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Review Article

Good Functions of Microbiome

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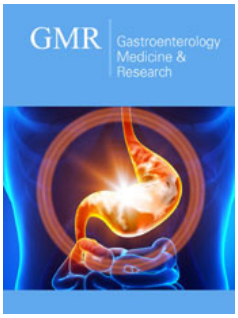

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Abstract

Undoubtedly, there are many medical professionals who see the microbiome from afar and once they detect the diverse and numerous functions that this new super organ has, they will undoubtedly turn their eyes towards it. These different functions will attract not only professionals but also a large public, who is interested in various medical topics. All this will generate countless articles and groups of all the new lovers of the microbiota, all with good intentions, but we must be attentive to false orientations, which will also be seen in the near future. Since the subject is vast and transcendent. If one looks at recent reviews, most researchers determine that the microbiome has immunological, metabolic and endocrine functions. They may include inflammatory or other aspects. In this review we have detected more than 40 functions of the microbiome, which makes it a very special and vital organ. Relevant articles, and how these functions work, have been added to each of the functions, to provide a more scientific aspect to this article and restore the dignity of the microbiome, which has been forgotten for so long.

Keywords: Microbiome (Microb); Microbiota (Mic); Intestinal Microbiota (IM)

Introduction

The microbiome (Microb) begins to acquire relevant heights when knowing how it Impacts our lives, when it was determined that its genetic content is greater than the cells (a hundred times more), that it does not rival them, but rather complements them, by coexisting with the host (human being) through symbiotic relationship.

Kind of you give me, I give you. Below are the different function of the microb found to date and more will surely appear. This physiology occurs fundamentally in the digestive tract, through 100 billion bacteria and other microorganisms (Intestinal Microbiota) IM. The G-I tract contains approximately 100 billion bacteria, being the site of interactions between the host immune system and microorganisms.

Microbiome functions

1. Collaborates with Neurological Function, through the Gut-Brain Axis.
2. Confers Resistance to Inflammatory Processes.
3. Grants Resistance to Infections.
4. Healthy microbiota and mucus are essential compliments to prevent the invasion of bacteria and viruses.
5. Helps assimilate nutrients.
6. Intervenes in the physiology of Obesity, through energy balance, by increasing metabolic inflammation, insulin resistance and dysglycemia.
7. It allows the survival of commensal symbiotic microbes.

8. It competes for the ecological niches and thus prevents the colonization of pathogens, through the secretion of antimicrobial peptides.

9. It favors endocrine functions from the carbon cycle in the soil, to the fermentation of food in the intestine.

10. It guarantees a supportive environment during pregnancy.

11. It has specific functions in the metabolism of nutrients, xenobiotics and drugs.

12. It impacts brain function, behavior, and anxiety, as well as mood, cognition, and pain regulation.

13. It influences energy, glucose, and lipid homeostasis by controlling different metabolic pathways.

14. It intervenes in the decomposition of food carcinogens.

15. It is a source of folate (Vitamin B-9).

16. It is involved in the formation of memory mechanisms of systemic immunity, such as oral tolerance.

17. It is responsible for degrading organic compounds including food additives, bile salts and cholesterol

18. It keeps the gut in a state of controlled inflammation.

19. It metabolizes lipids and multiplies the ability to digest complex polysaccharides that would otherwise be inaccessible nutrients.

