

# *Lactobacillus* Genomics and Metabolic Engineering

<https://doi.org/10.21775/9781910190890>

Edited by

Sandra M. Ruzal<sup>1,2</sup>

<sup>1</sup>Universidad de Buenos Aires  
Facultad de Ciencias Exactas y Naturales  
Departamento de Química Biológica  
Buenos Aires  
Argentina

<sup>2</sup>CONICET – Universidad de Buenos Aires  
Instituto de Química Biológica de la Facultad de Ciencias  
Exactas y Naturales (IQUIBICEN)  
Buenos Aires  
Argentina



Copyright © 2019

Caister Academic Press  
Norfolk, UK

[www.caister.com](http://www.caister.com)

British Library Cataloguing-in-Publication Data  
A catalogue record for this book is available from the British Library

ISBN: 978-1-910190-89-0 (paperback)

ISBN: 978-1-910190-90-6 (ebook)

Description or mention of instrumentation, software, or other products in this book does not imply endorsement by the author or publisher. The author and publisher do not assume responsibility for the validity of any products or procedures mentioned or described in this book or for the consequences of their use.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher. No claim to original U.S. Government works.

Cover design adapted from images provided by Sandra M. Ruza: scanning electron microscopy images of *Lactobacillus acidophilus* grown with and without high salt.

#### **Ebooks**

Ebooks supplied to individuals are single-user only and must not be reproduced, copied, stored in a retrieval system, or distributed by any means, electronic, mechanical, photocopying, email, internet or otherwise.

Ebooks supplied to academic libraries, corporations, government organizations, public libraries, and school libraries are subject to the terms and conditions specified by the supplier.

# Contents

	Preface	v
1	<b>A Genomic Perspective on Niche Adaptability in <i>Lactobacillus</i></b> Ewelina Stefanovic and Olivia McAuliffe	1
2	<b>Genetics and Genomics of <i>Lactobacillus sakei</i> and <i>Lactobacillus curvatus</i></b> Lucrecia C. Terán, Raúl R. Raya, Monique Zagorec and Marie-Christine Champomier-Vergès	19
3	<b>Complex Oligosaccharide Utilization Pathways in <i>Lactobacillus</i></b> Manuel Zúñiga, María Jesús Yebra and Vicente Monedero	31
4	<b>Production of Lactate Using <i>Lactobacillus</i></b> Mariana C. Allievi, María Mercedes Palomino and Sandra M. Ruzal	61
5	<b>Modifications of <i>Lactobacillus</i> Surface Under Environmental Stress Conditions</b> Mariana C. Allievi, Sandra M. Ruzal and María Mercedes Palomino	81
6	<b>S-Layer Proteins from Lactobacilli: Biogenesis, Structure, Functionality and Biotechnological Applications</b> Mariano Malamud, Patricia A. Bolla, Paula Carasi, Esteban Gerbino, Andrea Gómez-Zavaglia, Pablo Mobili and María de los Angeles Serradell	105
7	<b>Bacteriophages of <i>Lactobacillus</i> Species</b> María Eugenia Dieterle and Mariana Piuri	131
8	<b>DNA Transfer in <i>Lactobacillus</i>: An Overview</b> María Mercedes Palomino, Joaquina Fina Martin, Mariana C. Allievi, María Eugenia Dieterle, Carmen Sanchez-Rivas and Sandra M. Ruzal	149
9	<b>Recombinant Gene Expression in Lactobacilli: Strategies and Applications</b> Clemens Peterbauer, Stefan Heintl, Aleš Berlec and Reingard Grabherr	169
10	<b>Genomic Overview of Acquired Antibiotic Resistance Mechanisms in <i>Lactobacillus</i></b> Cecilia Rodríguez, Lucía Petrelli, María Soledad Ramírez, Daniela Centrón, Elvira María Hebert and Lucila Saavedra	187
	Index	207

