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Mini Review

Aging and the Impact on the Intestinal Microbiota

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Abstract

The intestinal microbiota participates, with its various actions in the function of intestinal homeostasis and the protection of the intestinal immune balance. The objective of this review article is to draw attention to the interaction of the intestinal microbiota with aging, the changes that occur during its process, and the role of diet in maintaining the physiological process for a healthy state of the intestinal microbiota. The role of nutrients, and especially of probiotic foods and those with a prebiotic effect, has been reviewed.

Keywords: *Gut Microbiota; Aging; Diet; Food Components*

Introduction

In recent years, attention has been drawn to the meaning of a stable, diverse, and abundant intestinal microbiome; which is in equilibrium (eubiosis), as an indicator of healthy state. This criterion is based on research carried out over the course of this millennium that has shown the participation of the gut microbiome in human health with a close link in its characteristics, such as the integration of the intestinal barrier, the intestinal pro-inflammatory and anti-inflammatory balance g, the immune status, metabolism, and the microbiota-gut-brain axis [1,2]. A large proportion of the body's immune function is dedicated to maintaining homeostasis with the microbiota, as shown by the fact that 70% of the body's lymphocytes reside in gut-associated lymphoid tissue [3].

The 21st century has been called "the era of the gut microbiome" because of the influence that bacteria, fungi, viruses, and archaea that coexist in the intestine can have on health and disease in humans [4].

The intestine of humans and mammals in general is occupied by the microbial population estimated at 3.8 x 1013 microorganisms, which varies from between 1000 to 1500 bacterial species. Ninety nine percent belong to the phylum or domains of *Firmicutes, Bacteroidetes, Proteobacteria* and *Actinobacteria*. They outnumber other members of the gut community [1,5]. This community is the most abundant and most diverse in the body and constitutes the "intestinal microbiome", which together with the immune system of the intestine and the mucosa of the organ wall form the "intestinal ecosystem". This ecosystem that inhabits the small and large intestine comprises more than 100 trillion microbial cells (estimated to be 10 times the number of other cells in the human body) that has almost 3.3 million intestinal microbial genes, and it is through the interaction of the microbiome with the intestinal epithelium that we can determine physiological changes in the brain [6].

The current review aims to summarize published human studies on the gut microbiota in relation to changes that occur with age and aging, and the role of diet in maintaining a proper balance and healthy state of the gut microbiome. An unstructured review of the publications in PubMed, Scimago, Google Scholar in the last 10 years until October 2021 was carried out.

Results

The homeostasis of the intestinal microbiome critically influences the health and aging of the host [7], which is characterized by a continuous and progressive process that determines a decreased physiological function in all body systems, with changes in populations bacterial infections of the intestinal microbiota [3], as the role of the microbiome in metabolic diseases (type 2 diabetes mellitus [8], obesity [9], non-alcoholic fatty liver [10], intestinal (inflammatory bowel disease [11], especially in Crohn's disease and colon cancer) [12]; cardiovascular [13] and neuropsychiatric diseases [5,14,15] (such as the autism spectrum, anxiety, depression, schizophrenia, Parkinson's disease and Alzheimer's) [16].

Researchers have stipulated the impact of the gut microbiota (GM) with variations in the human aging process. This physiological process is characterized by a decline in the functions of tissues and organs with an increased risk of the appearance of different diseases associated with old age [3]. In this direction, recent studies report the dominant microbiota (phylum, families, and genera) in the healthy adult varies in the course of the following years, with a reduction in its proportion and diversity throughout life, with variations in other less prevalent species. These changes are an expression of adaptability in the aging process and are beneficial and an expression of a healthy microbiota. However, in less healthy people, there is no variation, and the microbiome remains relatively static, since low diversity has also been associated with different health problems, with a trend in mortality earlier than people with a microbiota identified as presumably healthy. Likewise, it is stated that the modifications that occur in the composition of the microbiota are different from those reported in different conditions associated with dysbiosis. On the other hand, new evidence has suggested the gut microbiome may participate in an integral way in the inflammatory changes that occur in relation to age [3,7].

Gut microbiota and aging

It has been postulated in the aging process that a series of factors occur that influence the dysbiosis of the gut microbiota [17]. Among them, the following stand out: increased intestinal permeability, low-grade inflammation of the intestinal mucosa, appearance of pathobionts (potentially pathogenic bacteria), decrease in intestinal motility, metabolism, immune activity, with predisposition to the disease and the association to consumption of multiple drugs, events developed in the area of decrease in the aforementioned diversity of the gut microbiota [18].

