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Plant Antioxidants and Health

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With 144 Figures and 63 Tables

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Preface

Antioxidants are small molecules, such as tocopherol, ascorbate, selenite, and many more, which occur naturally in fruits, vegetables, and beverages and possess a unique chemical activity that quenches the reactive oxygen species (ROS). ROS can be very harmful for human system as it damages macromolecules and cell components by oxidation reaction. Daily intake of natural antioxidants prevents the occurrence of many cardiovascular, heart, and neurological diseases and extends the life span. Polyphenols and carotenoids are some major bioactive molecule groups which are obtained from plants and play significant role as antioxidants. Currently, various research groups are actively working on various cellular models to evaluate the antioxidant capacity of bioactive molecules and their role in prevention of various ailments. Examples of such compounds are epigallocatechin gallate, a catechin-based flavonoid in green tea leaves, curcuminoids from turmeric, cinnamon extract, and resveratrol from red grapes. In the present COVID-19 pandemic, natural dietary sources rich in antioxidants, such as polyphenols and carotenoids, have been clinically proven to reduce oxidative stress and inflammation, which play important role in progression of COVID-19 severity. Therefore, this is a timely compilation of information as one book. This book aims to provide a comprehensive account of sources of antioxidants, their beneficial activity, mechanism of action of these antioxidants, and their involvement in prevention of various diseases and improvement of general health (anti-aging effect). The chapters are written by well-recognized group leaders working in this field. The book is divided into four parts: I "Antioxidant Resources," II "Utilization of Antioxidants," III "Antioxidants and Health," and IV "Screening, Preservation, and Determination Methods for Antioxidants," spread over 29 chapters. The additional attraction of book is the detailed part which gives insights of many analytical methodologies involving diverse instrumental techniques that are being developed for the separation, identification, and quantification of antioxidant compounds with detailed description of certain advanced methods of extraction, such as microwave-, ultrasound-, enzyme-assisted, and supercritical fluid extraction. Microencapsulation methods for food antioxidants and various methods to measure antioxidant activities can be beneficial literature for budding researchers in this field. Besides dietary supplements, the antioxidants play key role in industrial chemicals added during synthesis of synthetic rubber, plastics, and fuels to prevent oxidation, or as preservatives in food and cosmetics.

This aspect is covered in the book by emphasizing role of antioxidants in edible and non-edible active packaging films. The book will be useful for academicians, biotechnologists, researcher, and medical practitioners as well as industries involved in manufacturing of antioxidants-rich dietary supplements. The editors are thankful to all the contributors for their cooperation and patience during the process of publication. The editors are also grateful to the editorial team at Springer, Sylvia Blago, and Johanna Klute for their continued professional expertise and support during book production.

Kraków, Poland — Professor H. M. Ekiert
Udaipur, India — Professor K. G. Ramawat
Udaipur, India — Dr. Jaya Arora

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About the Editors

Professor Halina Maria Ekiert is Head of Chair and Department of Pharmaceutical Botany in the Pharmaceutical Faculty, Medical College, Jagiellonian University, Kraków (Poland), since 2015. Her scientific career was associated first with the Pharmaceutical Faculty at Medical Academy in Kraków (Poland) and after reorganization (since 1993) with the Pharmaceutical Faculty at Medical College of Jagiellonian University. In the years 1999–2014, she was acting Head of Chair and Department of Pharmaceutical Botany. The areas of her scientific interests are associated mainly with pharmaceutical sciences with strong background in plant biotechnology, phytochemistry, analysis of natural products, and biological activity of plant secondary metabolites. Her biotechnological interests include medicinal and/or cosmetic plant in vitro cultures, endogenic production of bioactive plant secondary metabolites, and biotransformations of exogenic substrates in in vitro cultures. Coumarins, phenolic acids, flavonoids, schisandra lignans, phenylpropanoid glycosides, iridoids, catechins, glucosinolates, and arbutin are the special objects of her interest. Throughout her career, Prof. Ekiert received postdoctoral internships at German universities (Bonn – 1993, Würzburg – 1998, and Marburg am Lahn – 2000, two trainings). The trainings in Bonn and in Marburg were supported by DAAD – German Academic Exchange Service. Her scientific achievements include more than 130 published articles with total number of citation of approximately 1480 and H-index of 24 (according to Web of Science), a few book chapters (published by Springer, Science Publisher, and Studium Press), and the role of co-editor and/or editor at Springer

Nature and also guest-editor with the MDPI journal – *Molecules*.

