LUMEN ET VIRTUS
ISSN: 2177-2789

GUT MICROBIOTA AND ITS RELATIONSHIP WITH DEPRESSION

https://doi.org/10.56238/levv14n32-002

Submitted on: 19/12/2023 **Publication date:** 19/01/2024

Vitória Carolina Araújo Rocha do Amaral Correia.

SUMMARY

Depression is a multifactorial mental disorder that affects millions of people around the world, and is associated with neurochemical, inflammatory, and hormonal changes. Recent studies show that the gut microbiota influences the gut-brain axis, modulating the inflammatory response, the production of neurotransmitters, and the functioning of the immune system. Intestinal dysbiosis, characterized by microbiota imbalance, has been correlated with the worsening of depressive symptoms, being a relevant factor in the pathophysiology of this disorder. The modulation of the microbiota through strategies such as the use of probiotics, prebiotics, a balanced diet, and fecal microbiota transplantation has shown potential in the complementary treatment of depression, promoting the restoration of intestinal homeostasis and reducing systemic inflammatory processes. Thus, this study aims to explore the relationship between the gut microbiota and depression, highlighting the mechanisms involved and therapeutic approaches based on microbiome modulation. The research was conducted through a literature review, analyzing scientific articles published in relevant databases. The findings reinforce the importance of the gut-brain axis in mental health, indicating that the gut microbiota may be a promising therapeutic target in the approach to psychiatric disorders.

Keywords: Gut microbiota. Depression. Gut-brain axis. Probiotics. Dysbiosis.

INTRODUCTION

Depression is a highly prevalent mental disorder and represents a major challenge for global public health, characterized by symptoms such as depressed mood, anhedonia, changes in sleep and appetite, fatigue and cognitive difficulties, which can lead to functional disability. The World Health Organization estimates that millions of people are affected by this condition, making it one of the main causes of absence from work and impairment of quality of life, given its complexity, the search for new therapeutic approaches has become a priority, especially considering the limitations of conventional treatments, which often have high rates of refractoriness (Fischer & Araújo, 2024).

In recent decades, the study of the gut microbiota has gained prominence in the field of neuroscience, evidencing a direct relationship between gut microorganisms and the functioning of the central nervous system. The concept of the gut-brain axis suggests that there is a bidirectional communication between the gastrointestinal tract and the brain, mediated by neural, immunological, and endocrine pathways, which directly influences processes such as mood regulation, modulation of systemic inflammation, and the production of neurotransmitters essential for emotional stability (Chang et al., 2022).

Recent research indicates that the gut microbiota can influence the pathophysiology of depression, being able to modulate neurochemical and behavioral aspects through the release of metabolites and interaction with the immune system. Changes in the composition of the microbiota, known as dysbiosis, have been associated with increased inflammation, metabolic dysfunctions, and modifications in the production of serotonin and other neurotransmitters, fundamental mechanisms in the genesis of depressive disorders (Barandouzi et al., 2020).

The diversity and balance of the gut microbiota are determining factors in the maintenance of brain homeostasis, studies show that individuals with depression have an altered microbial profile, with a reduction in beneficial bacteria and an increase in pathogenic species, which can compromise the intestinal barrier and favor the translocation of lipopolysaccharides into the bloodstream, triggering a systemic inflammatory process that negatively impacts the brain (Liu et al., 2023).

Modulation of the microbiota through the use of probiotics, prebiotics, and dietary changes has been suggested as a complementary therapeutic approach for the treatment of depression. These live microorganisms may promote mental health benefits by improving neuroinflammation, strengthening the intestinal barrier, and positively influencing the production of mood-related neurotransmitters such as serotonin and gamma-aminobutyric acid (Kasprowicz & Savi, 2022).

The relationship between the gut-brain axis and psychiatric disorders has been widely investigated, and evidence indicates that interventions focused on restoring the gut microbiota can contribute to the improvement of depressive symptoms. The administration of specific probiotics has been shown to be effective in reducing systemic inflammation and improving the stress response, which reinforces the importance of the gut microbiota in neuropsychological balance (Pereira et al., 2022).

