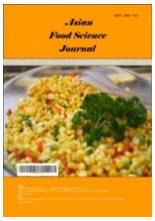

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The Dialogue between the Intestine-brain Axis: What is the Role of Probiotics?

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Introduction: Communication between intestine-brain axis is complex and uses different pathways. This communication forms a bidirectional axis whose equilibrium depends on the composition of the microbial community that inhabits the intestines. This ecosystem has a modulator role on the intestine-brain axis. Because of this, intestine-brain axis becomes a fascinating growing study area. The intestinal dysbiosis hurts the host's health and can lead to several psychiatric diseases.

Aim: The present opinion described highlight an emerging theme in medicine, the interesting communication that is established between the intestine-brain axis. The function that intestinal probiotic microorganisms play in the health and disease of the host's has been gaining prominence. This is a promising area with an increasing number of studies which demonstrates its importance.

Conclusion: In this context, the new class of probiotic microorganisms "psychobiotic" appear to have a significant role in the maintenance of eubiosis, revealing a new therapeutic potential for mental health.

Keywords: Probiotic food; intestine-brain axis; mental health.

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1. INTRODUCTION

The present opinion described intends to highlight an emerging theme in medicine, the interesting communication that is established in the intestine-brain axis. The function that intestinal bacterias play in the health and disease of the host's has been gaining prominence. Psychobiotic use is a promising area with an increasing number of studies which demonstrates its importance.

The intestinal microbiota has been reported to be involved in several physiological processes including immunomodulation, energy balance and activation of the enteric nervous system [1,2]. The individual's microbiota profile is controlled by factors such as diets, genetics, sex and age. The microbiota is responsible for important functions in human health. In particular, dysbiosis of the intestinal microbiota is correlated with various diseases of the central nervous system. For example, a low number of *Bifidobacterium* spp. and/or *Lactobacillus* spp. results in individuals with a high level of depressive disorder [3,4].

Evidence of microbiota-intestine-brain axis communication can be found from the relationship between intestinal dysbiosis and functional gastrointestinal disorders and disorders of the central nervous system [5]. New strains of probiotic microorganisms are an important focus of future studies to elucidate their potential, highlighting the probiotics contribution in mental health.

2. INTESTINE-BRAIN AXIS

According to previous studies, the interest in the connection between intestinal health and psychological well-being received the name “Intestine-Brain Axis”, which is a bidirectional regulatory system involving the brain, the central nervous system and the intestine [6]. The intestine-brain axi send and receive information through the enteric nervous system, through neural pathways, as well as through the bloodstream [7].

Although the interactions of the intestine-brain and microbiome are multifactorial and not well understood, the intestine-brain axis system functions as a communication channel between the intestinal microbiome and the brain [6]. The intestine-brain axis provides a pathway of bidirectional communication that can cause several pathophysiological consequences if there is deregulation. This axis is regulated at the neural, hormonal and immune levels [6]. Fig. 1 shows the “Intestine-Brain Axis” mechanism.