Prof. Ekiert has collaborated with Würzburg University, and she currently collaborates with Technical University of Braunschweig (Germany), the University of Messina (Sicily, Italy), and the University of Split (Croatia). She is academic teacher with extensive and broad experience in pharmaceutical botany, plant biotechnology, and phytochemistry. She has guided PhD students and candidates for habilitation in the field of plant biotechnology.

Prof. Dr. Kishan Gopal Ramawat is a former professor and head of the Botany Department, M.L. Sukhadia University, Udaipur, India, and has longstanding research experience. He received his PhD in plant biotechnology in 1978 from the University of Jodhpur, India, and afterwards joined the university as a faculty member. In 1991 he moved to the M.L. Sukhadia University in Udaipur as associate professor and became professor in 2001. He served as the head of the Department of Botany (2001–2004, 2010–2012); was in charge of the Department of Biotechnology (2003–2004); was a member of the task force on medicinal and aromatic plants in the Department of Biotechnology, Government of India, New Delhi (2002–2005); and coordinated UGC-DRS and DST-FIST program (2002–2012).

Prof. Ramawat completed his postdoctoral studies at the University of Tours, France, from 1983 to 1985, and later returned to Tours as visiting professor (1991). He also visited the University of Bordeaux 2, France, several times as visiting professor (1995, 1999, 2003, 2006, 2010), and in 2005, he went to Poland in an academic exchange program (2005). Through these visits in France, Prof. Ramawat and Prof. Mérillon established a strong connection, which has resulted in productive collaborations and several book and reference work publications.

Prof. Ramawat has published more than 170 well-cited peer reviewed papers and articles, and edited several books and reference works on topics such as the biotechnology of medicinal plants, secondary metabolites, bioactive molecules, herbal drugs, and other

topics. His research was funded by several funding agencies. In his research group, Prof. Ramawat has supervised doctoral thesis of 25 students. He is an active member of several academic bodies, associations, and editorial boards of journals.

Dr. Jaya Arora, assistant professor, Department of Botany, Mohanlal Sukhadia University, Udaipur, has been teaching botany since 2012. She obtained her MSc and PhD in botany, with specialization in plant tissue culture and secondary metabolite production, from Mohanlal Sukhadia University. She was awarded the Maharana Fateh Singh Award in 2000 for meritorious performance during her matriculation and the Gargi Award and Scholarship for matriculation by the Government of Rajasthan, India, 2000. Dr. Arora joined the Council of Scientific & Industrial Research (CSIR) NET–JRF in 2008. She has been working the past 14 years on production of useful metabolites from medicinal plants using biotechnological methods and published 25 papers in journals of repute. This work is funded by various funding agencies such as UGC, CSIR, and RUSA, MHRD. Currently, she is supervising five PhD students. Dr. Arora has co-authored one comprehensive textbook for UG students entitled *Molecular Biology and Plant Biotechnology* and co-edited one international reference book entitled *Medicinal Plants: Domestication, Biotechnology and Regional Importance*, published by Springer International Publishing.

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Part I

Antioxidant Resources

Natural Food Antioxidants

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Aniket P. Sarkate, Vaishnavi S. Jambhorkar, and Bhagwan K. Sakhale

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Abstract

Due to increasing awareness about various effects of antioxidants, it has become an essential part to understand and thoroughly study the various antioxidants and their biological effect on day to day lifestyle. Oxidative stress being major

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