CHAPTER-7

Feeding of Dairy Animals-

Principles of feeding dairy animals, feeding of different categories of dairy animals viz., new born calf, heifers, pregnant, lactating, dry calf an bulls; feeding during extreme weather condition, requirements of water for different categories of animals

Objectives

Feeding of animals is to provide all nutrients in optimum ratio and adequate quantity to maintain the health, production and well being of animals. Scientific feeding is to optimize the production through balance feeding where carbohydrate, protein, fat, vitamins, minerals from feeds along with water to the animals for sustainable production. This will reduce calf mortality, cost of feeding and disease management at the same time will improve the production performance and economy of the farmers.

Principles of feeding dairy animals

For feeding of dairy animals, one should know the requirement of the animals which are again depends on breed and level of production, parity and body weight etc. Requirement of an animal weighing 350 kg, producing 10 litres of milk with 4.5 percent fat is different from the animals with same milk production, fat percent having different body eight and vice versa. It is also important to consider the relationship between feed nutrients intake and milk output ratio of an animal or efficiency of nutrient utilization as high producing animals utilized feed nutrients more efficiently than low producing animals. Similarly, feed ingredients available to the farmers or to that area and their nutritional value is also important for feeding animals. One feed may be available to one particular area, may not be available to other and nutritional value of same feed may differ from region to region depending on stage of harvesting, variety and processing methods. However, dairy cows are the excellent converter of feed and fodder nutrients into milk. Ration of cows composed of forages and agro-industrial by products which can not be directly be consumed by humans. Agro-industrial by products, mill by products includes maize gluten meal, brewers' grain, distillers' grain, wheat bran, rice polish etc. India with around 10, 25, 30 percent deficiet of dry, green and concentrate feeds, ranks 1st in world milk production (128 million tonnes). This is possible because of selective breeding, scientific feeding and better disease management of dairy animals. In addition to scientific and better feeding management farmers must follow dairy replacement progamme for future productivity and success of dairy enterprise. Genetic improvement in the dairy hers depend on replacing

cows leaving the herd with superior heifers. The following steps to be taken for successful dairy replacement programme.

1. Calf mortality to be reduced below 2 percent of live births.
2. Heifers should be bred at 60 percent of its mature body weight below 18 months of age, though the age is much longer in buffaloes.
3. First calf should come from the heifers at 28 months or less at 80-85 percent of its mature body weight.
4. Energy, protein, amino acid and minerals should be correctly balanced and to promote optimum growth and milk production.

Thumb rule of feeding animals

Feeding of dairy cows prime considerations must be to ascertain and to meet up the requirements in terms of dry matter, protein/ digestible or metabolizable protein and energy in terms of total digestible nutrients or metabolizable energy for 24 hours. The requirement of quantity of dry matter (DM) depends on the body weight of the animals and level of production. Dairy cows needs around 2-2.5 kg DM for every 100 kg live weight, while, crossbred cows and buffaloes needs 2.5- 3.0 kg daily. Naturally, all the requirement of energy, protein, vitamins and minerals come from total DM allotted to a particular animal. However, DM allowances may be divided in to concentrate (grains, oilcakes, mill by products an mineral and vitamin mixtures) and roughages (green fodders like maize, gorghum, oats, berseem, cowpea etc. and dry fodders like lucerne hay, sorghum hay, wheat and rice straw etc.). Under normal conditions, concentrates with around 18-20 percent protein may be given 1/3rd of total ration while 2/3rd may be given as roughage to have the protein around 8-14 percent depending on requirement of the animals. Again, among the roughages, 2/3rd may be dry or 3/4th, if sufficient succulent greens available, while 1/3rd green may be given, if succulent legume available 1/4th may be given.

Feeding of newborn: Dairy calf is born is virtually without immunity from diseases. Immunity must be acquired from immunoglobulins absorbed through the intestinal wall during first 24 hours of life. After this period absorption ability of intestine to immnoglobulins diminished greatly. Primary source of these immunoglobulins is colostrum or 'yellow milk', the first secretion from the udder after parturition. Colostrum contains antibodies to protect the newborn against disease, as well as being lower in fat and higher in protein than ordinary milk. Bovine colostrum from pasture-fed cows contains immunoglobulins specific to many human pathogens, including *Escherichia coli, Cryptosporidium parvum, Shigella flexneri, Salmonella, Staphylococcus* and rotavirus (which causes diarrhea in infants). Before the development of antibiotics, colostrum was the main source of immunoglobulins used to fight infections. Mean percentages of fat, protein, and lactose in colostrum are 6.7, 14.9,

