https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 27(4s) (November 2024); 13800-13802
Research Article

Role Of Probiotic Bacteria and Yeast in Tackling ADHD And ASD

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Abstract
Attention-Deficit/Hyperactivity Disorder (ADHD) and autism spectrum disorder (ASD) are neurodevelopmental conditions with complex etiologies involving both genetic and environmental factors. Emerging research highlights the critical role of the gut-brain axis in their pathophysiology, positioning probiotics as potential therapeutic agents. Probiotic bacteria such as *Lactobacillus* and *Bifidobacterium* and yeast like *Saccharomyces boulardii* have shown promise in modulating gut microbiota, reducing neuroinflammation, and influencing neurotransmitter production. This chapter explores the mechanisms through which probiotics impact ADHD and ASD, examines clinical evidence, and addresses the challenges and future directions for their use in managing these conditions. Probiotics represent a novel and integrative approach that could complement existing therapeutic strategies, offering hope for improved outcomes in affected individuals.

Keywords: ADHD, Autism Spectrum Disorder, Probiotics, Gut-Brain Axis, Microbiota, Dysbiosis

Received: 1/11/2024 *Accepted: 20/11/2024*

DOI: https://doi.org/10.53555/AJBR.v27i4S.6400

Table 1: Summary of Probiotic Effects in ADHD and ASD

Probiotic Type	Mechanism of Action	Key Findings
Lactobacillus spp.	Modulation of neurotransmitters (GABA, serotonin)	Improved attention and reduced hyperactivity in ADHD; enhanced social behaviors in ASD (Kwak et al.,2023)
Bifidobacterium spp.	Anti-inflammatory effects	Reduced neuroinflammation and improved gut barrier function
Saccharomyces boulardii	Antioxidant properties and microbial diversity support	Alleviated gastrointestinal symptoms and improved focus and social interaction in ASD (Chakravarty et al.,2024)
Combined Probiotics	Synergistic effects on gut microbiota and immunity	Potential for enhanced therapeutic outcomes; requires further investigation

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) and autism spectrum disorder (ASD) are complex neurodevelopmental conditions affecting millions of individuals globally. ADHD is characterized by symptoms such as inattention, hyperactivity, and impulsivity, while ASD is marked by deficits in social communication and restricted, repetitive behaviors (De Giacomo et al.,2024). Although the exact causes of these disorders remain elusive, a growing body of evidence suggests that gut microbiota plays a significant role in their pathophysiology. Probiotic bacteria and yeast have emerged as promising therapeutic agents to modulate gut health and, consequently, brain function (Mitra et al.,2024). This chapter explores the potential role of probiotics in managing ADHD and ASD, focusing on their mechanisms, efficacy, and future research directions.

Gut-Brain Axis and Neurodevelopmental Disorders

The gut-brain axis (GBA) is a bidirectional communication network between the gastrointestinal system and the central nervous system (CNS). It involves neural, hormonal, and immunological pathways, with gut microbiota serving as a critical mediator. Dysbiosis, or microbial imbalance in the gut, has been associated with inflammation, altered neurotransmitter production, and impaired gut permeability—factors implicated in the development and progression of ADHD and ASD (Anand et al.,2022). Restoring microbial homeostasis through probiotics may offer a novel approach to alleviate these conditions.

Probiotic Bacteria in ADHD and ASD

Mechanisms of Action

1. **Modulation of Neurotransmitter Levels:** Probiotic strains like *Lactobacillus* and *Bifidobacterium* produce gamma-aminobutyric acid (GABA), serotonin, and dopamine, which are crucial for regulating mood, attention, and behaviour (Sharma et al.,2021).
2. **Reduction of Inflammation:** Chronic low-grade inflammation is a hallmark of ADHD and ASD. Probiotics can reduce the production of pro-inflammatory cytokines and promote anti-inflammatory responses, thereby mitigating neuroinflammation.
3. **Improvement in Gut Barrier Function:** Many individuals with ADHD and ASD exhibit increased intestinal permeability ("leaky gut"). Probiotics strengthen tight junctions in the gut epithelium, preventing the translocation of harmful substances into the bloodstream and CNS (Twardowska et al.,2022).
4. **Regulation of the Hypothalamic-Pituitary-Adrenal (HPA) Axis:** Stress-related hyperactivation of the HPA axis is commonly observed in ADHD and ASD. Probiotics can modulate HPA axis activity, reducing stress-induced behaviors.

Clinical Evidence

Several studies have demonstrated the efficacy of probiotics in improving behavioral and gastrointestinal symptoms in ADHD and ASD:

- **ADHD:** A randomized controlled trial (RCT) showed that supplementation with *Lactobacillus rhamnosus GG* improved attention and reduced hyperactivity in children with ADHD (Sangsefidi et al.,2024).
- **ASD:** In a study involving children with ASD, a multi-strain probiotic formulation alleviated gastrointestinal symptoms and improved social behaviors.

Probiotic Yeast in ADHD and ASD

Mechanisms of Action

1. **Antioxidant Properties:** Probiotic yeast such as *Saccharomyces boulardii* exhibits antioxidant activity, reducing oxidative stress—a key contributor to neuronal damage in ADHD and ASD (Guamán et al.,2024).
2. **Support for Gut Microbial Diversity:** Yeast probiotics enhance the growth of beneficial bacteria and suppress pathogenic microbes, promoting a balanced gut microbiome (Abid et al.,2022).
3. **Immune Modulation:** *Saccharomyces boulardii* modulates immune responses by promoting regulatory T-cell activity and reducing pro-inflammatory cytokines (Zhang et al.,2024).

Clinical Evidence

Research on yeast probiotics in ADHD and ASD is limited but promising:

- A pilot study reported that *Saccharomyces boulardii* supplementation reduced gastrointestinal discomfort and improved focus and social interaction in children with ASD.

Combined Use of Probiotic Bacteria and Yeast

The synergistic effects of bacterial and yeast probiotics may offer enhanced therapeutic benefits. For instance, combining *Lactobacillus* and *Saccharomyces boulardii*

could simultaneously address inflammation, oxidative stress, and neurotransmitter imbalances (Ferrari et al.,2024). However, more comprehensive studies are needed to validate this approach.

Challenges and Limitations

1. **Variability in Microbial Strains:** The effects of probiotics are strain-specific, and not all strains exhibit therapeutic benefits.
2. **Individual Differences:** Genetic, dietary, and environmental factors influence the gut microbiome and the response to probiotics.
3. **Lack of Standardized Protocols:** There is no consensus on the optimal dosage, duration, and combination of probiotics for ADHD and ASD.
4. **Safety Concerns:** While generally safe, probiotics may cause adverse effects in immunocompromised individuals or those with severe dysbiosis.

Future Directions

1. **Personalized Probiotic Therapies:** Advances in microbiome profiling and precision medicine could enable the development of tailored probiotic interventions.
2. **Longitudinal Studies:** Long-term RCTs are needed to establish the sustained effects and safety of probiotics in ADHD and ASD.
3. **Exploration of Novel Strains:** Identifying and characterizing new probiotic strains with neuroprotective properties could expand therapeutic options.
4. **Integration with Other Therapies:** Combining probiotics with behavioral, dietary, or pharmacological interventions may enhance overall efficacy.

Conclusion

Probiotic bacteria and yeast hold significant promise in managing ADHD and ASD by targeting the gut-brain axis. Although current evidence is encouraging, further research is essential to optimize their use and address existing limitations. A multidisciplinary approach integrating probiotics into conventional treatment regimens could pave the way for improved outcomes in individuals with these neurodevelopmental disorders.

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