20. It modulates intestinal motility and makes visceral perception possible.

21. It prevents the overgrowth of opportunistic bacteria that are present in the gut.

22. It produces thousands of metabolites, which replace many of the host's functions.

23. It stimulates the development of new tissue in the cecum and Peyer's patches.

24. It stimulates the production of natural antibodies.

25. It protects against microbial invasion.

26. Keeps the intestinal barrier intact.

27. Key mechanism for host defense.

28. Maintains intestinal homeostasis.

29. Metabolic contributions to Short Chain Fatty Acids, such as butyrate.

30. Modifies micro-environmental conditions through changes in pH.

31. Preserves the viability of stem cells.

32. Prevents death from skin and mucosal diseases caused by opportunistic pathogens.

33. Prevents the development of neoplasms.

34. Produces SCFA, peroxides and bacteriocins. SCFAs generate neuro-immuno-endocrine regulation.

35. Produces substances that inhibit or eliminate indigenous substances.

36. Produces anti-inflammatories.

37. Promotes development.

38. Protect life.

39. Provides digestive enzymes and substrates for enterocytes, preventing diseases caused by opportunistic pathogens.

40. Regulates the Energy Balance. Regulates metabolic, endocrine and immune functions.

41. Secretes small cationic antimicrobial peptides (defensins).

42. Strongly interacts with the intestinal epithelial barrier

43. Synthesizes and excretes vitamins K and B12, in excess.

44. Train and develop the main components of the innate and adaptive immune system, through nutrients, metabolites and antigens.

Now, we will review different articles that are related to the exposed functions:

Collaborates with neurological functions, through the gut-brain axis: The most important function of the Gut-Brain Axis (GBA) is bidirectional communication between the central and enteric nervous systems, because it links the brain´s cognitive and emotional centers with peripheral intestinal functions [1]. Likewise, this link is made through the vagus nerve, the immune system, bacterial products and metabolites [2]. Having outlined that the Gut Microbiota can modulate some morbid neurological processes [3].

Confers resistance to inflammatory processes: Bioactive molecules from IM and their inflammatory actions have been determined at distant sites such as the brain [4].

Grants resistance to infections: The host is protected by IM through a process known as colonization resistance. This process is partly unknown, but there are studies in which the infected host demonstrates resistance to infection, in which bile acids, using taurine sulfonic acid, play a crucial role [5].

Healthy microbiota and mucus are essential compliments to prevent the invasion of bacteria and viruses: Research on intestinal mucus and healthy microbiota has changed diametrically, and today enormous attention is paid to both, as true shields that protect against invasions by bacteria and viruses [6].

Intervenes in the physiology of Obesity, through energy balance, by increasing metabolic inflammation, insulin resistance and dysglycemia: Cavallari JF and his group [7] state

that the IM has been implicated in the control of energy balance and extraction of nutrients from dietary sources.

The IM acquired in childhood develops immunity: It has been determined that the composition of IM affects health from the prenatal period to childhood, so if we take care of babies from then on, will not develop dysbiosis, with the consequent appearance of alterations in the immune system, in the brain development, body growth and lungs [8].

It allows the survival of commensal symbiotic microbes: The current objective to promote health is to conserve the diversity of IM, which will develop disease prevention and the presence of a stable number of comensal organism [9].

It competes for the ecological niches and thus prevents the colonization of pathogens, through the secretion of antimicrobial peptides: The defense function of IM is important for intestinal homeostasis, as it competes for ecological niches, while releasing bacteriocins and producing differences in environmental processes. For this function they rely on the release of SCFAs [10].

It favors endocrine functions from the carbon cycle in the soil, to the fermentation of food in the intestine: IM is an immune organ and is based on its metabolic capacity to regulate and produce multiple compounds, which once in the circulation influence distant organs. A confirmed example is what happens in the metabolism of carbohydrates [11].

It guarantees a supportive environment during pregnancy: The study by Gao U, plus his group, confirms together with the other previous clinical models, that maternal IM provides significant action on the composition on adaptive and innate elements of the baby´s immune system after it is born [12].

It has specific functions in the metabolism of nutrients, xenobiotics and drugs: IM complements the production of liver enzymes and is related to the metabolism of the diet. Especially bacteria. These metabolic pathways can be explored through omics methodologies, mathematical models, and enzymatic assays [13].

It impacts brain function, behavior, and anxiety, as well as mood, cognition and pain regulation: The development of IM can affect behavior; it generates it through the Microbiota-Brain Axis. The same goes for pain [14,15].

It influences energy, glucose, and lipid homeostasis by controlling different metabolic pathways: There is interaction between metabolic activities and the host, mediated by metabolites generates by bacteria, which affect the nervous, metabolic and immune systems. If this physiology is carefully detected, it could be part of specific therapeutics or appropriate diagnoses [16].