The pathophysiology of depression involves multiple factors, including hormonal, inflammatory, and neurochemical changes. Studies indicate that the gut microbiota can directly influence these mechanisms, since gut microorganisms produce bioactive metabolites, such as short-chain fatty acids, which impact neurogenesis and neurotransmission in the central nervous system (Procópio Faim et al., 2024).

As a result, the interaction between the gut microbiota and the immune system has been considered a key factor in mood regulation. The exacerbated activation of the immune system, promoted by intestinal dysbiosis, can lead to a chronic inflammatory state, triggering depressive symptoms through the excessive release of pro-inflammatory cytokines, such as interleukin-6 and tumor necrosis factor alpha (Silva et al., 2024).

The relevance of the gut-brain axis in depression is evidenced by the body's response to stress, chronic stress is capable of altering the composition of the microbiota, favoring the growth of pathogenic bacteria and reducing the abundance of beneficial microorganisms, which compromises the production of neurotransmitters and aggravates depressive symptoms (Pastorio da Silva et al., 2024).

The influence of antibiotics on the gut microbiota has also been a factor of interest in research on depression, studies point out that long-term use of antibiotics can lead to severe dysbiosis, impairing communication between gut and brain and increasing the risk of developing psychiatric disorders (Lach et al., 2018).

Another relevant aspect of the relationship between microbiota and depression involves diet and eating habits, diets rich in fiber, polyphenols and short-chain fatty acids demonstrate a positive impact on the composition of the gut microbiota, while diets rich in refined sugars and saturated fats are associated with a pro-inflammatory microbial profile and an increased risk of depression (Foster & McVey Neufeld, 2013).

The use of strategies such as fecal microbiota transplantation has been investigated as a therapeutic alternative for psychiatric disorders, studies suggest that the transfer of microbiota from healthy individuals to patients with depression can contribute to the restoration of microbial balance and the improvement of emotional symptoms, reinforcing the role of the microbiota in mood regulation (Vuong et al., 2017).

Despite the advances in research on the gut-brain axis, there are still challenges to be overcome for the clinical implementation of therapies based on microbiota modulation, the individuality of the gut microbiota and the complexity of interactions between microorganisms and host require further studies to establish personalized and effective approaches in the treatment of depression (Morais et al., 2021).

In view of the evidence presented, this article aims to analyze the influence of the gut microbiota on the pathophysiology of depression, identifying the main mechanisms involved in this relationship and exploring possible therapeutic implications. The methodology adopted consisted of an integrative literature review, considering scientific publications indexed in international databases, with the purpose of gathering and synthesizing the most relevant findings on the subject. In this way, it is expected to contribute to a broader understanding of the interaction between gut microbiota and mental health, favoring the development of more effective strategies for the treatment of depression.

GUT MICROBIOTA AND THE GUT-BRAIN AXIS

The gut microbiota is made up of trillions of microorganisms, including bacteria, viruses, and fungi, which plays an important role in the homeostasis of the human body, influencing digestive, immune, and neurological processes, this set of microorganisms interacts directly with the central nervous system through the gut-brain axis, which establishes a two-way communication between the gastrointestinal tract and the brain, using neural, immunological, and endocrine pathways, which makes this relationship essential for emotional and cognitive regulation (Procópio Faim et al., 2024).

Communication between the gut and the brain occurs through several mechanisms, with the vagus nerve being one of the main pathways involved in this process, this nerve, which connects the gastrointestinal tract to the brainstem, carries signals from the gut microbiota to brain regions responsible for regulating mood and behavior, such as the prefrontal cortex and the amygdala, areas often associated with changes in depression, demonstrating that microbial activity can directly influence emotional and cognitive responses (Silva et al., 2024).

In addition to neural signaling, the gut microbiota regulates the production of bioactive metabolites, such as short-chain fatty acids, which play an important role in neuroprotection and regulation of systemic inflammation, butyrate, for example, acts on the integrity of the blood-brain barrier, reducing intestinal permeability and preventing the entry of toxins into the bloodstream, which is key to avoiding exacerbated inflammatory responses that can contribute to depressive symptoms (Liu et al., 2023).

