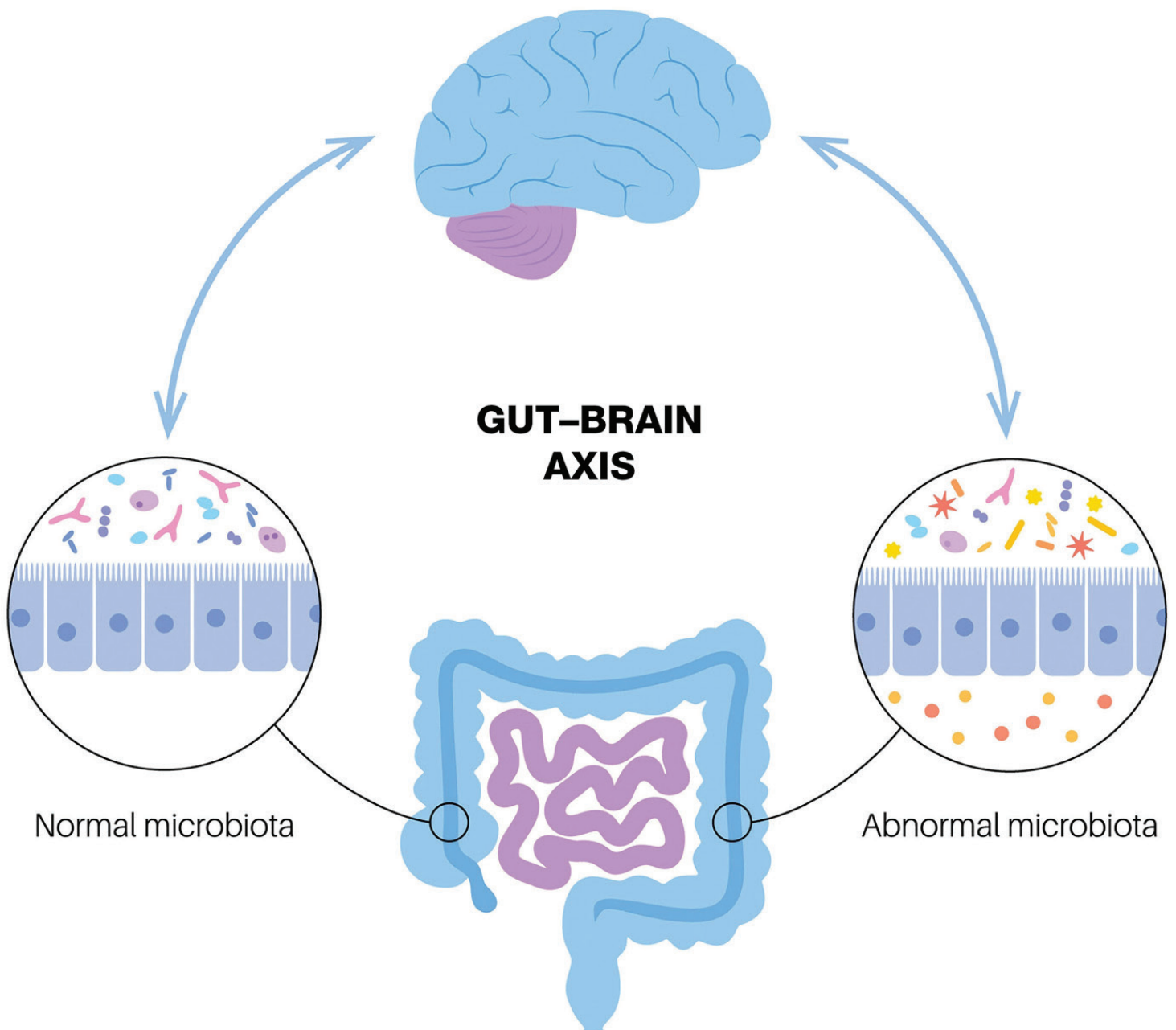


# Biotics and the Gut–Brain Axis in Neurological Disorders

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.



