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Review Article

Feeding Management of Dairy Animals During Lean Season and Natural Calamities

Jakir Hussain[1], Jitendra Saharia[2], Papori Talukdar[3], Ashim Kumar Saikia[4] and Kanak Ch. Barman[5]

[1]*Associate Professor, Department of Livestock Production and Management, College of Veterinary Science, AAU, Khanapara, Guwahati, India*

[2]*Professor & Head, Department of Livestock Production and Management, College of Veterinary Science, AAU, Khanapara, Guwahati, India*

[3]*Assitant Professor, Department of Animal Nutrition, College of Veterinary Science, AAU, Khanapara, Guwahati, India*

[4]*Associate Professor, Department of Animal Nutrition, LCVSc, AAU, Joyhing, North Lakhimpur, India*

[5]*Assistant Professor, Department of Animal Nutrition, College of Veterinary Science, AAU, Khanapara, Guwahati, India*

***Corresponding Author:** Jakir Hussain, Associate Professor, Department of Livestock Production and Management, College of Veterinary Science, AAU, Khanapara, Guwahati, India.

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Abstract

Feeding is the most expensive aspect of rearing dairy cattle. The dairy farmers face very critical situation during the natural calamities and lean season to feed their livestock. Feeding management of appropriate technique plays a great role in such a grim situation. Out various feeds, the straw is a very easy source of dry fodder for livestock round the year and can be preserved for long period. But, nutritional value of straw is very meager. Therefore, it is necessary to make straw a palatable, digestible and nutritionally qualified feed by several techniques like chopping or soaking in water, treating with urea-molasses, lime, NH4, NaOH or biological enzymes. The preservation of surplus fodder as hay and silage are better techniques for feeding large ruminants during the lean season. The total mixed ration (TMR) and complete feed block (CFB) are some other very good methods of complete balance feeding for dairy animals. In emergency urea molasses liquid diet (UMLD) and urea molasses mineral block (UMMB) are quite helpful. Tree leaves, vegetable leaves, sugarcane tops and bagasse are also very good supportive feeds for cattle and buffaloes in emergency situations. Establishment of fodder banks can provide high-quality feed during the lean season. Fodder production without soil by hydroponic method is the most advance technology for feeding dairy bovines to fulfill their required nutritional demand.

Keywords: Dairy animals, Natural Calamities, Lean Season, Straw, Silage, Molasses, Lime, Ammonium, TMR, UMLD, UMMB, Fodder Bank and Hydroponic

Introduction

Livestock sector plays an important role in the national economy and socio-economic development of India. The contribution of the livestock sector to the agricultural gross value and allied sectors was 31.0 per cent during 2020-21 and it provided 6.2 per cent to the total added gross value (GVA) of India during the same period. The dairy animals are the pillars of livestock sector which contributed 65.88 per cent to the total output of livestock sector during the same year [1]. Dairy is the single largest commodity in India and it is employing more than 8 crore farm families directly in our country [2]. The dairy sector creates job for millions of the rural poor people and do women empowerment and upscale their socio-economic status. This is the only sector which can provide round the year income to the farmers and supply organic fertilizer for the crop field and renewable energy in the form of draught power, bio-gas and dried cow-dung. About 70 per cent of the dairy cattle and buffaloes in India are reared by the rural people and it is in the hands of small and marginal farmers and landless labourers. Dairy animals support them as their back bone which provides livelihood. But regular occurrence of different types of disasters or natural calamities often put them to a great setback to their economic condition. The natural calamities in the form of flood and drought or fodder scarcity during lean season greatly hamper the routine feeding schedule of the dairy animals compelling for reduction in milk production, health deterioration, increase disease incidence and mortality in extreme cases. Therefore, different technologies for storage of feed resources and feeding unconventional feed ingredients during the natural calamities or scarcity period have been worked out by the animal nutritionist, which have the capability to meet the challenges of feeding the dairy cattle. In gen-

eral feed cost accounts for about 70 percent of the total cost of raising dairy cattle and buffaloes. In this article, some of easily adaptable feeding technology for dairy cattle has been discussed in brief.