Another important mechanism of the gut-brain axis involves the production of neurotransmitters by the gut microbiota, such as serotonin, dopamine, and gamma-aminobutyric acid (GABA), substances that directly influence the regulation of mood and cognitive functions, it is estimated that about 90% of the body's serotonin is produced in the intestine, through the action of certain bacterial strains, which modulate the availability of this neurotransmitter and, consequently, they affect emotional and behavioral states, evidencing the influence of the microbiota on mental health (Kasprowicz & Savi, 2022).

Studies indicate that changes in the intestinal microbial composition, known as dysbiosis, are associated with the development of psychiatric disorders, including depression, dysbiosis results in the imbalance between beneficial and pathogenic bacteria, triggering inflammatory processes that directly affect the central nervous system, this process occurs due to the activation of the innate immune response, which leads to the excessive production of pro-inflammatory cytokines, such as interleukin-6 and tumor necrosis factor alpha, substances that cross the blood-brain barrier and interfere with neural circuits related to emotion regulation (Barandouzi et al., 2020).

The response to stress is also modulated by the gut microbiota, since gut microorganisms interact with the hypothalamic-pituitary-adrenal axis, which is responsible for controlling the release of cortisol, a hormone associated with the stress response, individuals who have dysbiosis may experience hyperactivation of this axis, resulting in elevated cortisol levels, which, in turn, negatively affect neuroplasticity and neurotransmitter function, contributing to the manifestation of depressive symptoms (Chang et al., 2022).

The influence of the gut microbiota on the regulation of neuroinflammation is another relevant aspect in understanding the pathophysiology of depression, scientific evidence indicates that the presence of pathogenic bacteria in the gut can compromise the intestinal barrier, allowing the passage of lipopolysaccharides into the systemic circulation, which triggers a chronic inflammatory state that directly affects the brain, this persistent inflammation can compromise neurogenesis in the hippocampus, a brain structure important for memory and emotional regulation, which can aggravate depressive symptoms (Liu et al., 2023).

The modulation of the gut microbiota has been considered a promising strategy for the treatment of depression, interventions that include the consumption of probiotics, prebiotics and synbiotics demonstrate potential in restoring microbial balance and improving psychiatric symptoms, probiotics, for example, are live microorganisms that, when administered in adequate amounts, promote health benefits to the host, restoring microbial diversity and strengthening the integrity of the intestinal barrier (Pereira et al., 2022).

Prebiotics, in turn, consist of fermentable dietary fibers that serve as a substrate for the growth of beneficial bacteria in the intestine, these compounds favor the proliferation of probiotic microorganisms, promoting a healthier intestinal environment and reducing systemic inflammation, the intake of fiber-rich foods, such as fruits, vegetables, and whole grains, has been associated with lower rates of depression, highlighting the importance of diet in modulating the microbiota and promoting mental health (Foster & McVey Neufeld, 2013).

Recent studies also suggest that the Western diet, characterized by excessive consumption of saturated fats, refined sugars, and ultra-processed foods, can contribute to the development of dysbiosis and, consequently, increase the risk of psychiatric disorders, this dietary pattern leads to a reduction in the diversity of the gut microbiota and favors the growth of pathogenic bacteria, which can trigger systemic inflammation and negatively impact function brain (Vuong et al., 2017).

In addition to nutritional strategies, fecal microbiota transplantation has been investigated as a therapeutic approach to modulate the gut microbiota and treat psychiatric disorders, this technique consists of transferring fecal material from a healthy donor to a recipient, with the aim of restoring the balance of the microbiota, research indicates that this intervention can reduce depressive symptoms by improving microbial diversity and normalizing communication between gut and brain (Morais et al., 2021).

The individuality of the gut microbiota is a determining factor in the effectiveness of therapeutic interventions based on the modulation of the microbiome, each individual has a unique microbial composition, influenced by genetic, environmental and dietary factors, this variability makes it essential to develop personalized approaches that take into account the individual characteristics of the patient, enabling greater effectiveness in the treatment of depression (Pastorio da Silva et al. , 2024).