The human GM undergoes a series of transformations in the first years of life, from birth, during the first year of life, influenced by the type of lactation (breast milk or artificial milk), when solid feeding begins until reaching a stable microbiota between 2 to 3 years of age, which may be related to other factors, such as cesarean section and the use of antibiotics, with greater repercussions due to broad spectrum and the appearance of diseases [19].

The microbial community of the gut is characterized by wide inter-individual variation; however, its intra-individual variation is stable throughout life. The development achieved in childhood maintains its stability for decades until middle age, when a progressive process of changes in its composition begins through old age. In aging, transformations of a eubiotic or dysbiotic nature can occur, that is, related to a stable intestinal microbiota, in a continuous process of transformation adapted to physiological changes with an impact on a diminished and not very diverse composition versus a static microbiota, without transformations related to the adaptation events and imbalance in microbial composition, expression of susceptibility traits for different diseases [20].

Studies to investigate the traits of the intestinal microbiota in humans have usually been carried out in feces. In a recent study, the bacterial composition of the small intestine was investigated, and the diversity of the duodenal microbiome and coliforms increase in older

subjects, as well as the prevalence of *Proteobacteria* and anaerobes phylum. Likewise, *Bacteroides, Lactobacillus,* and *Escherichia* increase only with chronological age, while *Klebsiella* increases with the use of drugs and *Clostridium* with various conditions. On the other hand, the decrease in microbial diversity in older adults was associated with the combination of chronological age, number of associated diseases, and number of drugs used [20].

Gut microbiota and nutrients

Nutrients in food are a decisive factor in the composition and preservation of the gut microbiome. The diet can provide foods with a probiotic and prebiotic effect that are decisive for maintaining a healthy microbiota in the elderly.

Lily and Stilwel [21] in 1965, proposed the initial criterion on the term probiotic, as "substances secreted by a microorganism that stimulate the growth of others". The World Gastroenterology Organization [22] revised the definition, maintained what was postulated by the FAO / WHO in 2001, by establishing "they are live microorganisms that, when administered in adequate quantities, contain a benefit for the health of the host." It is of interest to point out that a probiotic must meet the following characteristics [23]:

1. Non-pathogenic properties.
2. Ability to survive through the digestive tract.
3. Adherence to the intestinal epithelium.
4. Colonization in the intestinal tract.
5. Production of antimicrobial substances.
6. Adequate survival (stability) in food or in powder or liquid form.

Foods that contain probiotics

Fermented products, such as yogurt, kefir, and a type of fermented cabbage (sauerkraut) provide a balance in the gut microbiota. Probiotics modify the composition of the microbiota for a certain time, but prebiotics contribute to the formation of probiotic bacteria in the small intestine, and especially in the colon, for a long time. Other less popular foods that contain probiotics are sweet and sour cucumbers, kombucha (green tea drink sweetened with different flavors and fermented by the effect of a symbiotic colony of bacteria and yeasts called SCOBY (Symbiotic Culture Of Bacteria and Yeast); mass, (in Japanese it means source of flavor), it is a fermented seasoning that gives a great contribution of flavor to foods, its most common use is in soups but it is also used for salads, vegetables and sauces; and tempeh (traditional from Indonesia) is a Food made from fermented soybeans, presented in the form of cake or nougat, contains an important supply of probiotics and proteins and vitamin B12 [24].

In 1995, Gibson and Roberfroid [25] established the concept of a prebiotic based on "indigestible food ingredients with a beneficial effect on the growth and/or activity of one or a limited number of bacterial species in the colon, thereby improving the Health". Prebiotics are related to the proliferation of intrinsic intestinal bacteria, the main components are fructo-oligosaccharides, inulin, isomalto-oligosaccharides, polydextrose, lactulose and resistant starch. Oligosaccharides, such as those in soybeans, galacto-oligosaccharides, and xyl-oligosaccharides are also prebiotic agents.

The main foods with prebiotics are the following:

- Artichokes, chicory, asparagus and banana: Contain inulin, a natural prebiotic.

- Legumes, chicory, potato and sweet potato: They have raffinose and stachyose.
- Garlic, onion and leek: They have derivatives of inulin and fructooligosaccharides.
- Wheat, oats and barley: They have inulin.

