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UNVEILING THE MIND-GUT CONNECTION: A MINI-REVIEW ON PSYCHOBIOTICS

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ABSTRACT

The emerging domain of psychobiotics introduces an innovative framework in mental health treatments by leveraging the reciprocal interaction between the gut bacteria and the brain. The therapeutic benefits of psychobiotics, which include probiotics and prebiotics, on mental well-being are mediated through complex interactions with the gut microbiota and numerous neuroactive pathways. This brief analysis delves into the present comprehension of psychobiotics and their prospective uses in mental health. The available body of research indicates that psychobiotics exhibit potential in mitigating symptoms associated with anxiety, sadness, and stress-related pathologies. Mechanistic insights demonstrate their capacity to regulate the generation of neurotransmitters, control stress response systems, and improve the integrity of the gut barrier. Even with the encouraging results, additional investigation is necessary to clarify the most effective formulations and tailored interventions. The utilization of psychobiotics in mental health therapy holds great potential since it presents a natural and productive approach to enhancing mental well-being and supplementing conventional treatments.

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1. INTRODUCTION

The complex interplay between the gastrointestinal tract and the central nervous system has received considerable scholarly interest recently, as new investigations have provided insights into the impact of gut bacteria on mental well-being. Psychobiotics have emerged as a viable route among the different therapies addressing the gut-brain axis. When consumed in sufficient quantities, these living microbes provide mental health advantages by interacting with the gut microbiota. This brief review delves into the present comprehension of psychobiotics and their prospective utilization in mental health.

2. PSYCHOBIOTICS AND MENTAL HEALTH

Emerging research indicates that the gut microbiota significantly influences brain function and behavior regulation via multiple mechanisms, such as the gut-brain axis, the immune system, and neurotransmitter synthesis. Psychobiotics are a class of drugs that essentially comprise probiotics, which are live beneficial bacteria, and prebiotics, which are substances that facilitate the growth of beneficial bacteria. These substances can regulate the makeup and activity of the gut microbiota, thereby influencing mental well-being.

Scientific research has shown that psychobiotics are effective in reducing symptoms of anxiety, sadness, and stress-related ailments. In preclinical models and clinical trials, it has been demonstrated that specific strains of Lactobacillus and Bifidobacterium can mitigate anxiety-like behavior and alleviate symptoms associated with

depression. In addition, prebiotics such as inulin and oligofructose have been linked to mood and cognitive function enhancements.

3. MECHANISM OF ACTION

The psychobiotic effects are attributable to a complex interplay between the gut bacteria and the host, involving multiple mechanisms. The administration of psychobiotics has the potential to regulate the synthesis of neurotransmitters, including serotonin and gamma-aminobutyric acid (GABA), which are crucial for regulating mood. Moreover, they can impact the synthesis of short-chain fatty acids (SCFAs), which are microbial byproducts that possess anti-inflammatory and neuroprotective characteristics.

Table 1. Mechanism of action of psychobiotics

Bacteria	Model	dose	findings	Possible Mechanism
Bacillus coagulans MTCC 5856	Clinical trial 2	billion spores	Robust efficacy for the treatment of patients experiencing IBS symptoms with major depressive disorder	Production of SCFAsand antimicrobial and anti-inflammatory substances.
Bifidobacterium longum 1714	Clinical trial	1 × 109 CFU/day	Reduced stress and improved memory	Brain-Derived Neurotrophic Factor (BDNF) synthesis through vagal activity
Bifidobacterium longum NCC300	Clinical trial	1 × 1010 CFU/g	Reduction in depression scores on Hospital Anxiety and Depression Scale and reduced responses to negative emotional stimuli in multiple brain areas	Release of neuroactive compounds through vagal signaling as well as BDNF regulation.
Clostridium butyricum MIYAIRI 588	Clinical trial	60 mg/day	In combination with antidepressants, is effective in the treatment of treatment-resistant major depressive disorder.	Regulation of proinflammatory agents.
Lactobacillus casei Shirota	Clinical trial	1 × 109 over 8 weeks	Decrease in the cognitive state anxiety scores, somatic state, and perceived stress scale.	
Lactobacillus casei Shirota	Clinical trial	100 mL of a fermented beverage containing more than 1 × 109 CFU/mL/day	Salivary cortisol and plasma L-tryptophan levels were increased in the placebo group, while the experimental group had higher fecal serotonin levels. Lower rate of subjects experiencing common abdominal and cold symptoms, and total number of days experiencing these physical symptoms	Hypothalamic-pituitary-adrenal (HPA) axis modulation and promotion of serotonin synthesis
Lactobacillus gasseri CP2305	Clinical trial	1 × 1010 CFU	Stress-associated behaviors were improved, as well as the sleeping quality. The parabiotic	Regulation of inflammation mechanisms.