and 2.5, respectively. Concentrations of IgG_1, IgG_2, IgA, IgM, and lactoferrin are 35.0, 6.0, 1.7, 4.3, and 0.8 mg/mL, respectively. Mean concentrations of fat-soluble vitamins, including retinol, tocopherol, and beta-carotene, are 4.9, 2.9, and 0.7 µg/g, respectively. Mean concentrations of water-soluble vitamins were 0.34, 0.90, 4.55, 0.60, 0.15, 0.21, and 0.04 µg/mL for niacin, thiamine, riboflavin, vitamin B12, pyridoxal, pyridoxamine, and pyridoxine, respectively. Mean concentrations (mg/kg) of selected minerals in colostrum are Ca -4.716; P- 4.452; Mg- 733; Na -1.058; K- 2.845; Zn -38; Fe- 5.3; Cu -0.3; S -2.595; and Mn -0.1). Colostrum is secreted upto 72 hours of parturition and may be fed to the calf as much as it can take voluntarily. Upto 3 months, the energy and protein requirement are met by whole and skim milk. The average daily intake of milk is around $1/10^{th}$ body weight. At the same time after 2.5 months, may be exposed to soft grasses to acquainted and adjusted with the fodders and proper development of rumen. Milk replace, may be given to the calves having protein level 20-22%, calf starter may also be fed to the calves which have 18-20% protein and 80% total digestible nutrients with minimum 3% fat. Calf starter must be palatable with highly digestible nutrients.

Feeding of growing calves: Indian Council of Agricultural Research (ICAR) has given detailed specification on the nutrients requirements and we can take two examples. For 100 kg growing cattle calves growing @550 g/day requires 2.8 kg dry matter, 270 g digestible crude protein, 2.1 kg total digestible nutrients, 10 g Ca, 8 g P, 10 mg carotene and 300 IU vitamin A per day. Similarly, for 180 kg cattle calves growing 550 g/ day requires 4.7 kg DM, 310 g DCP, 2.9 kg TDN, 15 g Ca, 12 g P, 18 mg carotene and 8 IU vitamin A. For 120 kg buffalo calves growing @450 g/day, requires 3.1 kg DM, 179 g DCP, 1.9 kg TDN, 14 g Ca, 11 g P, 16 mg carotene and 4 IU vitamin A. For buffalo calves weighing 260 kg growing @550 g/day, requires 6.2 kg DM, 410 g DCP, 3.5 kg TDN, 20 g Ca, 16 g P, 30 mg carotene and 13 IU vitamin A. These all nutrients to be supplemented through roughage and concentrate discussed in other chapters.

Feeding of heifers: Female calves grown mainly for milk purposes and their feeding starts from the beginning i.e., birth. Colostrum to be fed in adequate quantity to make the animal resistant against many diseases. Then proper vaccination and dosing should be done regularly. Fed the animals properly as per requirements as stated in thumb rule method and calculations based on chemical composition of every feed ingredients. DM intake may vary from 2.5 to 3.0% per 100 kg body weight, for 400 kg body weight animal DM requirement may be 10-12 kg. This DM should be supplied through roughages (fodders like maize, sorghum, oats, berseem, lucerne, cowpwea, tree leaves and straws, stovers and agro- industrial byproducts and others available in a particular region singly or in combinations) and concentrates which contains around 20% protein and 75% TDN. Protein or crude protein in the ration may be around 12-14 % and TDN may be around 60-70%. Neutral detergent fibre (comprising of cellulose, hemicelluloses and lignin) may

be 30-40%, Ca- 0.4 to 0.5%, P- 0.34-0.4%, trace mineral salts -0.3% or mineral mixture 2% in the concentrate mixture is sufficient to meet the requirement of animals.

Feeding of pregnant animals

Pregnancy means mother plus foetus, so in fulfilling the requirement of pregnancy includes the maintenance requirement of mother and demand of growing foetus which is high in last trimester of pregnancy. In last 60 days of pregnancy, lives weight of the animal increases almost by 25-30 kg depending on the breed and management condition besides their foetal growth. For example, an animal (cattle and buffalo) weighing 350 kg body weight requires about 5.0 kg DM, 230 g of digestible crude protein and 2.7 kg TDN for maintenance. If the weight of the animal is around 500 kg, needs 6.5 kg DM, 300g DCP and 3.4 kg TDN. If the respective animals are in last two months of pregnancy then, the requirement will be 6.4 kg DM, 290 g DCP and3.4 kg TDN; and 8.6 kg DM, 430 g DCP and 4.8 kg TDN, respectively. In addition to Ca, P and other macro and minor or trace minerals are essential to supply for proper management of the foetus. Fat soluble vitamins like vitamin A, D and E also to be incorporated in the ration of the animals for optimum health and production. Further, animals need regular exercise, optimum fresh and clean drinking water even under intensive system of management.