Treatment of paddy straw

Availability of quality feeds and fodders for livestock is seasonal. Moreover, there is deficiency of animal feeds in many developing countries including India. In such conditions, the demand of agricultural by products like dry straw available after crop harvesting is of paramount importance for feeding the livestock. But due to its very low nutritive value and digestibility feeding of straw is not sufficient to maintain the production and mainly fulfill the satiety value of the animal. The lignin and silica content provide structure to the rice plant but they appear as an obstacle for digestion. In countries that experience feed scarcity or deficiency of good quality forages, paddy straw remains as the practical, abundant and cheap source of fodder for feeding cattle, buffalo, goat and sheep. Pre-treatment of straw is necessary to improve its nutritive value and digestibility to enhance its contribution to improving meat and milk production [3]. In Southeast Asian countries, rice straw is commonly used to feed more than 90 per cent of the ruminant population [4]. The dry matter (DM) of paddy straw ranges from 92 to 96 percent and crude protein (CP) ranges from 3 to 7 percent [5]. The paddy straw in ruminant have DM digestibility coefficient of about 45-50 percent [3].

Physical treatment of paddy straw

The structure of paddy straw can be changed physically by soaking, chopping, pressing and steaming to increase the surface area and penetration by the rumen microorganism. It leads to increase in palatability and improve digestion. Several physical treatments have been discussed here under.

Soaking of paddy straw

Dustiness is a great problem for feeding of livestock as it may cause coughing and respiratory problems besides reducing palatability. Simply soaking of straw in water may decrease its dustiness and increase the palatability and consumption due to softening of its stems. Soaking is very simple economical method of paddy straw treatment. Water is sprinkled heavily to make the straw fully wet or the straw is washed ringed in water and kept it overnight. The lignin and cellulose component of straw become loose and soft due to absorbtion of water. Walker (1984) [6] stated that soaking along with steaming under high pressure have direct effects on the cell delignification of rice straw. In such condition microbial enzymes able to uphold fermentation process quickly and thus increase the straw digestibility. The heat treatment leads to an increase in cellulose digestibility from 20 to 40 per cent [7]. The straw must be supplemented with better feeds for production purpose, [8]. The concentrate mixture fortified with vitamins, minerals, energy and protein should be supplemented with the straw for better digestibility leading to improved health and production.

Chopping of paddy straw

Chopping reduces the size of paddy straw and increases the surface area to mass ratio and thus it becomes easily accessible to the rumen microbes. But excess grinding may lead faster passage and retention time will reduce with less opportunity for digestive action. The reduction in particles promotes animal's consumption due to easy to grasp and mastication and enhancement of palatability. However, over consumption of the feed creates pressure and the retention time in the gut is reduced. It decreases digestibility of paddy straw. Chopping, grinding and pelleting have beneficial effects in breaking down the cell wall contents of rice straw [3] and increase palatability. But over eating should be judiciously avoided.

Pressure steaming

Steam treatment of paddy straw is very efficient in making it soft by loosening the fibre through breakdown and separation of the cellulose, hemicelluloses, lignin and sugars of paddy straw, but it involves higher cost [9,10]. So it is not at all affordable for the common livestock farmers. Therefore, financially this is not a viable method.

Chemical treatment of paddy straw

Different chemicals can be used to treat the paddy straw for changing the structure and bonds at molecular level leading to quick reaction by the rumen microbes. Thus the efficiency of microbial digestion is improved.

Sodium Hydroxide (NaOH) treatment

The use of NaOH for paddy straw treatment was started long back during forties of last century [11]. The FAO [12] recommended the Beckman method, in which the straw is treated with 1.5 percent NaOH for 18-20 hours before rinsing with tap water. The NaOH acts on the straw through reduction of proteolysis and accelerating delignification by unlocking the linkage between the lignin and cellulosic contents of the straw and facilitates efficient microbial enzymatic action. The reaction of NaOH on the cell wall contents of rice straw causes breakdown of the esterified bonds between the phenol groups and the cellulosic components of straw thus favoring the enzymatic hydrolysis [13-16]. There are few drawbacks of

using NaOH for treating the paddy straw. The cost of NaOH comparatively higher than urea and sometimes it is not available. The excess use of NaOH may also be a threat to the environment [17].