			administration also prevented increases in basal salivary cortisol release and expression of stress-responsive microRNAs	
Lactobacillus casei Shirota	Clinical trial and in vivo murine model	Milk fermented with 1 × 109 CFU/mL	Increases in salivary cortisol levels and incidence rate of physical symptoms were significantly suppressed. In rats, water avoidance stress-induced increases in plasma corticosterone were suppressed, and the number of corticotrophin-releasing factor-expressing cells in the paraventricular nucleus was reduced.	HPA axis regulation
Bifidobacterium breve 1205	In vivo murine model	1 × 109 CFU/mL	Reduced anxiety in the marble-burying test and induced lower anxiety in the elevated plus maze	Immune system regulation and gut hormones secretion.
Bifidobacterium breve CCFM1025	In vivo murine model	0.1 mL/10 g body weight daily at 1 × 109 CFU/mL	Reduced depression and anxiety behaviors. The hyperactive HPA response and inflammation were also alleviated. Expression of the brain-derived neurotrophic factor was increased, while chronic stress was restored.	Capacity of SCFAs to improve serotonin levels, and regulation of the HPA axis and BDNF synthesis.
Bifidobacterium infantis 35624	In vivo murine model	1 × 1010 live bacterial cells/100 mL drinking/day	Normalization of the immune response, reversal of behavioral deficits, and restoration of basal noradrenaline concentrations in the brain.	Anti-inflammatory properties.
Bifidobacterium longum 1714	In vivo murine model	1 × 109 CFU/mL	Reduced anxiety in the marble-burying test; decreased stress-induced hyperthermia, lower anxiety in the elevated plus maze, and antidepressant-like behavior in the tail suspension test.	Immune system regulation and gut hormones secretion.
Faecalibacterium prausnitzii ATCC 27766	In vivo murine model	1 × 109 CFU by oral gavage	Preventive and therapeutic effects on depression and anxiety behavior, higher levels of SCFAs in the cecum, and higher levels of	SCFAs synthesis, immune system stimulation, and HPA axis regulation.

			cytokines interleukin-10 in the plasma. Corticosterone, C-reaction protein, and Interleukin-6 levels were normalized.	
Lactobacillus helveticus NS8	In vivo murine model	1 × 109 CFU/mL in drinking water	The anxiolytic effect in hyperammonia-treated rats was associated with a reduction in hippocampal serotonin 5-HTP levels.	Downregulation of inflammation and serotonin metabolism
Lactobacillus plantarum ATCC 8014	In vivo murine model	Bacterial suspensions at 1 × 107 CFU/mL	Favorable effects on oxidative markers of the blood and amygdala, as well as on concentrations of amygdala serotonin and brain-derived neurotrophic factor (BDNF). Beneficial effects were observed on the elevated plus maze and forced swimming tests.	HPA axis downregulation due to oxidative stress reduction.

Moreover, it has been demonstrated that psychobiotics can modulate the hypothalamic-pituitary-adrenal (HPA) axis, which serves as the principal stress response mechanism. Consequently, they can alleviate the adverse consequences of prolonged stress on mental well-being. Furthermore, these substances have the potential to improve the structural integrity of the gastrointestinal barrier and reduce systemic inflammation, both of which have been linked to the development of mood disorders.

4. FUTURE DIRECTIONS

Although the initial results of psychobiotics show promise, there are still some unresolved inquiries. Subsequent investigations ought to prioritise the clarification of the most effective strains, doses, and duration of psychobiotic therapies for diverse mental health disorders. Furthermore, there is significant promise in optimising therapeutic outcomes through the advancement of personalised psychobiotic therapies that are tailored to individual gut microbiota patterns.

5. CONCLUSION

Psychobiotics offer a new and encouraging method for enhancing mental well-being by specifically targeting the connection between the gut and the brain. By modulating the gut microbiota and activating multiple neuroactive pathways, psychobiotics can alleviate symptoms of anxiety, depression, and stress-related diseases. With the ongoing advancement of research in this area, psychobiotics have the potential to become effective supplements to traditional treatments for mental health disorders, providing optimism for a more promising future in psychobiotic-based therapies.

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COMPETING INTEREST

The authors declare no conflict of interest.

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