Other foods with prebiotic activity include breast milk, which contains more prebiotic elements; walnuts (consumption helps grow more *lactobacilli*); such as chocolate (helps increase) and asparagus (effect on the populations of *lactobacilli* and *bifidobacteria*), the apple that contains prebiotic pectin and the corn that has resistant starch.

Alterations in diet represented by high concentrations of saturated fat and carbohydrates contribute to a state of dysbiosis of the intestinal microbiota. Factors of dysbiosis include, along with an unbalanced diet, environmental toxins, medications. psychological stress and other pro-inflammatory states, and are implicated in metabolic, chronic non-communicable inflammatory, neuropsychiatric diseases, and cancer.

Although a link between GM, nutrition and chronic inflammation has not yet been established, the possibility of modulating the composition of the gut microbiota through diet has been suggested to influence composition and diversity to promote healthier aging and longevity.

In the light of the most recent knowledge, the concept of a diet with symbiotic content (probiotics and prebiotics) represents a challenge to modulate GM in the aging process and promote and maintain a healthy microbiota. Likewise, the administration of probiotics and prebiotics aimed at achieving healthy longevity is a new direction to be developed [26].

Discussion

The challenge for a long life with healthy aging has been related in part to the gut and GM, whose microorganisms encode 150 times more genes than the human genome, linked to metabolic reactions of interest in the normal physiology of the host and its metabolism.

The most precise trait of the relationship between GM and old age is based on maintaining a stable microbiota, in relation to the course of the years, with the own changes that occur during aging, to maintain traits proportional to a healthy and dynamic microbiota, in which the diet participates in a decisive way in its homeostasis and other physiological functions.

Foods that have probiotic and prebiotic effects are of recognized benefit, by determining intestinal fermentation with decomposition of dietary fibers by anaerobic GM with production of short chain fatty acids (butyrates, propionates and acetate), which have effects on the host, as they easily enter the circulation from the intestine, with beneficial functions in energy metabolism. Acetate can lower serum cholesterol and triglyceride levels, propionate can lower glucose levels, and butyrate can increase insulin sensitivity [27].

It is of interest to emphasize that there is agreement on the influence of diet and medications, especially antibiotics, on the composition and balance of the microbiota for health. In this direction, it is of interest to refer to the criteria postulated by the Ukrainian researcher Elier Metchnikoff [28], Nobel Prize in Medicine in 1908 and deputy director of the Pasteur Institute in Paris at the beginning of the 20th century, who developed the hypothesis of a link between aging and the intestinal microbiota with the possibility of regulating its balance with the habitual consumption of yogurt for health benefits. This very up-to-date criterion is linked to recent studies related to the association between aging and GM [18,27].

The biotherapeutic effects of probiotics have been studied in children and adults with evidence on the promotion of a beneficial bacterial community and the elimination of harmful germs that cause dysbiosis and its relationship with different diseases. These results are related to the inter -individuality of the GT, so they are specific to the genus and cep6 of the probiotic and of the host.

However, studies of prebiotics in the elderly have been limited to inulin and oligosaccharides, which have shown effects of modifying GM and modulating the immune system in older people. On the other hand, other prebiotic compounds, such as resistant starch, corn fiber, and polydextrose are of interest as they have the ability to modulate the microbiota and increase short-chain fatty acids.

Conclusion

The significance of age and the aging process have an impact on the intestinal microbiome with critical effects on the changes that occur in its composition, although the implications of the intestinal microbiome are not all clarified.

The role of the intestinal microbiome, its functions and stability for a healthy state in the context of the development of chronological age and biological age, the impact on the composition with events of eubiosis and dysbiosis of the microbiota and the interrelation with health were reviewed. Research results of the small intestine microbiome change significantly with age and aging. These criteria have postulated that changes in the gut microbiome can predict what health will be like in aging.

The right diet in the balanced GM and the importance of the probiotic and prebiotic effect of foods versus the harmful effect of unbalanced diets high in saturated fat and carbohydrates is emphasized; and the consumption of antibiotics are referred. Mention was made of the possibility of probiotic and prebiotic in the aging process, for a healthy microbiota, which may be promising for human health in the aging process, which requires new studies and research.

Interest Conflicts

The author declares no conflict of interest.

Bibliography

1. Rowland I., *et al*. "Gut microbiota functions, metabolism of nutrents and other food components". *European Journal of Nutrition* 57.1 (2018): 1-24.

