JIVA, 6(1):2008, 23-27

THE TECHNIQUE OF FEEDING TOTAL MIXED RATION

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The term total mixed ration (TMR) may be defined as, "The practice of weighing and blending all feedstuffs into a complete ration which provides adequate nourishment to meet the needs of dairy cows." A total mixed ration (TMR) is composed of forages, commodities/byproducts, grains, protein supplement(s), minerals, and vitamins that have been mixed together to make a balanced ration in which the weight of each ingredient is known. This mixture is offered as sole source of feed to cows. By blending all the forages, grains, commodities, protein and mineral-vitamin supplements, cows are less able to selectively consume individual ingredients. Ideally, each bite of feed a cow consumes will contain the same proportion of forages and concentrates.

The nutrient intake of dairy cattle is limited by the quantity of feed offered and the digestibility of the feeds. More specifically, the feed offered to lactating dairy cattle is usually heterogeneous in nature, consisting of many different feedstuffs, each possessing unjque chemical and physical characteristics. Dry matter intake is fundamentally important in nutrition because it establishes the amount of nutrients available to an animal for health and production. Underfeeding of nutrients restrict the production while overfeeding increases the cost of feed and result in excessive excretion of nutrients into the environment and at excessively high amounts causing adverse health effects.

Advantages Of A Total Mixed Ration

Total mixed dairy rations (TMR) offer an opportunity to improve business profits through improved animal performance and health, decreased feed wastage, reduced cost of feed, improved labor efficiency and improved butterfat. The installation of a TMR system normally requires added investments in feed mixing and distribution equipment. Additional storage facilities may be required as well.

Each bite consumed in TMR contain the required level of nutrients (energy, protein, minerals and vitamins) needed by the cow. Hence, metabolic disorders like acidosis, rumen parakeratosis, laminitis, reproductive disorders, and deficiency diseases reduce to minimum resulting in better performance of animals and reduced health expenses.

All forages grains, protein supplements, minerals and vitamins are thoroughly mixed. Therefore, the cow can do very little sorting for individual ration ingredients. This system is economical and efficient as it allows inclusions of low cost Agro industrial byproducts and low quality crop residues with their efficient utilization. Complete feed supplies ready made, balanced, low cost ration for ruminants for the benefit of landless laborers and small farmers.

Completely blended feeds, coupled with grouping the cows, permits greater flexibility in feeding exact amounts of nutrients (energy, protein, etc.) to more nearly nourish cows for their particular stage of lactation and level of milk yield. Grain mixtures can be fed to high producing cows, without overfeeding the late-lactation or lower-producing cows, resulting in more efficient feed use. Cows eat numerous small meals throughout the day, resulting in greater feed intake and better utilization of ingredients, such as urea. Fewer cows have digestive upsets and go off feed. Concentrate ingredients can be purchased in bulk at considerable savings and blended with forages on the farm.

Disadvantages of Total Mixed Ration

With a TMR system, each bite is a balanced diet. For small herds, a limiting factor influencing milk production is balancing the ration for the broad range of production levels within the herd. Diets too low in energy and protein may limit production of early lactating cows or result in thin cows with lower production and reduced reproductive efficiency. In contrast, diets too high in energy and protein can result in over conditioned cows at freshening with fat cow problems. In larger herds, cows can be grouped more homogeneously to better balance for nutrient requirements.

Production of a total mixed ration requires special equipments. The equipment must have the capability to blend the feed ingredients thoroughly. The mixer, preferably mobile, must be capable of accurately weighing each ingredient.

It is extremely important to keep the mixture exactly the same day after day and to make big changes gradually. The scanty nature, seasonal availability and wide nutritive value of unconventional feed ingredients call for constant attention on the nutriture of the diet.

Forage analysis is necessary and should include dry matter, crude protein, acid detergent fiber, neutral detergent fiber, calcium and phosphorus.

Early detection of problems with the ration system is possible by observing the bulk-tank milk level after each milking TMR can be used effectively by many dairymen, but it is not a substitute for good management. In fact, the intensity of management may be increased. Most of all, management skills and competency of the dairyman is critical to make this system work effectively.