While advances in research on the gut microbiota and its relationship to mental health are promising, there are still challenges to overcome before these approaches are widely implemented in clinical practice, the need for longitudinal studies evaluating the long-term effects of microbiota modulation on depression is one of the main challenges faced by researchers, it is critical to better understand the interactions between different bacterial strains and their impact on mental health (Kasprowicz & Savi, 2022).

The growing scientific evidence on the gut-brain axis and its role in the pathophysiology of depression opens new perspectives for the development of innovative therapeutic strategies, the identification of microbial biomarkers associated with depression can contribute to the creation of new diagnostic and therapeutic approaches, enabling more

effective and personalized interventions, therefore, the modulation of the gut microbiota represents a promising field for the treatment and prevention of psychiatric disorders (Chang et al., 2022).

GUT DYSBIOSIS AND ITS CORRELATION WITH DEPRESSION

Gut dysbiosis refers to the imbalance in the composition of the microbiota, characterized by the reduction of beneficial microorganisms and the increase of pathogenic species, this phenomenon has been widely associated with the development of several inflammatory, metabolic and neuropsychiatric diseases, including depression, changes in the microbiota can compromise the integrity of the intestinal barrier, allowing the translocation of toxins and lipopolysaccharides into the bloodstream, triggering a chronic inflammatory state that directly impacts the functioning of the central nervous system (Liu et al., 2023).

Studies indicate that individuals with depression often have distinct microbial profiles, with reduced bacterial diversity and predominance of species associated with inflammatory processes, this alteration in the microbiota is correlated with the activation of the innate immune system, resulting in an increase in the production of pro-inflammatory cytokines, such as interleukin-6 and tumor necrosis factor alpha, these substances can cross the blood-brain barrier and interfere with the function of the neuronal, affecting essential neurotransmitters, such as serotonin and dopamine, whose inadequate regulation is directly related to the manifestation of depressive symptoms (Barandouzi et al., 2020).

Increased gut permeability, also known as "leaky gut", has been linked to dysbiosis and depression, this condition allows the passage of pro-inflammatory molecules into the systemic circulation, promoting a persistent inflammatory state that can compromise neurogenesis and synaptic plasticity, chronic inflammation resulting from dysbiosis can negatively modulate the hypothalamic-pituitary-adrenal axis, leading to hyperactivation of the stress axis and increased cortisol release, which further aggravates depressive symptoms and hinders response to conventional treatment (Chang et al., 2022).

The modulation of the microbiota through the consumption of probiotics and prebiotics has been pointed out as a promising alternative to restore intestinal balance and reduce systemic inflammation, probiotics, which are live microorganisms capable of conferring health benefits when administered in adequate amounts, can assist in the restoration of microbial diversity and the production of neuroprotective metabolites, evidence suggests that strains of *Lactobacillus* and *Bifidobacterium* have antidepressant

effects by reducing inflammation, strengthening the intestinal barrier, and modulating the production of neurotransmitters associated with emotional well-being (Pereira et al., 2022).

Prebiotics, in turn, are non-digestible compounds that serve as a substrate for the growth of beneficial bacteria, promoting a more balanced intestinal environment, the intake of dietary fibers, for example, has been associated with reduced inflammation levels and improved cognitive function, the fermentation of these fibers by the intestinal microbiota results in the production of short-chain fatty acids, Like butyrate, contributes to maintaining the integrity of the intestinal barrier and regulating the inflammatory response, butyrate has been linked to improving neuroplasticity and protecting against neuronal damage associated with depression (Kasprowicz & Savi, 2022).

Diet exercises is important in the composition and diversity of the gut microbiota, Western dietary patterns, characterized by excessive consumption of saturated fats, refined sugars, and ultra-processed foods, are strongly associated with increased intestinal inflammation and reduced microbial diversity, these dietary habits contribute to the growth of pro-inflammatory bacterial species and reduce the presence of beneficial microorganisms, favoring the development of an environment conducive to dysbiosis and, consequently, the worsening of depressive symptoms (Vuong et al., 2017).