It intervenes in the decomposition of food carcinogens: Colorectal cancer being the second cause of death in the West, we analyze how metabolites produced by bacteria can inhibit it. This can be done through the fermentation of complex residues carried out by IM. To do this, it uses the benefits of butyrate, which establishes the integrity of the mucosa, suppressing inflammation and thus carcinogenesis, through gene expression and epigenetic modulation. [17].

It is a source of folate (Vitamin B-9): This biomolecule is essential in DNA synthesis, as well as in epigenetic regulation; IM being one of the factors of its production. Lactobacillus reuteri is present in this generation [18].

It is involved in the formation of memory mechanisms of systemic immunity, such as oral tolerance: IM is a priority in the formation and functioning of the host´s immune system, which maintains the symbiotic relationships, which translates health in human being. However, when this relationship is violated either through inadequate diets, the use of antibiotics or other medications that damage the microbiome that lacks resilience, dysbiosis appears and consequently the disease [19].

It is responsible for degrading organic compounds including food additives, bile salts and cholesterol: The incidence of IM in the metabolism of cholesterol and bile acids has been determined. When IM alterations occur, bile acids and cholesterol itself are affected. Being a real head break to understand the various bacterial functions, in this very difficult process [20].

It keeps the gut in a state of controlled inflammation: Inflammatory Bowel Disease and gut inflammation are associated with intestinal dysbiosis. Evidenced by alterations in the intestinal barrier and metabolites [21].

It metabolizes lipids and multiplies the ability to digest complex polysaccharides that would otherwise be inaccessible nutrients: Humanity has definitely stimulated an obesogenic environment, with overeating and lack of physical movement. Are there other factors such as IM, which affect your immune and intestinal barrier and through metabolic regulation and food digestion [22].

It modulates intestinal motility and makes visceral perception possible: Through the analysis of chronic constipation, the effect of IM on colonic movement has been studied. Even though it is not completely known how affect it. Has been considered that microbial metabolites intervene in the process through the immune function, the Central Nervous System, the hormonal environment and intestinal secretion [23].

It prevents the overgrowth of opportunistic bacteria that are present in the gut: Protection against pathogen colonization and growth can disrupt the healthy bacterial community. For this reason, IM has developed competitive metabolic interactions, immune responses and location of intestinal niches, to minimize the strategies that pathogens have generated to escape the actions of commensals [24].

It produces thousands of metabolites, which replace many of the host's functions: Not only are the nearly 100 trillion bacteria, also include fungi, viruses and protozoa; they encode more than 3 million genes, producing thousands of metabolites, overriding numerous host functions [25].

It stimulates the development of new tissue in the cecum and Peyer's patches: The gastrointestinal system has an important role in regulating immune homeostasis: It does so through the intestinal epithelial barrier, which is no static, and interacts with the cell of the immune system and IM, generating specific immune response to antigens, stabilizing tolerance and effector immune functions [26].

It stimulates the production of natural antibodies: Defined as germline-encoded immunoglobulins that are localized to people without prior antigenic experience: natural antibodies. These bind to exogenous components-may be bacteria. Having determined that they can act as first-line immunological components, against infections, apoptotic and necrotic cells [27].

It protects against microbial invasion: The immune system directs the maintenance of the host-microorganism symbiosis. Considering that the imbalances in the interactions impact on multiple immune-mediated diseases. They also affect nutritional responses, metabolism, circadian rhythm and immunity [28].

Keeps the intestinal barrier intact: Currently, it is confirmed that there is a leaky gut. Which derives fundamentally from the inflammatory process, coinciding with systemic disease, in metabolic alterations. Suggesting techniques to measure said permeability, consisting of independent bacterial culture and computational methodologies [29].

Key mechanism for host defense: IM has a series of mechanisms that generate protection from pathogenic microorganism. This defense is carried out through activation of the inflammasome, the secretion of antimicrobial peptides and IL-22, IL-17 and IL-10 presence [30].

Maintains intestinal homeostasis: IM translates balance of the immune system, through the elimination of pathogenic microorganism. At the same time, it generates self-tolerance, so that there is no self-immunity, and thus regulates immunological homeostasis [31].