# Current Books of Interest

Plant-Microbe Interactions in the Rhizosphere	2019
Porcine Viruses: From Pathogenesis to Strategies for Control	2019
<i>Lactobacillus</i> Genomics and Metabolic Engineering	2019
Cyanobacteria: Signaling and Regulation Systems	2018
Viruses of Microorganisms	2018
Genes, Genetics and Transgenics for Virus Resistance in Plants	2018
DNA Tumour Viruses: Virology, Pathogenesis and Vaccines	2018
Pathogenic <i>Escherichia coli</i> : Evolution, Omics, Detection and Control	2018
Postgraduate Handbook: A Comprehensive Guide for PhD and Master's Students and their Supervisors	2018
Enteroviruses: Omics, Molecular Biology, and Control	2018
Molecular Biology of Kinetoplastid Parasites	2018
Bacterial Evasion of the Host Immune System	2017
Illustrated Dictionary of Parasitology in the Post-genomic Era	2017
Next-generation Sequencing and Bioinformatics for Plant Science	2017
The CRISPR/Cas System: Emerging Technology and Application	2017
Brewing Microbiology: Current Research, Omics and Microbial Ecology	2017
Metagenomics: Current Advances and Emerging Concepts	2017
<i>Bacillus</i> : Cellular and Molecular Biology (Third Edition)	2017
Cyanobacteria: Omics and Manipulation	2017
Foot-and-Mouth Disease Virus: Current Research and Emerging Trends	2017
Brain-eating Amoebae: Biology and Pathogenesis of <i>Naegleria fowleri</i>	2016
<i>Staphylococcus</i> : Genetics and Physiology	2016
Chloroplasts: Current Research and Future Trends	2016
Microbial Biodegradation: From Omics to Function and Application	2016
Influenza: Current Research	2016
MALDI-TOF Mass Spectrometry in Microbiology	2016
<i>Aspergillus</i> and <i>Penicillium</i> in the Post-genomic Era	2016
The Bacteriocins: Current Knowledge and Future Prospects	2016
Omics in Plant Disease Resistance	2016
Acidophiles: Life in Extremely Acidic Environments	2016
Climate Change and Microbial Ecology: Current Research and Future Trends	2016
Biofilms in Bioremediation: Current Research and Emerging Technologies	2016
Microalgae: Current Research and Applications	2016
Gas Plasma Sterilization in Microbiology: Theory, Applications, Pitfalls and New Perspectives	2016

# Preface

The *Lactobacillus* genus comprises more than 200 formally recognized species characterized by their phylogenetic and metabolic diversity. Lactobacilli species are found in a variety of ecological niches such as decomposing plant materials, wine, meat and raw milk and are often commensals to plants and animals including humans. They are food-grade microorganisms widely applied in the fermented food industry due to their technological and health-promoting properties; these bacteria have been extensively used as starter cultures and as probiotics. This ten-chapter book aims to survey the most relevant aspects of the genus. Due to the available genomic information for the *Lactobacillus* genus, comparative genomic approaches have been taken to evaluate strains or species found in different niches, to give an insight into niche adaptation within the genus (see Chapters 1 and 2). A detailed description of the catabolic pathways of complex carbohydrates metabolism (see Chapter 3) and their relation to their main fermentation product, lactic acid (see Chapter 4) are depicted; the ability of *Lactobacillus* to respond to environmental conditions, focusing on osmotic

stress, by altering the nature of their cell wall for adaptation are explored (see Chapter 5). In particular, focus is made on S-layer proteins, with relevant and updated concepts regarding genetics, structural features, cell wall and self-assembly, functionality and biotechnological applications (see Chapter 6). Also, an updated revision is presented of phages infecting strains of *Lactobacillus* spp. with particular emphasis on structural studies on phage–host interactions (see Chapter 7). Overview of methods for the introduction of DNA into *Lactobacillus* species are described (see Chapter 8) and also tools and applications in different areas for recombinant gene expression (see Chapter 9). Finally, since commensal and environmental bacteria appear as a reservoir of antibiotic resistance genes, a genomic overview of these resistance genes in *Lactobacillus* are described (see Chapter 10).

I would like to express my gratitude to all the authors for their hard work and effort in contributing to this book. I am also very grateful to Annette Griffin at Caister Academic Press, who invited me to edit this book.

Sandra M. Ruzal



Aims and Scope: Metabolic Engineering (MBE) is devoted to the publication of original research papers on the directed modulation of metabolic pathways for metabolite over production or the improvement of cellular properties. Papers describing native pathway engineering and synthesis of heterologous pathways for converting microorganisms into microbial cell factories are also welcome. Experimental, computational, and modelling approaches for the elucidation of metabolic pathways and their manipulation by genetic, media, or other environmental means are presented. Efficient probing of metabolic Buy Lactobacillus Genomics and Metabolic Engineering on Amazon.com " FREE SHIPPING on qualified orders. Lactobacillus Genomics and Metabolic Engineering. by Sandra M Ruzal (Editor). ISBN-13: 978-1910190890. ISBN-10: 1910190896. Why is ISBN important? ISBN. This bar-code number lets you verify that you're getting exactly the right version or edition of a book. The 13-digit and 10-digit formats both work.