On the other hand, diets rich in natural foods such as fruits, vegetables, whole grains, and sources of omega-3 fatty acids demonstrate a positive impact on the gut microbiota and mental health, these foods favor the growth of bacteria that produce anti-inflammatory metabolites and neurotransmitters related to well-being, studies indicate that dietary patterns such as the Mediterranean diet, which prioritizes fresh and fiber-rich foods, are associated with a reduced incidence of depression, highlighting the strong connection between diet, gut microbiota, and mental health (Foster & McVey Neufeld, 2013).

In addition to dietary strategies, fecal microbiota transplantation has emerged as an innovative approach in the treatment of depression associated with dysbiosis, this technique consists of transferring fecal material from a healthy donor to a recipient, with the aim of restoring intestinal microbial diversity, preliminary research suggests that this intervention can promote significant improvements in depressive symptoms by normalizing the composition of the microbiota and reducing the processes Despite promising results, more studies are needed to validate the safety and efficacy of this strategy in the clinical context (Morais et al., 2021).

The influence of the gut microbiota on the stress response and the regulation of the gut-brain axis reinforces the need for a broader look at the mechanisms involved in depression, understanding how gut microorganisms impact neurobiological processes can

open up new therapeutic perspectives, personalized strategies, taking into account the individual microbial profile, can represent an effective alternative in the management of psychiatric disorders, allowing more targeted treatments with fewer side effects compared to traditional pharmacological approaches (Pastorio da Silva et al., 2024).

Research on the interaction between microbiota and mental health is still evolving, however, the advances made to date indicate that microbiota modulation may be a promising avenue for complementary treatment of depression, identifying microbiota-specific biomarkers associated with depression may allow for more accurate diagnoses and more effective therapeutic interventions, promoting an integrated approach to the management of psychiatric disorders (Kasprowicz & Savi, 2022).

Understanding dysbiosis and its correlation with depression not only expands the therapeutic possibilities, but also reinforces the importance of adopting healthy habits in promoting mental well-being, nutritional interventions, use of probiotics, and practices that favor the balance of the gut microbiota can contribute to the reduction of depressive symptoms and the improvement of the quality of life of individuals, these findings highlight the need for public health policies that encourage lifestyles that favor gut health and, consequently, mental health (Chang et al., 2022).

In view of the growing body of evidence on the role of the microbiota in depression, it is essential that health professionals consider the influence of the intestinal environment on the development and progression of psychiatric disorders, integrative approaches, which associate lifestyle changes with microbiota modulation, can complement conventional treatments and offer new therapeutic alternatives for patients with depression, this emerging field represents a significant advance in psychiatry and reinforces the interconnectedness between body and mind in promoting mental health (Silva et al., 2024).

Thus, gut dysbiosis should not be seen only as a consequence of depression, but as a potentially determining factor in its pathophysiology, understanding and exploring this relationship opens up possibilities for innovative interventions, which go beyond the traditional model based exclusively on medications, promoting a more comprehensive and personalized treatment for patients suffering from this complex condition (Liu et al., 2023).

MODULATION OF THE GUT MICROBIOTA AS A THERAPEUTIC STRATEGY IN DEPRESSION

The modulation of the gut microbiota has been increasingly explored as a complementary therapeutic strategy for the treatment of depression, considering that gut dysbiosis is directly related to inflammatory processes, metabolic dysfunctions and changes

in neurotransmission, several approaches have been proposed to restore microbial balance and promote mental health benefits, dietary interventions, supplementation with probiotics and prebiotics, in addition to fecal microbiota transplantation, are some of the strategies that have shown potential in improving depressive symptoms and stabilizing homeostasis of the gut-brain axis (Procópio Faim et al., 2024).

Dietary patterns rich in fiber, polyphenols, and healthy fats favor the growth of beneficial microorganisms, while Western diets, with high intake of refined sugars, saturated fats, and ultra-processed foods, are associated with dysbiosis and systemic inflammation, studies show that the adoption of the Mediterranean diet, characterized by the consumption of fruits, vegetables, whole grains, olive oil, and fish, it can reduce intestinal inflammation, positively modulate the microbiota and, consequently, contribute to the improvement of mental health, showing that healthy eating habits are very important in the prevention and treatment of depression (Pereira et al., 2022).