When feeding a TMR, it is important to monitor:

1. Dry matter or moisture content of forages and other wet byproducts being fed.
2. Amount of TMR consumed.
3. Amount of each feed in a TMR batch as the intake of the cow group changes.
4. Particle size of the TMR being fed.
5. Consistency of the particle size of the TMR being mixed, delivered, and left in the feed bunk.

Over mixing of TMR decreases the particle size of the forage. This, in turn, decreases cud chewing time and saliva production, which may lead to an increased incidence of problems such as ruminal acidosis, laminitis (foot problems), displaced abomasum (twisted stomach), decreased feed intake, decreased butterfat, decreased body condition (which may decrease ability to breed), and in severe cases, death. Generally, most models of TMR mixers need only three to six minutes of mixing time.

Dry Matter Intake

Normally a cross bred cow would eat 2.5-3% of body weight However cows in their early lactation eat less compared to the production demand resulting in weight loss. This could be reduced by encouraging the cow to eat more prior to calving to have some body reserves that could be utilized during the early lactation period. Uniform feeding with total mixed ration has shown to produce this effect. Additional dry matter intake is required when higher levels of milk production during lean season are desired. This is achieved by feeding total mixed ration ad lib. The frequency of feeding may also be increased which would further aid to maintain the rumen pH. During rainy season, the fodder contains lot of moisture and the dry matter content would be as low as 15-20%. Feeding of such fodder would cause the rumen fill but reduce the dry matter intake. In such conditions the fodder could be chopped, wilted, and then mixed with straw and concentrate to ensure the dry matter intake and when fed as total mixed ration it also balances the total nutrient content of the diet. The studies have shown the optimum dry matter content of total mixed ration to be between 50-60%.

What to feed?...

The main advantage of feeding total mixed ration is flexibility to incorporate [illegible] feedstuffs without disturbing the animal balance. Feeding as mixed ration [illegible] to suit the ingredients and improve palatability of unconventional feedstuffs. The major feed resources available to livestock in India are crop residues and agro-industrial byproducts. Major constraints observed in their incorporation are poor palatability, wide distribution and poor nutritive value. Such problems could very well be confronted by integrating the locally available feedstuffs in small quantity in the total mixed ration. Number of studies has been conducted in Agricultural Universities and other research institutions on wide variety of agro-industrial byproducts for evolving economic rations for livestock. Long-term studies have been carried out to evaluate the implications of incorporating such prod-

genomic research can best be summarized as follows.

1. Under certain circumstances and in some individuals diet can be a serious risk factor for a number of diseases

2. Common dietary chemicals can act on the human genome, either directly or indirectly to alter gene expression or structure.

3. The degree to which diet influences the balance between healthy and disease states may depend on an individuals genetic make up.

4. Some diet-regulated genes are likely to play a role in the onset, incidence, progression and or severity of chronic disease.

5. Dietary intervention based on knowledge of nutritional requirement, nutritional status and genotype [personalized nutrition] can be used to prevent, mitigate or cure chronic disease.

Disease Of Modern Civilization And Nutrigenomics

'Diseases of modern civilization' such as diabetes, heart disease and cancer, the risk of these diseases, is often associated with common single nucleotide polymorphisms, but the effect is dependant on dietary intake and nutritional status. This is often apparent in intervention studies employing a metabolic challenge. Each individual may have a unique response to environmental factors based on the distinctive combination of single nucleotide polymorphisms the genome. The polygenetic and multifactor nature of chronic disease requires substantial resources but the potential rewards in terms of quality of life and economy is enormous.

Obesity

Obesity is one area where the application of both genomic and nutritional genomic approaches has already been successful. The hormone leptin provides a signal from adipose tissue to the brain influencing food intake. The mutations in the leptin and leptin receptor genes have subsequently been shown to be associated with obesity in human. Based on these findings nutrigenomics may orientate the design and development of new functional foods for obesity, based on scientific knowledge of the impact of specific nutrients on the mammalian body weight control systems and their mechanisms of action.