Urea treatment of paddy straw

Urea treatment is the most practical and widely used chemical method for treating paddy straw. The main function of urea is to increase the protein content of the straw during the fermentation process. Urea should be dissolved first in water at the desired proportion and it can be sprayed into the paddy straw. The treated straw can be packed in the silo, empty drum or plastic bag. The rumen microbes grow faster when some readily available energy and protein are supplied in straw. The increased microbial population is then able to digest the straw to a greater extent. The recommended treatment rate is 4 kg urea per 100 kg of straw. Water is essential in the process, because it helps hydrolysis of urea. The water is also essential to form the alkali and to act as a vehicle for the ammonia to penetrate the cell walls. So, 40 per cent level of water (40 liters waster is mixed with 100 kg paddy starw) is required to get the desired effect [18] with the urea usually being added as a 10 per cent solution in water (4 kg urea in 40 liters water). After sprinkling and mixing urea solution, straw is stored in an air-tight bag or closed room or a compartment for about 7-10 days. The urea is hydrolyzed to release ammonia by ureolysis, which loosen the straw and make it soft by their action on the lingo-cellulose bonds. The digestibility of dry matter, organic matter and protein in such straw increases by about 5, 6 and 17 per cent, respectively [19]. It should also be noted that such urea treated straws should be fed to ruminant animals of age not less than 6 months. Moreover, daily allowance of such treated straw should be started with little amount and increased gradually when feeding an animal for first time. Such urea treated straw cannot be offered to sheep and goats, because they are extremely susceptible to urea toxicity. This process is advantageous over the use of NaOH, as the ammonia is readily derived from the hydrolysis of urea and the straw is protected from growth of molds. The ammonia supplies nitrogen for protein synthesis and reduces the cost of purchasing protein supplements. Urea with molasses can make paddy straw a complete and safe basal ration for ruminants [20].

Lime treatment

The calcium oxide (CaO) and hydroxide Ca $(OH)_2$ in lime solution improve fiber degradability like NaOH. It has longer solubility in water compared to NaOH and urea. The paddy straw and lime treatment can be performed by soaking and ensiling. It will increase degradability and supply the calcium and nitrogen to the treated straw [21]. It was reported that 3 per cent urea with 4 per cent lime at 50 per cent moisture for 3 weeks improve degradability and digestibility of the treated straw [22].

Biological treatment

Different enzymes, microorganisms and fungi enhance the degradation rate of the cell wall contents of paddy straw making other nutrients available to the animal. The enzymes secreted by fungi had strong affinity to metabolize lingo-celluloses [23]. The cost of commercially available enzyme inoculants and additives available in the market is continuously declining and can be used by ruminant raisers to increase their production efficiency as well as their farm income [24]. Milk production of dairy cows [25], growth of steers [26] and wool production of lambs [27] was reported to be increased by using fibrolytic enzymes. Due to high input cost and need of highly skilled person, enzyme treatment of paddy straw is not yet very popular amongst the farmers under small-scale production system.

Total mixed ration (TMR)

The TMR is a practice of feeding cows that combines all roughages, grains, protein feeds, minerals, vitamins and feed additives to a specific nutrient concentration into a single feed mixture. The roughages after chopping into small pieces need to be mixed with concentrate feed fortified with vitamins and minerals at the ratio of 60:40 or 50:50 as per the quality of feeds and fodders. The dried roughages or fodders are cut into pieces (≤ 2 cm) and mixed with concentrate ration either manually or mechanically. It is a kind of loose complete feed supplying balance nutrients to the animal in each bite, which improves digestibility and avoid selective feeding, bloat and acidosis. This practice has a great prospective in feeding and nutrition of dairy cattle. The TMR enables to utilize low quality roughages (straw and stovers) and reduces wastage of feed. The TMR establishes a balance ruminal environment in regards to its pH and other chemical and microbial profile. Thus it enhances the microbial digestion of feeds and increases the microbial protein synthesis. The TMR feeding in dairy cattle stabilizes rumen pH, increases dry matter intake, milk yield and fat content in milk [28,29] and microbial protein synthesis [30].

Complete feed block (CFB)

The CFB is a very useful technology during flood situations as it has multiple advantages like easy to transport, cheaper storage, easy to handling and reduces feeding cost as locally available feed ingredients can be utilized and can be stored for a considerable period. It helps utilizing locally available crop residues, agro-industrial by products and non-conventional feeds. The amount of straw

and concentrates in CFB varies with the type of animal to which it is to be fed. As a thumb rule CFB may be prepared in the ratio of 60:30:10: dry roughages: concentrate: molasses. As a survival ration straw component could be as high as 86 parts along with 10 parts molasses, 2 parts mineral mixture, 1 part urea and 1 part salt [31] during natural calamities and disasters for emergency needs. The CFBs are nutritious, easily digestible and handy to transport. The blocks may be square, circular or any other shape depending on the type of casing used in the machine. Inclusion of crop residues in the block is beneficial for their efficient utilization [32]. The advantages of CFB are

- Balance feeding and adequate intake due to more palatability.
- Feed blocks require one third space as compared to mash form.
- Left over feeds and wastages are very negligible on account of feeding CFB.
- Digestibility is more due to blending of concentrate and dry roughages after chaffing into smaller pieces.
- It increases voluntary intake and nutrient utilization of low-grade roughages.
- Feed cost can be reduced.

