

Review Paper

Nutrigenomics: A New Approach to Feed Formulation



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Citation Hashemi SR, Davoodi H, Arabiyan E. Nutrigenomics: A New Approach to Feed Formulation. The Journal of Qazvin University of Medical Sciences. 2020; 24(1):80-93. <https://doi.org/10.32598/JQUMS.23.5.8>

doi <https://doi.org/10.32598/JQUMS.23.5.8>



Received: 14 Oct 2019

Accepted: 15 Mar 2020

Available Online: 01 Apr 2020

Keywords:

Nutrigenomics, Gene expression, Nutrients, Food formulation

ABSTRACT

Nutrigenomics is the study of the effect of nutrition on gene expression which discusses how DNA is converted to mRNA and then converted mRNA to protein, and is the basis for understanding the biological activity of edible compounds. Nutritional manipulations and nutritional approaches are key tools to influence the performance and health of organisms. Today, it has been shown that better nutrition of animals selected for further production has a beneficial effect on their function. Despite the importance of this issue in production systems, there are no ways to clearly explain the molecular mechanisms of these changes. This review study aimed to investigate nutrigenomics as a molecular approach to the expression of genes involved in the health and growth of organisms. Searching was conducted in Scopus, PubMed, ScienceDirect, IranMedex, and Google Scholar databases on the studies conducted during 1990-2018 by using the keywords: "nutrigenomics", "gene expression", "nutrients", "food formulation". Initial stage yielded 120 articles. After excluding conferences papers, 58 remained for the final review. There are a limited number of nutrigenomics studies on the laboratory and farm animals, but it has been confirmed that there is an association between nutrition, genetics, fertility and growth. Therefore, the use of nutrients that can express gene expression in a way that improves the function and efficiency of organisms is essential in feed formulation as a new approach in nutrition.

Extended Abstract

1. Introduction

Gene expression is a dynamic process by which information from a gene is used in the synthesis of a functional gene product. The final products are often proteins, but in non-protein coding genes such as transfer RNA (tRNA) or small nuclear RNA (snRNA) genes, the product is a functional RNA [1, 2]. Nutrigenomics is a new

science studying the interaction between animal genome, nutrition and health. Nutrients are dietary signals to specific cells in the body which in turn influence gene and protein expression and subsequently metabolite production. Dietary manipulation and nutritional strategies are key tools for influencing the performance and health of organisms.

2. Materials and Methods

In this review study, Searching was conducted in Scopus, PubMed, ScienceDirect, IranMedex, and Google Scholar

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databases on the studies conducted during 1990-2018 by using the keywords “nutrigenomics”, “gene expression”, “nutrients”, “food formulation”. Initial search yielded 120 articles. After excluding extended abstracts and conference papers, 58 articles were finally selected for review. The results of some of these studies are outlined in this study.

3. Results

A comprehensive approach to the effect of effects of feed formulation and nutritional health at the molecular level requires understanding the interaction between genomes and nutrition. Nutrients that supply body fuel and act as cofactors and micronutrients can have important effects on the gene expression, protein and metabolism [5]. Transcription factors are the most important factors that simulate the effect of nutrients on the gene expression. These transcription factors are present in metabolically active organs, such as liver, intestine, and adipose tissue. They act as nutrient sensors by modifying the DNA transcription levels of specific genes in response to nutrients changes [7, 8]. Almost 40 types of micronutrients are required in the human diet. Low consumption of micronutrients such as vitamin B, vitamin E, carotenoids, folate, and vitamin D, can cause chromosomal abnormalities [9].

4. Discussion

Magnesium deficiency or replacement of Mg^{2+} ions with other divalent metal ions can result in increased genomic instability, inhibition of DNA repair, oxidative stress, aging and carcinogenesis [12]. It has been reported that selenium deficiency can affect protein synthesis patterns in mice by regulating the expression of certain genes at the transcriptional level [13]. Fatty acids, especially unsaturated fatty acids such as omega-3 fatty acids (α-linolenic acid) and omega-6 (linoleic acid), can interfere with a large number of transcription factors and thus directly affect the gene expression [14-17]. Amino acids have recently been suggested to play an essential role in regulating gene expression [36, 37]. Plant biotechnology has been a rich source of innovation and creativity in recent years. Herbal plants have been considered as a new dietary supplement. They exert their efficacy through secondary metabolites. The effect of some secondary metabolites on the expression of some genes has already been reported [57].

5. Conclusion

In recent years, with the development of equipment and the reduction of genetic testing costs, access to individuals' genotype information has become easier. Given the fact that genetic differences are important in people's dietary responses, it is important to identify the nutritional needs

based on a person's genetic map. The use of essential nutrients that can affect the gene expression in a way that improves the performance and efficiency seems necessary in feed formulation as a new strategy in nutrition.

Ethical Considerations

Compliance with ethical guidelines

This is a best-evidence review with no experiments on human or animal samples.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors contributed equally in preparing all parts of the research.

Conflicts of interest

The authors declared no conflict of interest.