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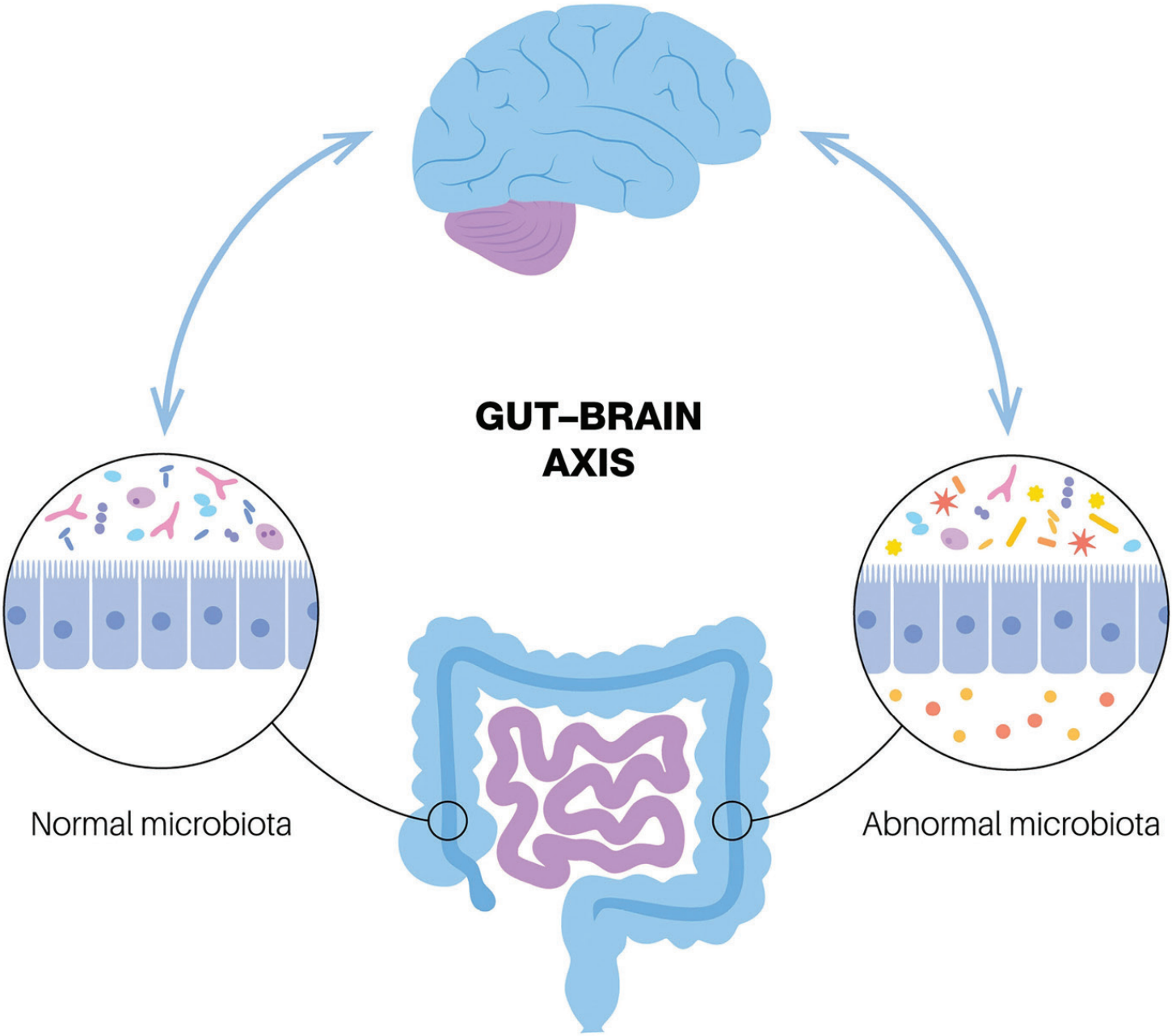
Biotics and the Gut–Brain Axis in Neurological Disorders