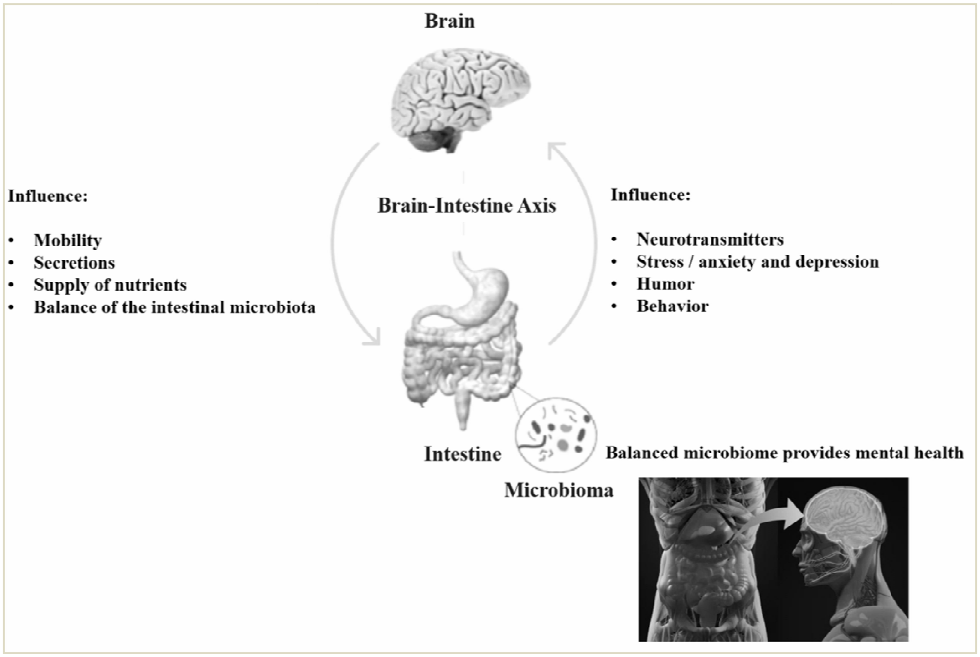

Fig. 1. System “Intestine-Brain Axis”. Figure created by author

Several afferent or efferent pathways are involved in the microbiota-intestine-brain axis. Antibiotics, environmental and infectious agents, neurotransmitters and intestinal neuromodulators, fibres, cytosines and essential metabolites transmit information about the intestinal state to the central nervous system. Such interactions seem to influence the pathogenesis of a series of disorders in which inflammation is implicated as mood disorder, stress and depression [8].

3. NEW CLASS OF PROBIOTIC "PSYCHOBIOTIC": WHAT IS THEIR FUNCTIONALITY?

A new class of probiotics that suggest potential applications in the treatment of psychiatric disorders are the "psychobiotics" [9,10,11]. Psychobiotic microorganisms can regulate neurotransmitters and proteins including gamma-aminobutyric acid, serotonin, glutamate and brain-derived neurotrophic factor and play important roles in the learning processes and memory [12,13].

Some probiotic strains of *Lactobacillus* spp. and *Bifidobacterium* spp., such as *Lactobacillus brevis, Bifidobacterium dentium* and *Lactobacillus plantarum* produce serotonina [14]. Also, strains of *Lactobacillus,* such as *L.* plantarum and *L.* odontolyticus produce acetylcholine [15]. Recently it was verified that the synthesis of serotonin in the intestine can be regulated by microorganisms [14,15,16]. Therefore, new probiotic strains are worthy of studies to elucidate their psychobiotic potential, particularly in psychiatric disorders. The intestinal microbiota is modified and evolves from birth, moving from an immature state in newborns during childhood to a more complex and diverse ecosystem in adulthood. Intestinal microbial imbalance can have negative consequences on the health of the host, leading to gastrointestinal, immunological and neurological disorders [10].

The nutrients consumed such as vitamins, amino acids, fibres and other bioactive substances can be metabolized by probiotic microorganisms present in the intestinal microbiome and converted in the intestinal lumen to biologically active molecules. These microbial metabolites can affect the host's physiological functions, such as the immune system and/or central nervous system [17].

4. OPINION

The knowledge extracted from the scientific literature demonstrates the importance of microbiota-intestine-brain axis. This association has proven to be fundamental for health and well-being. Serotonin is the key neurotransmitter on this axis and the vagus nerve is a determinant pathway for the correct functioning of this system. For a long time, the brain was searched exclusively for the origin of psychiatric disorders. However, the literature reflects that new research sources are needed. Because there is evidence of the capacity that the microbiome has in modulating behaviour and mood. Intestinal dysbiosis is blamed for the establishment of some psychiatric illnesses. Thus, it is understood that the influence that the enteric microbiota has on the intestine-brain axis justifies the growing interest that this theme has generated in the most diverse áreas, such as microbiology, biotechnology, gastroenterology, psychiatry, among many others.

The human microbiome must be considered as a "virtual organ" of the host, given its importance for its health. Thus, knowing and characterizing this diverse ecosystem seems to be crucial to understand its contribution to health and disease. Identifying what deregulates the balance of the microbial community, that is, what causes dysbiosis in an individual over time, becomes an important step in predicting pathological states and in developing new therapies. Currently, there is a current of research that has as a working hypothesis the contribution of enteric dysbiosis to inflammation of the gastrointestinal tract and its influence on the intestine-brain axis. There is evidence that any disturbance in the balance of intestine-brain axis produces changes in the response of stress and behaviour in general.

Due to diversity of microbial species that inhabit the gastrointestinal tract and the ability of some species have to synthesize neuroactive molecules, the digestive tract has a rich source with great potential for pharmacokinetics, which can influence intestinal health. Through simple strategies, such as a healthy diet and probiotics, individuals may improve intestinal microbiota contribute to maintaining a healthy ecosystem. Probiotics positively influence mood, possessing antidepressant and anxiolytic properties already proven in animals and humans, mainly the genera *Lactobacillus* and *Bifidobacterium*. Thus, the emerging concept of psychobiotics is opportune and gains more and more notoriety.

This could prove to be a promising therapeutic strategy aimed at modulating the microbiome.

