Nutrigenomics and microbiome modulation: Strategies for improved geriatric health

Nimmathota Madhavi*[1] , G. Ramya Bala Prabha[2] ,Kothapally Shruthilaya[2] , Sucheta Krupalani[2]

[1]Department of Pharmaceutics, CMR College of Pharmacy, Affiliated to JNTUH, Medchal, Kandlakoya, Hyderabad-501401.

[2]Department of Pharm. D, CMR College of Pharmacy, Affiliated to JNTUH, Medchal, Kandlakoya, Hyderabad-501401.

Email: nimmathota.madhavi@gmail.com

Abstract

Generally elder people may come across with many age related diseases due to lack of either nutrient supplements in their diet or with age and body physiological condition. Among many diseases cancer is the one which has grown substantially because of imparting pathways related to aging. The bioactive nutrients increases, their molecular effects are often evaluated to explore proteomics and metabolomics to explore their action towards aging. The involvement of body for diet-related disease and health status leads to signify the diagnostic and therapeutic strategies for targeting processes relevant to nutrition.

Keywords: Nutrition, Health, Nutrigenomics, Aging

1.Introduction

Nutrigenomics, the study of the interactions between nutrition and genes, is an emerging field that explores how diet influences gene expression and consequently health outcomes. Nutrigenomics shows the complexity and differences of the diet where some nutrients may be consumed in high non-toxic concentrations and they also bid to different targets and affinities. Nutrients have been discovered to influence gene expression through direct interactions with transcription factors (1). Nutrigenomics includes genetic profile differences as well as the effects of transcriptome differences and epigenetic mechanisms. The concept of nutrigenomics is based on the following assumptions: a) bioactive food ingredients have the ability to directly or indirectly affect the human genome b) dietary patterns and/or particular food ingredients may alter various cellular processes such as aging and severity of disease, and c) the balance between health and disease on an individual's genetic background determines the health consequences of a diet.

The composition of the human gut microbiota has been found to change with, and this change may be linked to the development of illness in the geriatric population (2). However, a healthy gut microbiota is crucial for promoting host health. Through competitive exclusion mechanisms including affinity site consumption, nutrition source and antimicrobial chemical generation, the gut microbiota of its host

offers a physical barrier (3). The composition and function of the gut microbiota are influenced by dietary patterns, and these effects can vary based on individual genetic makeup.

2. Nutrigenomics and dietary influence

The nutrigenomics enables us to comprehend the ways in which certain different food ingredients like proteins, carbohydrates affect gene expression and in turn influences the gut microbiota. Tools which are included under nutrigenomics are metabolomics, proteomics etc. Moreover, metabolic phenotype diversity in humans may raise blood pressure and diet relevant issues with respect to age (4).

Dietary substances have been shown to either directly or indirectly impact gene expression. Nutrition can function either as ligands at cellular level and can be broken down by primary or secondary metabolites. As an example, cellular energy gets generated via the beta oxidation pathway is utilized to metabolize fatty acids and produce cellular energy. Therefore, gene expression may be indirectly impacted by changes in the intercellular energy balance through nicotinamide adenine dinucleotide (NAD) homeostasis. The determination of the identity of galactosemia was the first a start. The typical recessive anomaly in galactose-1-phosphate uridyltransferase (GALT) has been identified as galactosemia. Lack of GALT leads to build up in the blood, which can lead to a variety of health issues including mental retardation. These recessive abnormalities are single gene traits, and are therefore helpful to identify and treat by changes in diet.

Considering the dietary chemicals happen to be common and that either directly or indirectly influences gene expression. Hence, it is observed that individuals after receiving diagnosis control it through making changes in the diet and regular exercise, which explains the role nutrition in altering the genomics information expression. Distinguishing these factors will play a crucial role in upcoming research plans aimed at understanding how diet influences the risk of developing disease and the rate at which they progress (5). Henceforth the above paragraph explains the relation between nutrients and gene expression in an individual is shown in Figure 1.

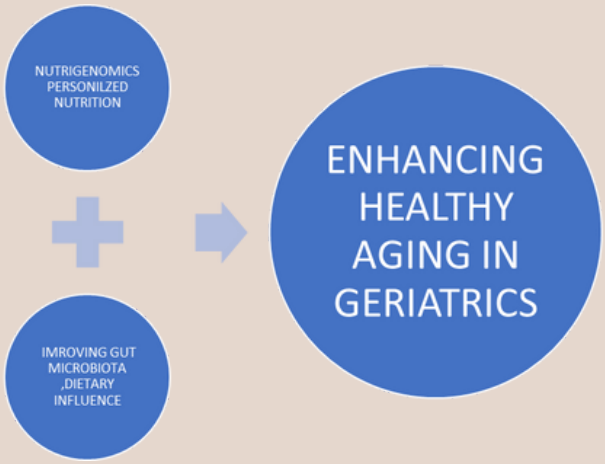

Figure 1. Relationship between nutrigenomics and gut microbiota

3. Changes in gut microbiota with aging

The beneficial bacteria in the gut mainly help with the breakdown of nutrients, managing drug absorption, stopping the growth of harmful bacteria (6). Changes in gut microbiota with age are linked to physiological shifts in the gastrointestinal tract, dietary habits, and a simultaneous decrease in the immune functioning, which could lead to higher risk of infection and weakness (7).