Urea molasses liquid diet (UMLD)

Molasses are rich in energy and can be used as a potential feed for the dairy animal during drought and scarcity after supplementing with deficient nutrients *viz.* protein, minerals and vitamins. It can be prepared by using molasses 84 parts, protein pellets 10 parts, urea 3 parts, mineral mixture 2 parts and common salt 1 part and vitamin supplement @ 25 g per 100 kg. The urea is mixed in molasses and left overnight in a plastic trough and in the next morning, it should be shaken well and other ingredients are mixed. The UMLD can also be fed to replace conventional concentrate mixture from 15-20 per cent under normal feeding regime in ruminant diets [33]. The roughages are very essential for the normal functioning of the rumen microbes and overall performance of the animals [34], when the UMLD is used.

Urea molasses mineral block (UMMB)

The Urea molasses mineral block **(**UMMB) is a suitable technology for feeding the livestock during the adverse circumstances like flood and drought. The UMMB developed by different private and government agencies are very helpful in saving life of animals during natural calamities. The national dairy development board (NDDB), Anand developed such licks containing 15, 45, 15, 10, 8, 4 and 3 per cent urea, molasses, mineral mixture, cotton seed cake, salt, calcite powder and sodium bentonite, respectively [35]. The UMMB has been found to be very beneficial technology as a strategic feed supplement for ruminants which provides a constant source of fermentable nitrogen throughout the day to promote growth of rumen microbes in normal feeding condition where dry fodder is the predominant source of roughages. The use of UMMB is not recommended for young calves because of immature rumen [36] and small ruminants are also vulnerable to urea poisoning .The benefits for feeding UMMB are [37].

- Increases palatability and feed intake
- It is a safe source of micronutrient and NPN with better utilization
- Supplies fermentable carbohydrates of molasses to the rumen microbes
- Reduce dustiness of concentrate feed and avoid sorting of ingredients.

Silage feeding

The silage is a very good method of fodder preservation through anaerobic fermentation. The preservation of excess fodder as silage during lush green period is a very good feeding technique for the ruminant of drought affected areas [38]. The process is very simple and involves harvesting of fodder crops at pre-flowering stage, drying it under sunshine to reduce the moisture content to the level of 60-70 percent, chaffing the fodders to 1-2 cm size and storing in a silo pit or silage bag in air tight condition. The poor quality roughages and agricultural residues can be ensilaged by incorporation of various substances like mineral mixture, urea, molasses, di-calcium phosphate (DCP), lactic acid bacteria (LAB) and salts as nutritional improvers and to fasten the silage production. Fodders can be preserved as silage for one year. But, once the silo pit or silage bag is opened it should be fed and finished within 3 weeks of time. Ensiling is considered a preferable preservation method of fodder crops to feed the animal during lean season.

Hay making

Hay prepared during lush green period would solve many problems of livestock in drought affected region [38]. The is prepared after harvesting the crops in their tender ages, when the stems and leaves remain very soft. The nutritive value of hay is better than its straw counterpart. The fodder crops are generally sundried or it is dried by hot air circulation in the room during rainy season. The hay is very good ration for dairy calves and goats. The suitable fodders for hay making are oat, cowpea, berseem and lucern. Other fodder crops like para, maize, sorghum can also be used for hay making.

Use of sugarcane crop residue as animal feed

The by-product of sugarcane *i.e.,* sugarcane tops, sugarcane bagasse, molasses can be fed to cattle and buffaloes during scarcity period. Bagasse is available in sugar factories and crushers after extraction of juice. Small amounts are also available with farmer during the process of jaggery preparation. Large proportion of bagasse is used as source of energy in the form of fuel for boilers. The palatability and nutritional value of bagasse for the livestock (cattle and buffaloes) are much better than the rice hull available from the huller rice mills and the latter may be used as fuel saving the former for the feeding in need during scarcity period. [35]. Sugarcane plays a pivotal role in the agricultural and industrial economy of our country. India is one of the largest producers of sugar, with sugarcane cultivation spread over 4 million hectares and annual production is estimated to be about 325 million tonnes [39].

A field level observations have confirmed that the problem of less milk yield, and low fat and 'solids not fat' (SNF) content was solved to a great extent with feeding of enriched trash to the dairy animals during the summer months [40].

