



# PROBIOTICS, PREBIOTICS, AND SYNBIOTICS

BIOACTIVE FOODS IN HEALTH PROMOTION



EDITED BY  
**RONALD ROSS WATSON**  
**VICTOR R. PREEDY**



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## Bioactive Foods in Health Promotion

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Edited by

### **Ronald Ross Watson**

University of Arizona, Division of Health  
Promotion Sciences, Mel and Enid Zuckerman  
College of Public Health, and School of  
Medicine, Arizona Health Sciences Center,  
Tucson, AZ, USA

### **Victor R. Preedy**

Department of Nutrition and Dietetics,  
Nutritional Sciences Division, School of  
Biomedical & Health Sciences,  
King's College London, London, UK



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Academic Press is an imprint of Elsevier



Academic Press is an imprint of Elsevier  
125 London Wall, London, EC2Y 5AS, UK  
525 B Street, Suite 1800, San Diego, CA 92101-4495, USA  
225 Wyman Street, Waltham, MA 02451, USA  
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK

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#### British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

#### Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-802189-7

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Printed and bound in the United States of America

Publisher: *Nikki Levy*  
Acquisition Editor: *Andrea Topping*  
Editorial Project Manager: *Billie Jean Fernandez*  
Production Project Manager: *Caroline Johnson*  
Designer: *Ines Cruz*



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# Safety of Probiotic Bacteria

Mohammad Abdollahi<sup>#,1</sup>, Amir Hossein Abdolghaffari<sup>\*,†</sup>, Maziar Gooshe<sup>#</sup> and Farnaz Ghasemi-Niri<sup>#</sup>

<sup>\*</sup>Medicinal Plants Research Center, Institute of Medicinal Plants, ACECR, Karaj, Iran, <sup>†</sup>Tehran University of Medical Sciences, International Campus (TUMS-IC), Tehran, Iran, <sup>‡</sup>Students' Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran, <sup>#</sup>Faculty of Pharmacy and Pharmaceutical Sciences Research Center, Tehran University of Medical Sciences, Tehran, Iran

## 1 INTRODUCTION

Probiotics are live microorganisms, conferring a health benefit on the host when administered in a sufficient amount (Butel, 2014). Originally, the term probiotic was used by Lilly and Stillwell in 1965 as opposed to the word antibiotic, to qualify “a microbial substance able to stimulate the growth of other micro-organism.” Subsequently, the idea of microbial origin led to a redefinition of probiotics as “living micro-organisms with beneficial effects on the host, by modifying the equilibrium of its gut microbiota.” The perception of interaction on the microbiota is no longer part of the definition; probiotics may act through other mechanisms and are defined as “live micro-organisms, when consumed in adequate amounts, confer a health effect on the host” (FAO/WHO, 2001a,b, 2002a,b).

Lactic bacteria, mainly the *Lactobacillus* and *Bifidobacterium* genera are the most commonly used bacteria as probiotic. Other genera, including the *Enterococcus*, *Streptococcus*, *Leuconostoc* genera, and others are also used. Most of these microorganisms result from fermented dairy products including kefir, Maasai milk, and Kurut (Martín et al., 2009).

There is evidence of demonstrated beneficial health recovery and disease management effects of probiotics in functional foods such as the digestible form of probiotics used in bioyogurt starter (Lourens-Hattingh and Viljoen, 2001), table olives (Lavermicocca et al., 2005), fermented soy milk (Shimakawa et al., 2003), and other fermented products. In addition, probiotics have been used as a platform for the delivery of drugs, enzymes, and nutrients. In the recent years, probiotics demonstrated various benefits as biodrugs (Sutton, 2008; Zuccotti et al., 2008). Recent studies highlight advantages of probiotics in modulating immunological factors, intestinal permeability, bacterial translocation, as well as secreting various metabolites (De Vrese and Schrezenmeir, 2008; Davis and Milner, 2009). Indeed, several studies demonstrated beneficial effects of probiotic consumption in the improvement of gastrointestinal (GI) diseases such as irritable bowel syndrome (IBS) (Nikfar et al., 2008; Hosseini et al., 2012a,b), inflammatory bowel disease (IBD) (Rahimi et al., 2008; Ghasemi-Niri et al., 2011, 2012; Saadatzadeh et al., 2012; Gareau et al., 2010), necrotizing enterocolitis (NEC) (Luedtke et al., 2012), pouchitis in ileal pouch anal anastomosis (Elahi et al., 2008), acute diarrhea in travelers (Salari et al., 2012), and infection or antibiotic-associated diarrhea (Murdock and Fields, 1984; De Vrese and Marteau, 2007; Sharp et al., 2009). Also, probiotics can protect intestinal epithelial cells by altering gut microbiota and modulating immune responses (Gratz et al., 2010; Fukuda et al., 2011). Furthermore, probiotics can affect colon cancer through inhibiting apoptosis in intestinal cells (Davis and Milner, 2009; Aureli et al., 2011). In addition, the beneficial effects of probiotics have been shown in improving liver function and relieving allergic diseases (Gratz et al., 2010; Morishita et al., 1999; Isolauri et al., 2012; Rautava, 2007).

The safety of probiotics is supported by the idea that the origin of many strains is from humans and they have a long history of safety with their use. Despite their widespread use, a few experimental and clinical studies indicated potential risks like bacteremia in some probiotic strains (Salminen et al., 2002). In addition, altering the commensal microflora and microbial flora in the GI tract might be a possible mechanism of probiotic's side effects (Murdock and Fields, 1984; Hempel et al., 2012).

While some probiotic organisms classified as generally regarded as safe (GRAS) such as *Lactobacilli*, *Bifidobacteria*, *Lactococci*, and yeasts, many probiotics were not categorized as GRAS; this is the case for enterobacteria or enterococci some strains of which are used for their probiotic properties (Butel, 2014).

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<sup>1</sup>Lead author