4. Genetics and microbial composition

Taking into account the differences among individuals at the microbiome level in depth research that combines the gut microbiome with the risk of developing diseases adds to the existing genetic expression. Several teams have indicated that the makeup of gut bacteria is passed down through genes, though research has shown mixed evidence regarding the genetic influence. Nonetheless, research done on inbred mice demonstrated that the genetic makeup of the host influences the structure of gut bacteria communities (8).

5. Significance of nutrigenomics and studying about gut microbiome to improving health

5.1. Personalized nutrition and healthcare

Inventing nutrition plans especially to an individual's needs to enhance the balance of gut bacteria is a key strategy in personalized eating. It's crucial to investigate how different foods. Another major point studies is that managing a person's diet to prevent or manage long term illnesses is significantly more difficult. For example, in individuals with hypertension with AA genotype who followed DASH (Dietary Approaches to Stop Hypertension) there was a notable reduction in blood pressure, but in individuals with GG genotype it was not observed (5).

5.2. Promoting healthy gut microbiota

By isolating definite food components that support good gut bacteria, nutrigenomics can play a role in creating functional foods and supplements designed to enhance gut health. One such intervention is introducing the probiotics and prebiotics. The probiotics when given in sufficient quantities, live organisms provide health advantage to the recipient. Probiotic bacteria have the potential to offer a range of health advantages by restoring disrupted gut bacteria, improving bowel movement, outcompeting harmful microorganisms, and boosting the production of short chain fatty acids (9). Prebiotics are non-digestible food components that promote the growth of beneficial bacteria.

The study of the normal gut bacteria's order and roles has shown that the genetic makeup of specific bacterial groups matches various tasks such as breaking down sugars, and getting rid of the xenobiotics (10). Therefore, maintaining a healthy gut microbiota is crucial for the overall wellbeing of older adults. By understanding the changes that occur in the microbiota with aging and implementing strategies to support a balanced microbial community, it is possible to improve health outcomes and enhance the quality of life.

5.3. Disease management and prevention

We are discussing the importance of the gut microbiota and nutrigenomics; the dietary interventions tailored to an individual's genetic makeup aid in preventing and controlling health issues such as obesity, diabetes, and inflammatory bowel disease by adjusting the balance of bacteria in the gut. This was accompanied by a rise in the count of *bacteroides fragilis* and *lactobacilli* bacteria (10).

6.Conclusion

The inter-paly between nutrigenomics and gut microbiota is pivotal in enhancing geriatric health. As aging process naturally alters the composition and functionality of the gut microbiota, integrating nutrigenomics insights can provide personalized dietary recommendations that help maintain microbial balance and overall wellbeing. In conclusion, embracing the synergy between nutrigenomics and gut microbiota can revolutionize geriatric care, offering more precise and effective strategies for promoting health and longevity in elderly population.

References

1. Rescigno T, Micolucci L, Tecce M, Capasso A. Bioactive Nutrients and Nutrigenomics in Age-Related Diseases. Molecules. 2017;22(1):105.
2. Riscuta G. Nutrigenomics at the Interface of Aging, Lifespan, and Cancer Prevention. The Journal of nutrition [Internet]. 2016;146(10):1931-9.
3. Sekirov I, Russell SL, Antunes LCM, Finlay BB. Gut microbiota in health and disease. Physiological reviews. 2010;90(3):859-904.
4. Kussmann M, Van Bladeren PJ. The Extended Nutrigenomics – Understanding the Interplay between the Genomes of Food, Gut Microbes, and Human Host. Frontiers in Genetics. 2011;2.
5. Kaput J, Rodriguez RL. Nutritional genomics: the next frontier in the postgenomic era. Physiological Genomics. 2004;16(2):166-77.
6. Jandhyala SM. Role of the Normal Gut Microbiota. World Journal of Gastroenterology. 2015;21(29):8787.
7. Salazar N, Valdés-Varela L, González S, Gueimonde M, de los Reyes-Gavilán CG. Nutrition and the gut microbiome in the elderly. Gut Microbes. 2016;8(2):82-97.
8. Ferguson JF, Allayee H, Gerszten RE, Ideraabdullah F, Kris-Etherton PM, Ordovas JM, et al. Nutrigenomics, the Microbiome, and Gene-Environment Interactions: New Directions in Cardiovascular Disease Research, Prevention, and Treatment. Circulation: Cardiovascular Genetics. 2016;9(3):291-313.
9. Hills Jr. Ronald D, Pontefract Benjamin A, Mishcon Hillary R, Black Cody A, Sutton Steven C, Theberge Cory R. Gut Microbiome: Profound Implications for Diet and Disease. Kompass Nutrition & Dietetics. 2022;2(1):1-16.
10. Arora T, Sharma R. Fermentation potential of the gut microbiome: implications for energy homeostasis and weight management. Nutrition Reviews. 2011;69(2):99-106.