

---

# Bioactive Natural Products for the Management of Cancer: from Bench to Bedside

---

Anil K. Sharma  
Editor

# Bioactive Natural Products for the Management of Cancer: from Bench to Bedside

 Springer

*Editor*

Anil K. Sharma

Department of Biotechnology

Maharishi Markandeshwar (Deemed to be University) Mullana

Ambala, Haryana, India

ISBN 978-981-13-7606-1

ISBN 978-981-13-7607-8 (eBook)

<https://doi.org/10.1007/978-981-13-7607-8>

© Springer Nature Singapore Pte Ltd. 2019

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 Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

---

## Preface

Natural biometabolites have been the mainstay of cancer chemotherapy, being a rich reservoir of candidate compounds for drug discovery. Recent efforts into the research and development of anticancer drugs derived from natural products have led to the identification of a variety of candidate molecules that inhibit cancer cell proliferation and metastasis via various mechanisms. With the advent of new technologies such as combinatorial chemistry and high-throughput screening, next-generation sequencing, and the ease of identifying abnormal genes, it is now possible to consider that natural products would sound the death knell for cancer. Moreover, natural products are likely to provide novel lead molecules which would be used as templates for restructuring them for potential anticancer drug candidates with enhanced biological properties. Moreover, nanomedicine-based natural products have recently shown promising therapeutic effects with better efficacy and target specificity against cancer countering drug resistance as well. Despite the increasing interest in natural product research, to our knowledge, still this area requires attention of the scientific community to explore the wide-scale mechanisms encompassing anticancer therapeutics with natural products being the lead compounds further redressing the growing problem of drug resistance against cancer. In order to fill these gaps and what kind of therapeutic roles natural products especially secondary metabolites play in the treatment and management of cancer, this book titled *Bioactive Natural Products for the Management of Cancer: From Bench to Bedside* has been able to successfully address the remarkable therapeutic potential of bioactive natural products against cancer.

The book has significant contributions in the form of book chapters by renowned authors as follows: Hala Gali-Muhtasib and his group highlighted the potential significance of anticancer alkaloids, underlying action mechanism, and clinical manifestations which were further supported by Batra and Sharma, expanding their studies to emerging alkaloids peeping into various factors and getting insight into the mechanism of action against cancer. Banerjee and his group shed light into the cancer etiology and therapeutic management by natural metabolites. Sharma et al. highlighted the potential anticancer therapeutic role of flavonoids especially flavones. Gajbhiye et al. emphasized the therapeutic properties of dietary polyphenols, flavonoids, terpenoids, and saponins in cancer chemoprevention. The same group further enlightened us with a vast immunogenic potential of natural products. Anshika Singh and S. Krishna further lead us to look into marine flora for their

immunomodulatory and therapeutic potential in the treatment of cancer. Bhattacharya and her group enlightened us by contributing a chapter on ligand-based designing of natural products paving a way for drug discovery of novel chemical entities. In another chapter, Nag and her group tried to address the mechanism of drug resistance in cancer and the potential role of nanomedicine-based natural products in countering the menace of drug resistance.

The book holds many unique flavors as follows:

1. Recent updates on natural metabolites and their therapeutics use against cancer
2. Unique and distinctive pathways and mechanistic insight into the mode of action of the metabolites
3. The use of these metabolites and nanoparticle-augmented adjuvant therapy to counter the ever-growing problem of drug resistance
4. Ligand-based drug designing of these natural metabolites to enhance their active potential and counter adverse side effects

Once again, my sincere thanks to all the contributing authors who worked as a team to let me complete this book. Special thanks to Dr. Bhavik Sawhney who was available all the time to impart his valuable inputs and assistance. Words of appreciation also go to Mr. Daniel Ignatius Jagadisan, the Production Team, and the Editor as well.

The book is dedicated to my parents and spouse who time and again kept inspiring me to accomplish this task and complete the said manuscript timely.

Ambala, Haryana, India

Anil K. Sharma

---

# Contents

<b>1</b>	<b>Anticancer Alkaloids: Molecular Mechanisms and Clinical Manifestations</b>	<b>1</b>
	Farah Ballout, Zeina Habli, Alissar Monzer, Omar Nasser Rahal, Maamoun Fatfat, and Hala Gali-Muhtasib	
<b>2</b>	<b>Emerging Alkaloids Against Cancer: A Peep into Factors, Regulation, and Molecular Mechanisms</b>	<b>37</b>
	Priya Katyal and Shivani Sharma	
<b>3</b>	<b>Mechanistic Insight into Cancer Aetiology and Therapeutic Management by Natural Metabolites</b>	<b>61</b>
	Vandana Singh, Deepak Kumar, Sheemona Chowdhary, Kunal Maniar, Meenu Narwal, Rajasri Bhattacharyya, and Dibyajyoti Banerjee	
<b>4</b>	<b>Flavones: Flavonoids Having Chemico-Biological Properties with a Preview into Anticancer Action Mechanism</b>	<b>71</b>
	Ajay Sharma, Hardeep Singh Tuli, Dharambir Kashyap, and Anil K. Sharma	
<b>5</b>	<b>Cancer Chemoprevention by Dietary Polyphenols, Flavonoids, Terpenoids, and Saponins</b>	<b>91</b>
	Rahul L. Gajbhiye, Sanjit K. Mahato, Anushree Achari, Parasuraman Jaisankar, and V. Ravichandiran	
<b>6</b>	<b>Immunogenic Potential of Natural Products</b>	<b>111</b>
	Rahul L. Gajbhiye, Sanjit K. Mahato, Anushree Achari, Parasuraman Jaisankar, and V. Ravichandiran	
<b>7</b>	<b>Immunomodulatory and Therapeutic Potential of Marine Flora Products in the Treatment of Cancer</b>	<b>139</b>
	Anshika Singh and Sudhir Krishna	

---

<b>8</b>	<b>Ligand-Based Designing of Natural Products . . . . .</b>	<b>167</b>
	Vandana Singh, Deepak Kumar, Sheemona Chowdhary, Kunal Maniar, Meenu Narwal, Rajasri Bhattacharyya, and Dibyajyoti Banerjee	
<b>9</b>	<b>Drug Resistance in Cancer and Role of Nanomedicine-Based Natural Products. . . . .</b>	<b>177</b>
	Deeptashree Nandi, Aakriti Singal, and Alo Nag	

---

## About the Editor

**Dr. Anil K. Sharma** is presently at M.M. (DU), Department of Biotechnology, Mullana, Ambala (India), where he has been a Professor and Head of the department since April 2012. Previously, he worked as a Senior Research Scientist in Health Sciences (UIC Chicago, USA; 2008–2010), Postdoctoral Research Fellow in Molecular Biology (Microbiology and Immunology Department, UIC Chicago, IL, USA; 2003–2008), and Senior Research Scientist at Ranbaxy (R&D, Gurgaon, Haryana, India; 2001–2003). He has authored more than 95 publications in peer-reviewed journals and received many prestigious awards and accolades including an Eminent Scientist Award for Molecular and Microbial Science (2017 and 2018), National Achiever Award (2016), and Bharat Excellence Award (2013). In addition to editing five books, he has been the Editor-in-Chief of two journals, and lead guest editor, editorial board member or reviewer of over 30 more.