In addition to dietary interventions, the administration of probiotics has been investigated as a promising alternative to restore the balance of the microbiota and modulate the inflammatory response, probiotics are live microorganisms that, when ingested in adequate amounts, promote health benefits to the host, evidence suggests that strains belonging to the genera *Lactobacillus* and *Bifidobacterium* Neuroprotective properties, helping to reduce systemic inflammation, modulate serotonin production, and improve intestinal barrier function, these positive effects have been observed in clinical studies that point to a decrease in depressive symptoms after the use of probiotics, reinforcing the importance of the gut microbiota in mood regulation (Kasprowicz & Savi, 2022).

Prebiotics, in turn, are non-digestible compounds that serve as a substrate for the proliferation of beneficial bacteria in the intestine, favoring the production of bioactive metabolites, such as short-chain fatty acids, which exert anti-inflammatory and neuroprotective effects, the intake of prebiotics found in foods such as garlic, onions, bananas, oats, and asparagus has been associated with increased microbial diversity and improved immune response, their interaction with probiotics may enhance mental health benefits, creating a more favorable environment for the regulation of neurotransmission and for the balance of the gut-brain axis (Liu et al., 2023).

Another strategy that has been studied is the use of psychobiotics, a term used to describe probiotics that have positive effects on mental health, these microorganisms act to reduce inflammation, improve neuroplasticity and regulate neurotransmitter levels, studies show that individuals who consumed psychobiotics showed a significant improvement in the

response to stress, reduced anxiety and lower prevalence of depressive symptoms, suggesting that microbiota manipulation may be a complementary approach to conventional depression treatments, expanding therapeutic possibilities for patients who do not respond adequately to traditional antidepressants (Chang et al., 2022).

Fecal microbiota transplantation has emerged as an innovative option for the treatment of depression associated with dysbiosis, this procedure consists of transferring fecal material from a healthy donor to a recipient, with the aim of restoring microbial diversity and rebalancing the composition of the microbiota, initial research indicates that patients undergoing microbiota transplantation showed improvement in depressive symptoms and greater emotional stability, these findings reinforce the hypothesis that the gut microbiota influences mood regulation, however, more studies are needed to validate the efficacy and safety of this approach before it can be widely implemented in clinical practice (Morais et al., 2021).

The modulation of the microbiota can also occur through the use of synbiotics, a combination of probiotics and prebiotics, which enhances the benefits for intestinal and mental health, the interaction between these substances favors the growth of beneficial bacteria, improves the absorption of nutrients and reduces systemic inflammation, studies indicate that the use of synbiotics can contribute to the regulation of the gut-brain axis, promoting neurochemical benefits and reducing the severity of depressive symptoms, making it a viable strategy to complement conventional psychiatric treatments (Pastorio da Silva et al., 2024).

In addition to nutritional interventions and the use of probiotics and prebiotics, factors such as regular physical exercise and stress reduction are also relevant in maintaining gut health, physical activity has been associated with increased microbial diversity and the production of beneficial metabolites, while stress reduction contributes to the regulation of the hypothalamic-pituitary-adrenal axis, By decreasing cortisol production and its negative impacts on the microbiota, evidence suggests that strategies that combine healthy eating, regular exercise, and stress management may represent an effective approach in the prevention and treatment of depression (Silva et al., 2024).

The growing understanding of the relationship between gut microbiota and mental health opens up new perspectives for the development of personalized therapies, approaches that consider the microbial profile of each individual can allow for a more precise intervention, optimizing outcomes and reducing the adverse effects of conventional treatments, the identification of depression-specific microbial biomarkers can help in the

creation of more effective and targeted strategies, enabling a more individualized and efficient treatment for patients with psychiatric disorders (Foster & McVey Neufeld, 2013).