My research group is in the early stages of the in vivo clinical evaluation of strains of probiotic microorganisms, using laboratory animals (mice), for psychobiotic effect. We are evaluating the behavioural, feces and urine of these mice. The concentration of the neurotransmitter "serotonin" present in the brain and intestinal regions of these mice will be quantified and evaluated. The researchers observed less aggressive behaviour in mice throughout the treatment. In the pre-clinical experiment, a positive activity of probiotics in animal welfare was observed.

5. CONCLUSION

According to the description of the scientific literature on the use of probiotics as psychobiotics, the author can conclude that the utility of probiotics extends to several areas such as psychiatry, gastroenterology, dermatology, endocrinology, among others. However news animals clinical experiments is necessary because, despite the existing evidence, the search for answers to elucidate the probiotics contribution mechanisms to health is in the initial stage.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Turnbaugh PJ, Ley RE, Mahowald MA, Magrini V, Mardis ER, Gordon JI. An obesity-associated intestine microbiome with increased capacity for energy harvest. Nature. 2006;444:1027-1031.
2. Sarkar A, Lehto SM, Harty S, Dinan TG, Cryan JF, Burnet PWJ. Psychobiotics and the manipulation of bacteria-intestine-brain signals. Trend Neuros. 2016;39:763-781.
3. Aizawa E, Tsuji H, Asahara T, Takahashi T, Teraishi T, Yoshida S, Ota M, Koga N, Hattori K, Kunugi H. Possible association of Bifidobacterium and *Lactobacillus* in the intestine microbiota of patients with major depressive disorder. J of Affec Disor. 2016;202:254-257.
4. Wallace CJK, Milev R. The effects of probiotics on depressive symptoms in humans: A systematic review. Annals Gen Psych. 2017;16-14.
5. Carabotti M, Scirocco A, Maselli MA, Severi C. The intestine-brain axis: Interactions between enteric microbiota, central and enteric nervous systems. Annals Gastroenterol. 2015;28:203-209.
6. Konturek PC, Brzozowski T, Konturek SJ. Stress and the intestine: Pathophysiology, clinical consequences, diagnostic approach and treatment options. J Physiol Pharmacol. 2011;62(6):591–599.
7. Bercik P, Collins SM, Verdu EF. Microbes and the intestine-brain axis. Neurogast Motil. 2012;24(5):405–413.
8. Petra AI, Panagiotidou S, Hatziagelaki E, Stewart JM, Conti P, Theoharides TC. Gut-microbiota-brain axis and effect on neuropsychiatric disorders with suspected immune dysregulation. Clin Therap. 2015; 37(5):984–995.
9. Dinan TG, Stanton C, Cryan JF. Psychobiotics: A novel class of psychotropic. Biol Psych. 2013;74:720-726.
10. Ross SM. Microbiota in Neuropsychiatry, Part 3 Psychobiotics as Modulators of Mood Disorders. Hol Nurs Prac. 2017; 31(4):270-273.
11. Magalhães-Guedes KT, Anunciação TA, Nascimento ASM. Psicobióticos na saúde mental contra transtorno da ansiedade e depressão. In: Luis Henrique Almeida Castro, Thiago Teixeira Pereira, Silvia Aparecida Oesterreich. (Org.). Ciências da Saúde: Campo Promissor em Pesquisa 7. 1 Ed. Ponta Grossa - PR: Atena Editora. 2020;1:105-112.
12. Lu Y, Christian K, Lu B. BDNF: A key regulator for protein synthesis-dependent LTP and long-term memory?. Neurobiol Lear Mem. 2008;89:312-323.
13. Martinowich K, Lu B. Interaction between BDNF and serotonin: Role in mood disorders. Neuropsychopharmacol. 2008; 33:73-83.
14. O'Mahony SM, Clarke G, Borre YE, Dinan TG, Cryan JF. Serotonin, tryptophan metabolism and the brain-intestinemicrobiome axis. Behav Brain Res. 2015;277:32-48.
15. Roshchina VV. New trends and perspectives in the evolution of neurotransmitters in microbial, plant, and animal cells. Adv Exp Med Biol. 2016;874: 25-77.

16. Silverman MN, Sternberg EM. Glucocorticoid regulation of inflammation and its functional correlates: From HPA axis to glucocorticoid receptor dysfunction. Annals New York Acad Sci. 2012;1261:55-63.

17. Hemarajata P, Versalovic J. Effects of probiotics on intestine microbiota: Mechanisms of intestinal immuno-modulation and neuromodula-tion. Therap Adv Gastroenterol. 2013;6 (1).

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