Feeding of lactating animals: Formulating ration for dairy animals is very difficult because there are a number of nutrients drained through milk. So nutritionists should look into three main things: maintenance requirement of the animal, quality and quantity of milk excreted and finally change of body weight. A cow producing 10 lit of milk, excreting about 8.8 lit of water through milk only. So, foremost important nutrient to be supplied to the animal is water. Just after parturition animal cannot take much DM due to stress, so dairy animals must be supplied with palatable feeds and other feeds that fulfils the energy and protein requirement. Rumen bypass protein or undegradable protein and bypass fat or calcium salt of long chain fatty acid may be given during this stage (fate of dietary protein discussed below). Requirements, for example, an animal (cattle and buffalo) weighing 350 kg body weight requires about 5.0 kg DM, 230 g of digestible crude protein and 2.7 kg TDN for maintenance. If the weight of the animal is around 500 kg, needs 6.5 kg DM, 300g DCP and 3.4 kg TDN for maintenance. In addition to that, for 4 % fat extra 45 g DCP and 315 g TDN to be given per kg of milk yield. For 7% fat, 63 g DCP and 410 g TDN extra to be given in the ration.

Fate of dietary protein in ruminants

Feed protein is composed of non protein nitrogen (NPN), true protein and fibre bound protein among which NPN and part of true protein degraded in the rumen, part of true protein digested in small intestine and fibre bound protein neither degraded in rumen nor

digested in intestine and excreted though faeces. Ruminal degradation of NPN and true protein leads to production of ammonia, amino acid and small peptides which are utilized by ruminal microbes to produce microbial protein in presence of readily available energy / fermentable energy source. Efficiency of microbial protein synthesis depends on type and source of diet of the animal and it may vary from 13-20 g microbial protein synthesis/ kg of organic matter digested in rumen. Ammonia usually utilized by fibre degrading bacteria while amino acid and small peptides utilized by sugar utilizing bacteria. Bacterial protein is well balanced and have all essential amino acids required by the organisms, though this may be inadequate depending on micronutrient supply for limiting amino acid synthesis and requirement of the animal for a particular stage of growth or lactation. If the growth rate is too high or milk production of the animal is high, then bacterial protein may not be sufficient to meet the requirement or amino acid from microbial source is not sufficient to meet the requirement at intestinal level. To increase the intestinal availability of dietary protein, ruminal degradation of feed protein to be reduced either by using naturally occurring bypass protein like cotton seed cake, maize gluten, fishmeal etc. or by protecting the highly degradable protein by formaldehyde, heat, tannic acid, lignosulphonate or encapsulation of protein or amino acids.

Feeding during feed and fodder scarcity: Scarcity of feed resources is a common problem limiting the animal production in the developing countries like India. Various natural calamities like floods, droughts and cyclone produces scarcity of foods and feeds. Among all, flood is the major devastating natural calamity leading to a heavy loss of vegetation. On an average about 50-60 percent of the cropped area in flood affected area remain submerged and it takes at least a minimum of 30 days to bring the field for cultivation purposes. Different kinds of damages caused by floods can be categorized as follows:

- ✓ Loss of standing crops due to submerging in flood water which is very difficult to harvest the grain and biomass.
- ✓ Damage of stored dry roughage due to water soaking followed by fungal growth causing loss of nutrients. This may decrease the palatability and thereby intakeof that particular fodder and feedstuffs.
- ✓ Washing away of dry roughage stored in open space by aggressive currents of flood water, mostly seen in hilly areas due to cloudburst.
- ✓ Damage of stored food grains by water soaking followed by fungal growth resulting in loss of nutrients and production of harmful/toxic metabolites. Most predominant fungi are *Aspergillus flavus* and *Aspergillus parasiticus* which produces toxins called aflatoxin B and G based on colour produces under uv rays (B- blue and G is green). Aflatoxin M also found in milk and very toxic to human beings.
- ✓ Pollution of water with dung, urine, debris and other wastes.

On the other hand, drought causes a different type of loss where there is no or limited growth of plants. In such condition, there is an acute shortage of feeds and fodder in flood affected areas. Therefore, there is a need to formulate feeding strategy for maintenance of animals to ensure its survival during and after flood. Feeding strategies during scarcity depend on the specific conditions prevailing in any particular area. In general the farmer has to make decisions based on economics, knowledge of nutrition, the availability of feed resources and the length of the drought may affect. There are many economical technological interventions may be adopted to encounter such problem of scarcity due to extreme weather condition and environmental calamities.