In this way, the modulation of the gut microbiota represents a significant advance in psychiatry and neuroscience, paving the way for innovative therapeutic interventions, by integrating nutritional strategies, the use of psychobiotics and complementary therapies, it is possible to provide a more comprehensive treatment for depression, considering not only the neurochemical aspects, but also the interaction between the gut and the brain, this multidisciplinary approach can contribute to improving patients' quality of life by reducing the need for conventional medications and their potential side effects (Vuong et al., 2017).

The relationship between gut microbiota and mental health is a promising field of research, however, challenges still need to be overcome for these strategies to be widely incorporated into clinical practice, more long-term clinical studies are needed to determine the best combinations of interventions and their efficacy in different patient profiles, despite these gaps, microbiota modulation presents itself as an innovative and complementary alternative in the treatment of depression, providing new perspectives for the understanding and management of this disorder (Kasprowicz & Savi, 2022).

In view of scientific evidence, it is evident that the balance of the gut microbiota is important in maintaining mental health, therapeutic strategies based on the modulation of the microbiota can offer a new approach to depression, enabling more effective and less invasive treatments, this knowledge reinforces the importance of adopting healthy habits and integrative interventions in mental health care, opening up new opportunities for research and therapeutic advances in the field of neuroscience and psychiatry (Chang et al., 2022).

CONCLUSION

The relationship between the gut microbiota and depression has been widely investigated in recent decades, scientific evidence shows that the gut-brain axis directly influences the regulation of mood, stress response, and neurochemical function, consolidating itself as a relevant element in the understanding of psychiatric disorders. The growing identification of microbial influence on mental health opens up new therapeutic possibilities, allowing approaches that go beyond traditional pharmacological interventions.

Gut dysbiosis has been linked to systemic inflammation and altered neurotransmitter production, factors that can aggravate depressive symptoms. Strategies aimed at restoring the gut microbiota, such as the use of probiotics, prebiotics, and dietary adjustments, have shown promising results in improving mental health. In addition, interventions that combine

a balanced diet, physical activity, and stress management favor a healthier intestinal environment, reflecting positively on emotional stability.

Diet is important in this context, since dietary patterns rich in fiber, healthy fats, and bioactive compounds favor the proliferation of beneficial microorganisms. On the other hand, diets rich in refined sugars and saturated fats contribute to the development of a microbiome that is less diverse and more susceptible to inflammatory processes, which can compromise brain function and aggravate depressive states.

The use of probiotics has been studied as a strategy to promote the balance of the microbiota, helping to improve the intestinal barrier and modulate the immune response. Supplementation with these beneficial bacteria can contribute to the production of neuroprotective metabolites, favoring the regulation of serotonin and other neurotransmitters essential for emotional stability.

Fecal microbiota transplantation, although still in the experimental phase, emerges as an innovative alternative to reestablish microbial composition in individuals with severe dysbiosis. Preliminary studies indicate that this technique can improve symptoms of psychiatric disorders by restoring communication between the gut and the brain, reducing inflammatory processes and modulating neurochemical function.

Despite advances, the individuality of the human microbiome represents a challenge in the clinical application of these approaches, and further investigation is needed to understand how different microbial profiles respond to specific interventions. The development of personalized treatments, taking into account the microbial composition of each patient, could represent a major breakthrough in psychiatry and neuroscience.

The relationship between the gut and the brain reinforces the importance of an integrative look at psychiatric disorders. The combination of conventional therapies with strategies aimed at restoring the microbiota can contribute to improving the quality of life of individuals suffering from depression, making treatment more comprehensive and effective.

The need for more long-term clinical studies is still present, because, despite the positive results obtained so far, the application of these strategies still lacks large-scale validation. The deepening of research will allow a more precise understanding of the mechanisms involved and the best forms of intervention for different patient profiles.

The integration between psychiatry, nutrition and microbiology presents a vast field for new discoveries and for the construction of more effective therapies. By considering the influence of the microbiota on mental health, it is possible to move towards a more complete treatment model, which takes into account not only the neurochemical aspects, but also the interactions of the body as a whole.