Metabolic Syndrome

Metabolic syndrome is a common condition, characterized by insulin resistance, dyslipidemia, abnormal obesity and hypertension, and is associated with a high risk of type 2 diabetes mellitus and cardiovascular diseases. Obesity is the key etiological factor in the development of metabolic syndrome. With increasing prevalence of obesity, the etiological role of nutrient derived metabolic stressors, fatty acids in particular, in the development of obesity and the metabolic syndrome is noted. Researchers are pointing out that pro-inflammatory stressors may predispose to obesity-induced insulin resistance. Reducing the impact of metabolic inflammatory stressors may reduce the adverse health effects of obesity and slow down the progression towards metabolic syndrome and type 2 diabetes mellitus.

Nutrition And Prevention Of Cancer

Increasing evidence points to numerous dietary components that modify the incidence of cancer as well as biological behaviour of tumors. Enhanced intake of a number of food components retards the process but it is obvious that addition to the diet is not always protective. Energy restriction is one of the most consistent modifiers of chemically induced cancer in animal models. With nutritional genomics, proteomics and metabolomics scientist are able to simultaneously elucidate the biological effects of dietary constituents on cell function and global gene expression. The genome sequencing coupled with technological advances is providing a fundamental opportunity to transform nutrition and cancer research. Functional and expression analysis of genes will facilitate the identification of causal gene in cancer and significantly stream line the bioactive food component- target validation process. Advances in nanotechnology would provide more sensitive indicators of nutritional status and help in building intervention strategies. Thus the future of nutrition and cancer research likely resides in being able to identify molecular targets for food components, and convince consumers that this genetic information will

assist in appropriate and tailored recommendations, show that this information can be managed ethically and responsibly.

Nutrigenomics -implications For Companion Animals

The major use of the dog and cat genome maps has been for the study of human genetic and nutritional status. Dogs and cats are excellent animal models for human genetic and nutritional studies. Because of the vast improvement made in veterinary medicine and companion animal nutrition in recent years, dogs and cats are living longer than ever before. Now instead of being complained by intestinal parasites or succumbing to viral infections like canine distemper they're living long enough to suffer from obesity and many of the same disease that affect their human owners. Once the gene responsible for developing a given disease is known dietary intervention may be able to avoid or prolong its development. If dietary intervention is not the answer, development of genotype specific drug therapy with more efficacy and less toxicity may be the alternative. Several dozen human drug metabolizing enzymes polymorphisms has been characterized. Because companion animals are likely to have similar polymorphisms, the type and dose of drug prescribed by veterinarians may soon be influenced by genotype.

Future Perspectives

Recent advances in systems biology provide a trajectory for future research in order to improve health of individuals and population. Disease prevention through personalized nutrition, thereby promoting wellness, will become more important as the obvious avenue of research in life science. More focus will need to be put on the natural ways of disease-prevention, rather than managing a disease after being sick. There is considerable potential to improve public health by means of diet. The development of policies, programmes and products for improving public health will need to be informed by innovative research which strengthens our fundamental understanding of the relationships between food and physiological functions related to health, as well as factors which influence choice of food and eating behaviour. This is a considerable challenge for nutrition and the organization of research will require to provide for the integration of appropriate disciplines and expertise, including recent advances achieved in molecular and cell biology and in the analysis of human genome.

Tantalizing opportunities waits in seven areas-4 basic and 3 applied in this post genome-sequencing era.

1. Identification of molecular biomarkers for nutrient status.

2. Characterization of single polynuclear polymorphisms associated with nutrition.

3. Development of national genome array nutrition database

4. Use of models at all phylogenetic levels for nutrition research.

5. Application of post genome sequencing tools to study diet and human health.

6. Application of these tools to the sole of nutrition in pathogenesis of human disease.

7. Development of a funding base for research on exercise and human health.

Summary

Nutrigenomics presents a new approach in nutrition research that joints the application of powerful functional genomic technologies, bioinformatics and molecular biology with more traditional methodologies to pursue its ultimate goal of personalized nutrition and state of wellness in human beings. Such diets are formulated not only on the qualitative and quantitative needs and the actual health status, but also on the genetic predisposition of an individual. This approach should lead to the prevention of onset of the so called DISEASES OF MODERN CIVILIZATION or enhance the efficiency of their therapy.

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