- ✓ Complete feed block (CFB): Complete feed block is composed of forage, concentrate and other supplementary nutrients in desired proportions capable to fulfil nutrient requirement of an animal. The CFBs can be used during flood situations due to easy transport. Complete feed system is advantageous against conventional system of feeding by reduced labour cost, maintenance of uniform roughage concentrate ratio, uniform feed intake favouring uniform supply of nutrients and maintenance of rumen environment. This system of feeding is well suited to our country as it helps utilizing locally available crop residues, agro-industrial by products and non-conventional feeds.

- ✓ Urea molasses mineral block licks (UMMB): The urea molasses mineral block is a strategic feed supplement for ruminant animals. Molasses, urea and other ingredients are used in the manufacture of molasses/urea feeds that are prepared as blocks. Crop residues are deficient in fermentable nitrogen, energy and minerals. In absence of adequate quantity of green fodder in the diet, rumen microbes don't get nutrients for their own growth. As a result, digestibility of fibrous feed in the rumen is affected. As ruminants can synthesize protein from non-protein nitrogen, UMMB supplementation delivers urea and energy in small doses on continuous basis. These preparations are an excellent way of providing readily degradable protein and readily fermentable energy to ruminant animals, and they help to increase the protein supply to the animal. The blocks can be made from a variety of components depending on their local availability, nutritive value, price, existing facilities for their use and their influence on the quality of blocks.

- ✓ Urea treatment of straws: Potential sources of feeds for livestock are by-products from both arable crops and agro-industrial processes. These can be valuable sources of nutrients for livestock, rich in both protein and energy. However, they are often low in nutritive value but rich in anti-nutritive factors. Many of the crop by-products (such as straws and stovers) are also extremely fibrous and more suitable for feeding to large ruminants (such as cattle and buffalo) rather than sheep and goats. There has been a considerable amount of work done on the urea treatment of straw. The

recommended treatment rate is 40 g urea/kg straw with the urea usually being added as a solution in water (40 g urea/L water) which is then sprinkled on the straw. The straw may then either be fed straight away, or ensiled to enable the urea to degrade the fibre to some extent. If the urea treated straw is fed straight away, then straw digestibility is increased by about 5 units, whereas if it is ensiled for ten days, the increase in digestibility is twice. If straw is treated with urea, the urea solution should be dispersed uniformally.

- ✓ Use of unconventional feedstuffs: Tree leaves, sugarcane tops and bagasse (bagasse is available in sugar factories and crushers after extraction of juice), mill by-products etc. may used for the purpose. Even aquatic plant like water hyacinth, azolla may also be fed to the animals during scarcity of feeds.
- ✓ Planting drought resistant trees for leaves may also be beneficial.
- ✓ Establishment of fodder bank to with the objective to store surplus fodder/crop residues, to make available nutritious fodder for scarcity period, to stabilization of fodder prices and maintenance of fodder round the year, to enhance the nutritive value of crop residues, to minimize the wastage of conventional and non- conventional fodder, to encourage dairy farmers for proper feeding to animals.

Water requirement of growth and milk production: Water requirements are equivalent to water consumed voluntary plus water intake through feeds. Requirements are influenced by many factors like growth rate, pregnancy, lactation, type of work, type of diet, feed intake and environmental temperature. Its therefore very difficult to calculate exact water requirements in animals.

However, the following table may be referred for water requirements in animals.

Environmental temperature	**Water intake / 100 kg liveweight**	
10^0C	Cattle	5.5 lit
	Buffalo	6.5 lit
27^0C	Cattle	6.0 lit
	Buffalo	7.0 lit
35^0C	Cattle	8.0 lit
	Buffalo	10.0 lit

Water intake per kg of DM intake in cattle may vary from 3.0 to 4.5 lit depending on environmental temperature while in buffaloes it may be 5.0 to 6.5 lit. Though in extreme high temperatures production of the animals decreased due to discomfort and that can

be minimized by supplying fresh drinking water along with leafy green fodders to the animals.

Review Questions

1. What is colostrum and why it is fed to new born calf?
2. An animal weighing 350 kg, producing 10 lit milk with 4% fat, what will be the DCP, TDN and DM requirement?
3. In last trimester of pregnancy, why nutrient requirement is more than dry period?
4. What is UMMB and urea treatment of straws?
5. What may be the possible impact on animals if environmental temperature rises above 35^0C?