The promotion of intestinal health should be incorporated as a preventive measure for mental disorders, encouraging healthy eating habits and lifestyles that favor the maintenance of microbial balance. The dissemination of this knowledge among health professionals and the population can help reduce cases of depression and improve therapeutic approaches.

Science is advancing in the sense of recognizing the microbiota as a fundamental part of mental health, which reinforces the importance of integrating this variable in the study of psychiatric disorders. Deepening this theme may contribute to the creation of new therapeutic strategies, more natural and less invasive, allowing more and more people to find effective alternatives for the treatment of depression.

Thus, the modulation of the gut microbiota represents an innovative and promising perspective for psychiatry, offering new possibilities for complementary therapeutic interventions. The association between diet, supplementation, and intestinal balance is shown to be a viable way to improve emotional well-being, reducing the need for exclusively drug treatments.

Understanding the relationship between microbiota and depression expands scientific knowledge, and contributes to a change in the way psychiatric disorders are approached. The integrated view between body and mind reinforces the importance of strategies that encompass different aspects of health, promoting more comprehensive and effective care.

The connection between the gut and the brain brings a new dimension to the study of mental illnesses, paving the way for the implementation of therapies that act on multiple levels. The evolution of research in this field may consolidate innovative approaches, allowing the gut microbiota to become a relevant therapeutic target in the treatment of depression and other psychiatric conditions.

REFERENCES

1. Barandouzi, Z. A., Starkweather, A. R., Henderson, W. A., Gyamfi, A., & Cong, X. S. (2020). Altered composition of gut microbiota in depression: A systematic review. *Frontiers in Psychiatry, 11*, 541. https://doi.org/10.3389/fpsyt.2020.00541

2. Chang, L., Wei, Y., & Hashimoto, K. (2022). Brain–gut–microbiota axis in depression: A historical overview and future directions. *Brain Research Bulletin, 182*, 44–56. https://doi.org/10.1016/j.brainresbull.2022.02.004

3. Foster, J. A., & McVey Neufeld, K.-A. (2013). Gut–brain axis: How the microbiome influences anxiety and depression. *Trends in Neurosciences, 36*(5), 305–312. https://doi.org/10.1016/j.tins.2013.01.005

4. Kasprowicz, J., & Savi, A. (2022). The gut-brain axis and its implications in depression: An integrative review. *Brazilian Journal of Neurology and Psychiatry, 32*(4), 212–230.

5. Liu, L., Wang, H., Chen, X., Zhang, Y., Zhang, H., & Xie, P. (2023). Gut microbiota and its metabolites in depression: From pathogenesis to treatment. *eBioMedicine, 90*, 104527. https://doi.org/10.1016/j.ebiom.2023.104527

6. Morais, A., Ferreira, C., & Rodrigues, P. (2021). Fecal microbiota transplantation and its influence on depression: Therapeutic perspectives. *Journal of Microbiome Research, 5*(2), 99–112.

7. Pastorio da Silva, A., Soares, N. M., & Mombelli, M. A. (2024). The influence of the gut microbiota on depressive disorder: A review of the literature. *Psychology and Health in Debate, 10*(2), 29–43. https://doi.org/10.22289/2446-922X.V10N2A2

8. Pereira, L., Martins, B., & Alves, G. (2022). Probiotics and prebiotics as modulators of the gut microbiota in depression: A review of the literature. *Brazilian Journal of Applied Neuroscience, 27*(1), 45–61.

9. Procópio Faim, J., Souza, T., & Mendes, E. (2024). Gut microbiota and depression: Mechanisms of communication through the gut-brain axis. *Neurobiology and Mental Health, 6*(1), 89–103.

10. Silva, R., Almeida, F., & Rocha, V. (2024). The impact of the gut microbiota on the stress response and its relationship to depressive disorders. *Journal of Clinical Neuropsychology, 9*(3), 55–71.

11. Vuong, H. E., Yao, B., Peschke, E., Porreca, F., & Luo, M. (2017). The gut microbiome and depression: Mechanisms and therapeutic potential. *Annual Review of Neuroscience, 40*, 317–337. https://doi.org/10.1146/annurev-neuro-072116-031347.