Edited by
Neeraj Mishra, Sumel Ashique, and Mithun Bhowmick



Biotics and the Gut–Brain Axis in Neurological Disorders

This book reviews the pivotal role of prebiotics, probiotics, and postbiotics in modulating the gut–brain axis, offering insights into their potential therapeutic applications and impact on neurological health. The initial chapters provide a foundational overview of prebiotics and introduce readers to the concept of the gut–brain axis. These chapters discuss bidirectional communication within the gut–brain axis and the impacts of gut dysbiosis on neurological health. Further chapters investigate the relationship between the gut–brain axis and autoimmune diseases, as well as the role of probiotics in major neurodegenerative diseases such as Alzheimer's and Parkinson's, amyotrophic lateral sclerosis (ALS), Huntington's disease, and conditions like multiple sclerosis (MS), epilepsy, and seizures. The book also examines the influence of prebiotics on mental health disorders such as anxiety and depression, and their impact on ischemic stroke via the gut–brain axis. It further covers the role of probiotics in reactive oxygen species (ROS) and inflammation-mediated neurodegenerative diseases and explores the correlation between gut microbiota, malnutrition, and neurological disorders. The book explores signaling pathways within the gut–brain axis and their relationships with neurological disorders, the application of prebiotics as functional foods, and the therapeutic potential of postbiotics and psychobiotics. This book is intended for scientists and researchers in the fields of microbiology, neuroscience, and gastroenterology. The book:

- Provides a thorough understanding of prebiotics, probiotics, and postbiotics, and their roles in the gut–brain axis;
- Explores bidirectional communication within the gut–brain axis and its impact on neurological health;
- Examines the relationship between the gut microbiota and various neurological disorders;
- Discusses the influence of prebiotics and probiotics on mental health disorders such as anxiety and depression;
- Investigates the connection between the gut–brain axis and autoimmune diseases;
- Covers advanced tools and bioinformatics approaches for studying gut microbiota and neurodegeneration.

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Contents

10 Role of Probiotics in Alzheimer's Disease and Parkinson's Disease

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10.1 INTRODUCTION

The notion of probiotics has been given by father of natural immunity, Elie Metchnikoff, a Nobel laureate who believed in achieving good health followed by deferred caducity on introducing edibles full of useful bacteria in routine diet (Kumar et al., 2020). The term probiotics comes from Greek origin, which signifies "for life," and is suggested to be coined and used by Ferdinand Vergin in his article "Anti- und Probiotika" published in 1954. This article revealed the advantageous consequence of beneficial bacteria on equating several antibacterial compounds, including antibiotics on intestinal microbiota (Markowiak & Slizewska, 2017). The World Health organization (WHO) and the Food and Agricultural Organization of the United Nations (FAO)-associated group of internationally acclaimed scientists working on probiotics defined it in most accepted description across the globe in year 2001. They refer "live microorganisms which when administered in adequate amounts confer a health benefit on host" as probiotics. Probiotics rich in beneficial bacteria along with yeast restores homoeostasis via maintaining gut biome of the overwhelming number of bacterial species residing in the human gut against further rise of other harmful bacteria even in experiencing the misbalancing conditions. This condition includes surgical procedure, unsuitable diet, immunosuppressive treatment, and gastrointestinal ailments (Alvarez-Olmos & Oberhelman, 2001; Doron & Gorbach, 2006; Slizewska, Markowiak-Kopec, & Slizewska, 2021; Snyder, 1997).

10.2 PROBIOTICS AND ITS BENEFICIAL EFFECTS ON HUMAN

Humans are exposed to various microorganisms, both pathogenic and nonpathogenic, which can pose health risks. Henry Tissier and Theodor Escherich's research on human intestine flora revealed that formula-fed babies lack fiber-digesting bifidobacteria, while breastfed infants have substantial bifidobacteria (Kechagia et al., 2013; Maduell, 2019). In today's scenario, probiotics has gained much popularity and is currently used for the treatment of several health complications. It has been proposed that obesity, a metabolic disorder affecting people of all ages, especially youngsters, across the world and referred to as pandemic of this century, can also be treated by using probiotics as an alternative therapy (Cai et al., 2023). Furthermore, probiotics may augment immunity in case of viral infection such as Covid-19 and human immunodeficiency (Blazquez-Bondia et al., 2022; Das, 2022). Table 10.1 and Figure 10.1 depict how probiotics produces beneficial consequences for several diseases and complications.

10.3 NEURODEGENERATIVE DISEASES (NDDS) AND PROTEIN AGGREGATION

The onset of dementia by usual manifestation of neurodegenerative disease has reached at catastrophic level. The loss of neurons is considered as the culprit of neurodegenerative disorders, a group of neurological ailment, resulting in the disruption of the peripheral nervous system (PNS) and the central nervous system (CNS) functioning (Wilson et al., 2023). Aggregation of proteins leads to alterations in proteostasis, causing neurodegenerative diseases. Several factors can trigger protein aggregation and cause neurodegenerative and non-neurodegenerative diseases. Proteins aggregates exhibit two morphological variants, amorphous and amyloids, characterized by ordered and unordered conformation of aggregates (Kaushik & Cuervo, 2015; Khan et al., 2015, 2017). Neurodegenerative infirmities include Alzheimer's disease, Parkinson's disease, Huntington's disease, Creutzfeldt disease, cerebral supra nuclear palsy and

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