2. Sherwin E., *et al*. "Recent development in understanding the role of gut microbiota in brain health and disease". *Annals of the New York Academy of Sciences* 1420.1 (2018): 5-25.

3. Buford TW. "Trust your gut: The gut microbiome in age-related inflammation, health, and disease". *Microbiome* 5.80 (2017): 1-11.

4. Leite G., *et al*. "Age and the aging process significantly alter the small bowel microbiome". *Cell Repots* 36.13 (2021): 109765.

5. Cryan JF and O'Riordan KJ. "The microbiota-gut-brain axis". *Physiological Reviews* 99.4 (2019): 1877-2013.

6. Maiuolo J Gliozzi M., *et al*. "The Contribution of Gut Microbiota–Brain Axis in the Development of Brain Disorders". *Frontiers in Neuroscience* (2021).

7. Han B., *et al*. "Microbial genetic composition tunes lost longevity". *Cell* 169.13 (2017): 1249-1262.

8. Aw W and Fukuda S. "Understanding the role of the gut ecosystem in diabetes mellitus". *Journal of Diabetes Investigation* 9.1 (2018): 5-12.

9. Cunningham AL., *et al*. "A review on gut microbiota: a central factor in the pathophysiology of obesity". *Lipids in Health and Disease* 20 (2021): 65.

10. Castañeda-Guillot C. "Fatty Liver disease: a new pandemic?" *EC Gastroenterology and Digestive System* 8.5 (2021): 15-19.

11. Alam MT., *et al*. "Microbial imbalance in inflammatory bowel disease patients at different taxonomic levels". *Gut Pathogens* 12 (2020): 1.

12. Flemer B., *et al*. "The oral microbiota in colorectal cancer is distinctive and predictive". *Gut* 67.8 (2018): 1454-1463.

13. Tang WH and Hanzen SL. "The Gut Microbiome and its Role in Cardiovascular Diseases". *Circulation* 135.11 (2017): 1008-1010.

14. Cenit MC., *et al*. "Influence of gut microbiota on neuropsychiatric disorders". *World Journal of Gastroenterology 23*.30 (2017): 5486-5498.

15. Huang T-T., *et al*. "Current Understanding of Gut Microbiota in Mood Disorders: An Update of Human Studies". *Frontiers in Genetics* (2019).

16. Cattaneo A., *et al*. "Association of brain amyloidosis with pro-inflammatory gut bacterial taxa and peripheral inflammation markers in cognitively impaired elderly". *Neurobiol Aging* 49 (2017): 60-68.

17. Castañeda-Guillot C. "Gut dysbiosis". *EC Gastroenterology and Digestive System* 7.3 (2020): 01-04.

18. Negpal R., *et al*. "Gut microbiome and aging: Physiological and mechanistic insights". *The Journal of Nutrition, Health and Aging* 4.4 (2018): 267-285.

19. Itani T., *et al*. "Establishment and development of the intestinal microbiota". *Anaerobe* 43 (2017): 4-14.

20. Leite G., *et al*. "Age and the axing process significantly alterthe small bowel microbioe". *Cell Reports* 36.13 (2021): 109765.

21. Lilly DM and Stillwell RH. "Probiotics promoving factors produced by microorganisms". *Science* 147 (1965): 747-748.

22. Guarner F., *et al*. "Probiotics and Prebiotics". *World Gastroenterology Organization* (2017).

23. Castañeda-Guillot C. "Probiotics. Update". *Revista Cubana de Pediatría* 90.2 (2018): 286-298.

24. Zommiti M., *et al*. "Update of Probiotics in Human World: A Nonstop Source of Benefactions till the End of Time". *Microorganisms* 8.12 (2020).

25. Gibson GR., *et al*. "DIetary modulation of the human colonic microbiota: introducing the concept of prebiotics". *Journal of Nutrition* 185.6 (1995): 1401-1412.

26. Wang Y., *et al*. "Probiotic supplements: hope or hype?" *Frontiers in Microbiology* (2020).

27. Kim S and Jazwinski SM. "The Gut Microbiota and Healthy Aging: A Mini-review". *Gerontology* 64 (2018): 513-520.

28. Mackowiak PA. "Recycling Metchnikoff: Probiotics, the intestinal microbiome and the quest for long life". *Frontiers in Public Health* 1 (2013): 52.

Volume 9 Issue 5 May 2022