**Taylor & Francis**

Taylor & Francis Group

<http://taylorandfrancis.com>

# Biotics and the Gut–Brain Axis in Neurological Disorders

Edited by  
Neeraj Mishra, Sumel Ashique, and Mithun Bhowmick



**CRC Press**  
Taylor & Francis Group  
Boca Raton London New York

---

CRC Press is an imprint of the  
Taylor & Francis Group, an **informa** business

Designed cover image: Shutterstock

First edition published 2026  
by CRC Press  
2385 NW Executive Center Drive, Suite 320, Boca Raton FL 33431

and by CRC Press  
4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

*CRC Press is an imprint of Taylor & Francis Group, LLC*

© 2026 selection and editorial matter, Neeraj Mishra, Sumel Ashique and Mithun Bhowmick; individual chapters, the contributors

Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, access [www.copyright.com](http://www.copyright.com) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. For works that are not available on CCC please contact [mpkbookspermissions@tandf.co.uk](mailto:mpkbookspermissions@tandf.co.uk)

*Trademark notice:* Product or corporate names may be trademarks or registered trademarks and are used only for identification and explanation without intent to infringe.

ISBN: 9781032882390 (hbk)  
ISBN: 9781032882406 (pbk)  
ISBN: 9781003536802 (ebk)

DOI: 10.1201/9781003536802

Typeset in Times  
by Deanta Global Publishing Services, Chennai, India

---

# Contents

Acknowledgment .....	viii
Preface.....	ix
About the Editors .....	x
<b>Chapter 1</b> Prebiotics: General Overview, Characteristics, and Application in Health Benefits .....	1
<i>Ayush Madan, Rahul Kumar, Pranshul Sethi, and Debasis Mitra</i>	
<b>Chapter 2</b> Introduction to the Gut–Brain Axis .....	13
<i>Ashish Garg, Abhavya Shukla, Sweta Garg, Prakash Pandey, Vishal Singh, and Gopal Rai</i>	
<b>Chapter 3</b> Introduction and Overview of Prebiotics, Probiotics, and Postbiotics .....	30
<i>Phool Chandra, Nishat Fatma, and Neetu Sachan</i>	
<b>Chapter 4</b> Bidirectional Communication in the Gut–Brain Axis .....	39
<i>Priya Chaudhary, Divya Kumari, Apurva, Narotam Sharma, and Pracheta Janmeda</i>	
<b>Chapter 5</b> Gut Dysbiosis and Its Impact on Neurological Health.....	49
<i>Hari Om, Kavita, and Pramod Kumar Kushwaha</i>	
<b>Chapter 6</b> Connection between Gut Microbiota and Neurodegenerative Diseases .....	71
<i>Aniruddha Sen, Vijay Singh, Bidisha Halder, Sapna Saini, Sumel Ashique, Radheshyam Pal, Sabina Yasmin, and Mohammad Yousuf Ansari</i>	
<b>Chapter 7</b> Gut Microbiota in Mental Health Disorders .....	81
<i>Saikat Santra, Rajdip Goswami, Bhaskar Pal, Subhajit Das, and Ayan Chatterjee</i>	
<b>Chapter 8</b> Gut–Brain Axis and Autoimmune Diseases: Correlation between Both.....	90
<i>Devid Chutia, Jadab Rajkonwar, and Srijita Chakrabarti</i>	
<b>Chapter 9</b> Signaling Events from the Gut: Regulate Brain Function and Its Link to Autoimmune Disorders .....	103
<i>Gagandeep Kaur, Parul Sood, Shabnam, Rupesh K. Gautam, and Nitin Jangra</i>	
<b>Chapter 10</b> Role of Probiotics in Alzheimer’s Disease and Parkinson’s Disease.....	118
<i>Mohsin Vahid Khan, Mohd Rumman, Anas Islam, Mohd Kamil Hussain, and Gulam Rabbani</i>	
<b>Chapter 11</b> Role of Probiotics in Amyotrophic Lateral Sclerosis (ALS) and Huntington’s Disease.....	128
<i>Mirunalini Gobinath, L Priyanka Dwarampudi, Shanmugam R, Subhajit Dutta, Parikshit Roychowdhury, and Swati Swagatika Swain</i>	
<b>Chapter 12</b> Role of Probiotics in MS, Epilepsy, and Seizures .....	141
<i>Kajal Gurow, Deepak Chandra Joshi, Uttam Singh Baghel, and Lata Bisht</i>	

---

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

*Mohsin Vahid Khan<sup>1</sup>, Mohd Rumman<sup>1</sup>, Anas Islam<sup>2</sup>,  
Mohd Kamil Hussain<sup>3</sup>, and Gulam Rabbani<sup>4</sup>*

<sup>1</sup> Department of Biosciences, Integral University, Lucknow, India

<sup>2</sup> School of Pharmaceutical Sciences, Integral University, Lucknow, India

<sup>3</sup> Department of Chemistry, Govt. Raza PG College, Rampur, India

<sup>4</sup> IT-medical Fusion Center, Gyeongbuk, Republic of Korea

## 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 homeostasis 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