Tree leaves and vegetable

The trees and shrubs have been shown to be capable of providing high quality fodder in the dry season [41]. Tree leaves such as *neem*, mango, banyan, pipal, babul, subabul, mahuva, banana, bamboo etc. are easily available in many places and can be used as green fodder for livestock. They are good source of protein (6-20% CP), calcium (0.5-2.5%) and Vitamin A. Complete feed prepared using 50 kg tree leaves, 5 kg groundnut cake, 25 kg vilayati babul pods (*Prosopis julifora* pods), 15 kg molasses, 1 kg urea, 1 kg salt and 2 kg mineral mixture is palatable to animal and forms a good maintenance ration. The vegetable leaves and creepers like cabbage, cauliflower and potato can also be used as animal feed during scarcity; they are rich source of crude protein and fair source of soluble sugars [42]. The role of fodder trees and shrubs for feeding livestock is important in countries like India where small land holdings and large ruminant densities result in an especially severe problem of feed availability. Generally these leaves are used for feeding sheep and goat and sometimes to cattle during crisis period [41].

Post flood feeding management.

After a flood, the forages get contaminated with soil, bacteria and flood debrises. Precautions should be taken so that livestock do not get ill by feeding on forages that have been contaminated by flood water [43]. Problem does not end with reducing the water level in case of flood related natural calamities. The situation become worse due to feeding of dirty and infected feeds and fodders. It causes diarrhea, parasitic infestation, bacterial and viral infection. So, livestock owners should be more careful and following points should be kept in mind during post flood conditions.

- Avoid grazing in water logging fields.
- Ensure clean and wholesome drinking water for animals.
- Don't provide wet feeds and fodders and make a habit of drying the feed materials before feeding.
- Feed ingredients should be protected from fungal contamination.
- Provide 40-50 g of salt per large animal and 10-20 g for small ruminants and calves daily through feed [35].
- Do not feed dry hay that has been soaked by flood water [43].

Creation of feeds and fodder bank

Livestock feeds and fodders are deposited in the fodder bank and provided to the pastorals and other farmers in need. Fodder banks can provide high-quality feed during the dry season, and are gaining acceptance among settled pastorals in the sub-humid zone [44]. Creation of feeds and fodder banks in natural calamity (drought and floods) prone areas is an important asset to meet the needs of livestock. The following types of feeds and fodder can be stored for meeting the above emergencies. The feed ingredients which become unfit for human consumption can be spared for livestock use and stored in feed banks either in silos or stores after testing it for aflatoxin contents, pesticides and drug residues [45]. Grasses from periphery of forest area, wastelands and farmlands may be harvested and stored as hay in briquettes and high density stacks. Crop residues of the major cereals like rice and wheat straws, coarse cereals, legumes, haulms left after removing grains from the crops may be stored in these banks. This programme is used to meet the fodder needs during extreme winters and snow covered seasons. The concept of haylage, mixed silage and TMR silage has widen the scope of feed banking and nutritional optimization for higher productivity. Silage making is not only a process of feed preservation but it also preserve nutrients, phytogenic substances, succulence and completeness of a ration, thereby further the scope of feed and nutrient banking [46].

Hydroponics fodder production

The latest concept for feeding of livestock to meet the nutritional demand during the harsh winter season or any natural calamities can be solved through effective fodder production without soil via the hydroponic technology. It is established that from 1 kg good quality maize seed about 7 kg of fodder can be obtained within 7 days with a little space in a simple tray (3 x 4 sq. ft. size) providing all facilities required for the physiology of plant. Such tray can be

accommodate in a congested places even in the apartments and roof tops. The interesting fact is that the trays are kept in rack one row above another with sufficient gap (2.5 ft.). Thus large numbers of tray can be put in one hydroponic chamber and increase the volume of production in a tiny place. The most of the urban and peri-urban livestock farming may practice the hydroponic technique in view of the lack of land for cultivation of fodder crops and huge deficiency of concentrate feeds (28.9%), dry fodders (23.4%) and green fodder (11.24%) in India [47].

Conclusion

There are lot of techniques and managemental tools for feeding of dairy animals. To meet the growing demand of improved livestock feeds for augmentation of production and reproduction such tools should be adopted by the farmers. Awareness and training programmes at farmers' door steps must be organized to popularize the feeding techniques. Most of the dairy farmers in the rural areas have not yet accepted these techniques for feeding their livestock. The technologies have to be reached every farm gate for the benefits of all stakeholders.

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