# Natural Products as Source of Molecules with Therapeutic Potential

Valdir Cechinel Filho Editor

# Natural Products as Source of Molecules with Therapeutic Potential

Research & Development, Challenges and Perspectives



Editor Valdir Cechinel Filho University of Vale do Itajaí - UNIVALI Itajaí, SC, Brazil

Library of Congress Control Number: 2018962876

#### © Springer Nature Switzerland AG 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

#### This book is dedicated to:

- My family (Valdir Cechinel\*, Amélia Copetti Cechinel\*, Emílio Cecconi\*, and Bilmar Canarin Cecconi—\* in memoriam)
- My wife Lenita Cecconi Cechinel and my daughters Camile C. Cechinel and Milene C. Cechinel
- My scientific fathers, Franco Delle Monache and Rosendo A. Yunes

for all the support, trust, and understanding.

## Acknowledgments

I thank all the authors and co-authors for the relevant participation as well as all the collaborators of the University of Vale do Itajaí (UNIVALI) and other partners. Special thanks to my daughter Camile for her excellent technical support.

## **Contents**

Rivaldo Niero, Valdir Cechinel Filho, and Rosendo Augusto Yunes
Plant Products with Antifungal Activity: From Field to Biotechnology Strategies
Liquid Chromatography for Plant Metabolite Profiling in the Field of Drug Discovery
Functional Foods as Source of Bioactive Principles: Some Marked Examples
The Role of Flavonoids as Modulators of Inflammation and on Cell Signaling Pathways
Current Approaches to the Isolation and Structural Elucidation of Active Compounds from Natural Products
Syntheses of Asymmetrically Substituted Pyrans of Natural Origin 233 Wiesław Szeja and Grzegorz Grynkiewicz
Natural Products as Sources of Anticancer Agents: Current Approaches and Perspectives

x Contents

Virtual Screening for the Discovery of Active Principles from Natural Products	33
Current Regulatory Environment of Herbal Medicinal Products in the European Union	65
Development and Use of Polymeric Nanoparticles for the Encapsulation and Administration of Plant Extracts	91
NMR Identification of Biologically Active Natural Products: Strategies and Challenges. 4 Gloria Ivonne Hernández-Bolio and Luis Manuel Peña-Rodríguez	65
Herbal Medicine and Public Healthcare: Current and Future Challenges 4  Dâmaris Silveira, Jose M. Prieto, Marcela M. Freitas, and Andre L. D. A. Mazzari	95
Index5	17

#### **About the Editor**



Valdir Cechinel Filho holds a bachelor's degree in Organic Chemistry from the Federal University of Santa Catarina (1987), a master's degree from the Federal University of Santa Catarina (1991), and a PhD from the Federal University of Santa Catarina (1995). He was Pro-rector and Vice-Rector of Postgraduate, Research, Extension and Culture of the University of Vale do Itajaí (UNIVALI) (2002–2018) and is currently a professor/researcher of the Postgraduate Program (M/D) in Pharmaceutical Sciences of UNIVALI. He conducts research projects in collaboration with national and international researchers. He is also the Coordinator of

the RIBIOFAR/CYTED/CNPq Network and RIBECANCER/CYTED/CNPq Network. He has experience in the field of Organic Chemistry, focusing on the following topics: bioactive natural products, synthesis of molecules of biological interest, and investigation of the relationship between chemical structure and biological activity. He has more than 360 published articles, 50 books and book chapters, and 10 patents in his name. He has supervised around 50 dissertations and theses. He serves as a Reviewer for more than 50 journals and as an Associate Editor of *Pharmaceutical Biology*. In 2012, he was awarded first place in the Caspar Stemmer Innovation Prize (FAPESC) for the Protagonist Innovation category. In 2013, he was a Finalist for the Santander Student Guide Award (partnership with the private sector) for his project developed in partnership with the pharmaceutical company Eurofarma. In 2015, he was a Finalist for the Santander 2015 Award, for the category Science and Innovation, with his project entitled "Search for new and effective anticancer agents from the Brazilian biodiversity." In 2017, he received the highest commendation of Academic Merit of the Council of Rectors of Brazilian Universities

xii About the Editor

(CRUB), supported by the CNPq, for his contribution to the Brazilian Higher Education. In March 2018, he became President of the Foundation UNIVALI and Rector of UNIVALI, with a mandate to head the Institution until 2022.