old litter would absorb the moisture in the fresh droppings, thereby the fly breeding is affected, but this dry litter provides suitable condition for predators and pupal parasitoides (Mullens *et al.*, 1996). Remove manure only in cooler months when flies are less active. The litter should not be removed during high fly season, because fresh droppings will encourage the fly oviposition. The removed material must be heaped in a location away from shed and if possible it can be covered with tarpaulin. By doing so all the developmental stages of flies will be destroyed by the heat generated from the heap

b. Storage of manure

Allowing manure to accumulate for long periods conserves beneficial arthropods and maximizes their populations. The storage of manure under the cages may facilitate drying and reduction of volume of manure, but it is dependent on absorption of moisture by the soil type present there. The dry litter not only discourages the fly breeding but also allow the natural predators of house fly such as beetle *Carcinops pumilio,* mite *Macrocheles muscaedomesticae* and pupal parasitoides *Spalangia endius* and *Dihrinus* spp. to proliferate. The natural predators of house fly like beetle *Carcinops pumilio* and mite *Macrocheles muscaedomesticae* feed on the house fly eggs and first stage larvae (Geden, 1990). A single beetle can ingest around 20 eggs per day. Whereas the pupal parasitoides *Spalangia endius* and *Dihrinus* spp. inject their eggs, with the help of ovipositor, into the pupa of house fly. The newly hatched out larva will eat away the pupa and kill them, finally adult parasitoides will emerge from the pupal case. A single parasitoid can infect 10

pupae (Sumathi 2008). For field use it has to be produced in large scale.

c. Composting

In-house composting can be done to manage insect populations in high-rise layer houses. Manure is agitated to incorporate oxygen and possibly a carbon source to aid in the composting process. This agitation results in increased temperature, an increased ammonia level, and decreased moisture content, all of which help reduce insect populations by 90 %. The agitation can be accomplished in several ways, but the most practical uses a commercial hydraulic-powered manure turner such as the "Brown Bear." Turning the manure pile twice a week is usually adequate.

iii. Water management

Water leakage should be arrested by replacing of faulty nipples. If wet areas are found due to nipple leakage, lime powder or fly ash can be sprinkled over that area to reduce moisture. High salt content in the feed and high house temperature make the birds to take more water, which will be passed out in the droppings. This will lead to wet litter problem, ultimately fly menace. Drain and fill low areas around the facility. The birds should be provided with clean water to prevent dysentery.

iv.Farm sanitation

Maintaining of strict farm sanitation itself is an important step for control of fly menace in poultry farms (Quisenberry and Foster, 1984). The broken eggs in the shed must be removed immediately or lime powder can be sprinkled over them. Similarly, dead birds should be put into a concrete pit instead of throwing them on the road. Spillage of feed stuff can be minimised to prevent attraction of flies into the farm premises. In addition, surroundings of shed should be free from vegetation (mowing of grasses), because good cross ventilation is necessary to keep litter in dry condition. Fly control through waste management and farm sanitation is the ideal option and hence chemical method of control should be tried only when all the managemental methods have failed.

REFERENCES

Axtel, R.C., (1970). Integrated fly control programme for caged poultry houses. J. Econ. Entomol., 63: 400 – 405.

Barth, C.L. (1986). Fly control through manure management. Poult.Sci., 65: 107 – 113.

Doiz, O., A.Clavel,S.Morales, M.Varea, F.J.Castillo,C.Rubio and C.R. Gomez – Lus .(2000). House fly (*Musca domestica*) as a transport vector of *Giardia lamblia*. Folia Parasitol 47 (4):330

Fatchurochim, S., C.J. Geden and R.C. Axtel. (1989). Filth fly (Diptera) oviposition and larval management in poultry manure of various moisture levels. J. Entomol. Sci., 24: 224 -231.

Geden, C.J. (1996). The role of coleopteran and acarine predators in house fly population regulation in poultry production facilities. Pp. 177 – 200 in Biocontrol of arthropods affecting Livestock and poultry, D.A.Rutz

and R.A. Patterson (eds).Westview press, Boulder

Mullens, B.A., N.C.Hinkle, and C.E.Szijj. (1996). Impact of alternating manure removal schedules on pest flies (Diptera: Muscidae) and associated predators (Coleoptera: Husteridae, Staphylinidae; Acarina: Macrochelidae) in caged layer poultry manure in southern California. J.Econ.Entomol, 89:1406 -1417.

Ponnudurai, G. and T.J. Harikrishnan. (2003). Incidence of cysticercoids of chicken tapeworm *Choanotaenia* i*nfundibulum* in *Musca domestica*. Indian J. Poult. Sci.38(3) 308 -310

Ponnudurai, G., and T. J. Harikrishnan (2011) Monitoring of house fly population in caged layer house in Namakkal, Tamil Nadu. Indian. Vet. J 88 (6) 22-23

Quisenberry, S.S., and D. E. Foster. (1984). Cost – benefit evaluation of house fly (Diptera: Muscidae) control in caged layer poultry house. Poult. Sci., 63:2132 - 2139

Sasaki, T., M. Kobayashi, and N.Agui. (2000). Epidemiological potential of excretion and regurgitation by *Musca domestica* (Diptera: Muscidae) in the dissemination of Escherichia coli O157: H7 to food. J.Med.Entomol.37:945-949

Willis, L.E., B.A.Mullens and D.A. Mandeville.(1990). Effects of pesticides on filth fly predators (Coleoptera: Misteridae, Staphylinidae; Acarina: Macrochelidae, Uropodidae) in caged layer poultry manure. J. Econ. Entomol. 83:451 – 457.