Metabolic contributions to short chain fatty acids, such as butyrate: SCFA generated by bacterial fermentation of dietary fiber are mediators of the beneficial actions produced by IM. These acids also modulate host health, utilizing glucose homeostasis, intestinal barrier, appetite regulation, immune modulation, and obesity [32].

Modifies micro-environmental conditions through changes in pH: Microorganism alter the environment by takin resources and producing metabolites, altering their own development, such as that of pathogenic organisms. These facts translate changes in environmental pH, which in extreme cases kill bacteria and subsequently stabilize them [33].

Preserves the viability of stem cells: More frequently, the positive incidence of IM on intestinal epithelial stem cells is observed. It does this through its actions in ecological niches and possibly in cells themselves. Determining nutrient absorption, endocrine signaling, immune response, energy homeostasis and systemic health [34].

Prevents death from skin and mucosal diseases caused by opportunistic pathogens: The gut and the skin are very active in the immune system and at the same time are exposed to the outside environment. Both have diverse microbiota to maintain homeostasis, and adequate composition of microorganisms, strong epithelial barriers, and complex regulatory mechanisms that govern interactions. With these unique mechanism they interact with commensal population and host repair [35].

Prevents the development of neoplasms: The function of protection against pathogens is given by immune system, in which the IM has important actions. The microbiome is outstanding in mitigating cancer risk [36].

Produces SCFA, peroxides and bacteriocins. SCFAs generate neuro-immuno-endocrine regulation: The evidence support the functions that IM has. SCFAs play an interesting role in neuro-immuno-endocrine regulation. It is important that in the near future these acids may be used as therapeutics in the regulation of the indicated function [37].

Produces substances that inhibit or eliminate indigenous substances: Interest has arisen in analyzing IM in relation to the pathogenesis of SUD substances, having detected that through metabolomic, immunological and neurological mechanism [38,39].

Produces anti-inflammatories: Bacterial byproducts of metabolic processes, including some SCFAs, inhibit inflammatory action; that is, they are considered anti-inflammatory [40].

Promotes development: Characteristics of the gut microbiota can affect the development of brain, lungs, immune system as body growth [41].

Protect life: The characteristics of microbiota-immunity crosstalk have significant roles in health and thus, usually maintain life. While imbalance in the interactions of this binomial contribute to numerous immune-mediated disorders [42].

Provides digestive enzymes and substrates for enterocytes, preventing diseases caused by opportunistic pathogens: Symbiotic microorganisms provide immune homeostasis, protection against pathogen colonization, and immune responses, and are mediated by a variety of mechanism, including direct killing, competition for limited nutrients, and enhancement of immune response [43].

Regulates the energy balance. regulates metabolic, endocrine and immune functions: The Microb is an organ that could contribute to global malnutrition, since its action in regulating energy balance is significant [44].

Secretes small cationic antimicrobial peptides (defensins): Enteric endogenous peptides are essential in defense. They shape the IM and help maintain intestinal homeostasis, contributing to innate immunity [45].

Strongly interacts with the intestinal epithelial barrier: The host and the IM have mutual interactions that translate health and help in the provision of nutrients. As a first-line response,

and communicate with commensal bacteria, in order to shape the function and composition of the bacterial community [46].

Synthesizes and excretes vitamins K and B12, in excess: Micronutrients with a physiological impact on various biological responses, including host immunity. The human being obtains Vitamin B from IM, and when there are deficiencies of it, translates into immunological alterations [47].

Train and develop the main components of the innate and adaptive immune system, through nutrients, metabolites and antigens: This is due because the immune system is localized to the gut, there is a strong interaction between the intestinal epithelial layer, the local mucosal immune system and IM.

Conclusion

Undoubtedly, new functions of IM will continue to appear and this will bring researchers closer to developing new and more efficient specific therapies, as well as better knowledge, which will facilitate medical action.

Conflicts of Interest

The authors declare that do not have affiliation or participation in organizations with financial interests.

Ethical Approval

This report does not contain any study of human or animal snnubjects carried out by the authors.

Informed Consent

The authors obtained informed written consent from the patients, in order to develop this article.

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