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REVIEW

Nutrigenomics: Emerging face of molecular nutrition to improve animal health and production

K.B. Kore, A.K. Pathak and Y.P. Gadekar

Centre of Advanced Studies in Animal Nutrition,
Indian Veterinary Research Institute, Izatnagar 243 122, India.

Introduction

Traditional research related to animal nutrition is mainly deals with either deficiency or excess of the particular nutrient which leads to ill health as well as decreased animal production. But genomic revolution has propelled the development of several new technologies that can be applied in nutritional sciences (*Collins,et.al.,* 2003). New techniques like genomic, proteomic, metabolomic, and bioinformatic are now making their ways to solve the intervening puzzle between nutrient and genes (Daniel, 2002).

This era of newer technologies have the potential to improve the nutritional assessment and measures of bioavailability of various nutrients to get sustainable livestock production. The application of these innovative tools and the concepts developed from genomic studies assures to revise the thinking of researches engaged in nutritional science to improve animal health and ultimately the production. (Dawson, 2006)

Since, recently various clinical trials deals with nutritional research have proved the relationship among diet, health, disease and production. Its well known fact that dietary deficiency, imbalance of nutrients and or excess of diet has a profound effect leads to ill health indicative of that dietary compound have direct effects on molecular processes which ultimately change the gene expression. Advancement in nutritional science discovered that nutrients or their metabolites can regulate the various bodily functions directly or by stimulating or inactivating specific regulators. Hence, to study the nutrient gene relationship or interaction between genomics and nutrition, nutrigenomics has been introduced in the nutrition research (Mariman, 2006).

Nutrigenomics Concept

DellaPenna, in 1999, who defines first time nutritional genomics as the general approach to gene discovery that is currently most applicable to compounds of nutritional importance that are synthesized or accumulated by plants and other organisms (Ordovas and Corella, 2004). It is a science which deals with role of nutrient in gene expression or their interrelationship.

According to *Chavez,et.al.*(2003) Nutrigenomics is the study of molecular relationships between nutritional stimuli and the response of the genes. Müller and Kersten, (2003) defined the nutrigenomics as 'the application of high-throughput genomic tools in nutrition research. Applied wisely, it will promote an increased understanding of how nutrition influences metabolic pathways and homeostatic control; how this regulation is disturbed in the early phase of a diet-related disease, and to what extent individual sensitizing genotypes contribute to such disease.'

Nutrient Gene Interaction

The diet has long been regarded as a complex mixture of natural substances that supplies both the energy and building blocks to develop and sustain the organism. However, nutrients have a variety of biological activities. Some nutrients have been found to act as radical scavengers known as antioxidants and as such are involved in protection against diseases. Other nutrients have shown to be potent signalling molecules and act as nutritional hormones (Müller and Kersten, 2003). Some of the plant secondary metabolites also known as phytochemicals act as a modulator of animal health and production.

Many diseases and disorders are related to suboptimal nutrition in terms of essential nutrients, imbalance of macronutrients, or event toxic concentrations of certain food compounds. There are multietioetiological diseases which are due to interaction of different nutrients along with several genes (Mariman, 2006). Due to remarkable diversity in all living beings differences in food digestion, nutrient absorption, metabolism, and excretion have been observed and genetic

diseases in these processes have been reported. The functional integrity of gene is mainly depends on metabolic signals that the nucleus receives from internal factors, e.g. hormones, and external factors, e.g. nutrients, which are among the most influential of environmental stimuli. Genomes evolve in response to many types of environmental stimuli, including nutrition. Therefore, the expression of genetic information can be highly regulated by, nutrients, micronutrients, and phytochemicals found in food (Van Ommen, 2004).

Application of Nutrigenomics in Animal Health and Nutrition

From a practical point of view, gene expression studies will allow for the identi?cation of pathways and candidate genes responsible for economically important traits. Dietary mani-pulations and nutritional strategies are key tools for influencing ruminant production. There is a usual belief that nutrition and genetic makeup both strongly influence the reproductive performance of milch animals. This is particularly important during the transition period and early lactation, when the animal is particularly sensitive to nutritional imbalances. Nutrigenomics and nutritional geno-mics are providing new tools that can be used to more clearly understand how nutritional manage-ment can be applied to address disease, performance and productivity in animals.

In the changing scenario of ruminants nutrition the objective of nutrigenomics is to study the effects of diet on changes in gene expression or regulatory processes that may be associated with various biological processes related with animal health and production. In studies of steers under nutritional restriction due to intake of poor quality feeds, expression of specific genes associated with protein turnover, cytoskeletal remodeling, and metabolic homeostasis was clearly influenced by diet (*Byrne,et.al.,*2005). These studies provide application of nutrigenomics to resolve the molecular markers important in nutrition research.

There is vary scares information about effect of diet on expression of genes related to productive or reproductive traits of livestock, it may be possible to begin to understand the importance of the relationship between individual nutrients and the regulation of gene expression. To understand this concept of nutrigeomics a study of diet induced gene expression is discovered in which selenium deficiency shown to alter protein synthesis attranscriptional level (*Rao,et.al.,* 2001). It leads to adverse effect like enhancement of stress through up-regulation of specific gene expression and signaling pathway. On the other hand genes responsible for detoxification mechanism and protection from oxidative damage were hampered, these consequences ultimately leads to alteration of phenotypic expression of related symptoms of selenium deficiency.

From the above example it is apparent that possibly nutrigenomics can be used to identify the specific markers to manipulate gene expression through use of nutrients or their combinations so as to improve productive as well as overall animal performance. Nutrigeonmics will be a path breaking tool through identification of pathways and candidate genes responsible for dietary induced diseases and ultimately reduction in production losses due to these diseases in animals. The discoveries of gene markers related to economically important traits like milk, meat, wool production etc whose expression can be improved by dietary regimens is a need of today's nutrigenomic research which will help for sustainable livestock production.

Conclusion

Molecular nutrition in terms of nutrigenomics will serve as a new tool for nutritional research in mitigating the problems related to animal health and production. In coming year's innovations in nutrition research with use of various molecular technologies will indubitably update our basic understanding of nutrient gene interrelationship and help to define new methods for managing animal production. Finally by targeting the specific gene through nutritional manipulation, it may be possible to get the desired livestock performance in terms of health as well as production.

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