

## Plant and Human Health, Volume 2

Munir Ozturk • Khalid Rehman Hakeem  
Editors

# Plant and Human Health, Volume 2

Phytochemistry and Molecular Aspects

 Springer

*Editors*

Munir Ozturk  
Vice President of the Islamic World  
Academy of Sciences  
Amann, Jordan

Department of Botany and Centre for  
Environmental Studies  
Ege University  
Izmir, Izmir, Turkey

Khalid Rehman Hakeem  
Department of Biological Sciences  
Faculty of Science  
King Abdulaziz University  
Jeddah, Saudi Arabia

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*Dedicated to Our Ancient Herbalists*



*“Medicine from Honey”—a 1224 Arabic translation of the manuscript *De Materia Medica*, written by the ancient Greek physician, *Dioscorides* (40–90 AD)*

## Foreword



Medicinal plants have been a rich source of medications since the very birth of man. Traditional Chinese medicine has been extensively documented for many thousands of years. The Chinese pharmacopoeia, *Shennong Ben Cao Jing*, records plant medicines such as ephedra and hemp. Egyptian medicine employing plant-based drugs dates back to 2900 BC, but preserved records in the form of *Ebers Papyrus* containing about 700 drugs mainly of plant origin go back to around 1550 BC. There is also evidence of the use of plants for healing purposes date back to 2600 BC in Mesopotamia indicating the existence of a plant-based system of treatment in which about 1000 plant-based medicines were used. Ancient Ayurvedic medicine, as documented in the *Atharva Veda*, the *Rig Veda*, and the *Sushruta Samhita*, employed hundreds of pharmacologically active herbs and spices. The medicinal applications of plants became known to the Western world through Greek and Roman practitioners, particularly through the treatises contributed by the Greek physician Dioscorides (1st century AD), and the Roman physicians Pliny the Elder (1st century AD) and Galen (2nd century AD). Later came the Islamic contributions to herbal medicine with the advent of physicians such as Abu Ali Ibn Sina (980–1037), better known in the West as Avicenna, whose book, *Al-Qanun fi al-Tibb*, was used

as a standard textbook of medicine in Europe for over 700 years. Abu Bakr Muhammad ibn Zakariya al-Razi (865–925 AD) wrote over 200 books and categorized substances as vegetable, animal, or mineral, whereas other earlier alchemists had divided them into “bodies,” “souls,” and “spirits.” He was the first to use opium for anesthesia. Al-Idrisi, born in Cordova, during the Islamic era in Spain in 1099, wrote many books on medicinal plants including *Kitab al-Jami-li-Sifat Ashtat al-Nabatat*. Another major contribution from Spain came from Abu Muhammad Ibn al-Baitar (1197–1248), who composed the encyclopedia on medicinal plants entitled *Kitab al-Jami al-Adiwaya al-Mufrada* that presented the work of 150 authors. Abu-Rayhan Biruni, Ibn Zuhr, Peter of Spain, and John of St. Amand also contributed pharmacopoeias describing the use of medicinal plants. The most comprehensive encyclopedic set of volumes on medicinal plants in recent times has been the 57 volume series entitled *Studies in Natural Product Chemistry* (Elsevier Science, Ed. Atta-ur-Rahman) that describes thousands of bioactive constituents discovered from the most important medicinal plants.

It was at the beginning of the nineteenth century when rational drug discovery from plants commenced with the isolation of the analgesic and sleep-inducing agent morphine from opium by the German scientist Serturner in 1817. Other medicinal herbs were then examined for active principles leading to the isolation of a host of important compounds, including quinine, caffeine, nicotine, codeine, atropine, colchicine, cocaine, and capsaicin, from various plant sources. Following the discovery of penicillin in 1928, attention was also turned to the bioactive substances in microbes. The developments of synthetic drugs led to a certain decrease in interest in natural materials as sources of drugs because of the challenges associated with large-scale availability. However, a significant proportion of new drugs approved by FDA are still derived directly or indirectly from medicinal plants. For instance, out of the 1073 new chemical entities (belonging to the group of small molecules) approved between 1981 and 2010, only 36% were purely synthetic, while the remainder were either natural products or their analogues. Similarly during the period 1940–2014, out of the 175 small molecules approved against cancer, 85 were natural products or their derivatives. These include paclitaxel and its derivatives from yew (*Taxus*) species, vincristine and vinblastine from periwinkle (*Catharanthus roseus* (L.) G. Don), and camptothecin and its analogs initially discovered in the Chinese tree *Camptotheca acuminata* Decne. Other important natural products include the cholinesterase inhibitor galanthamine approved for the treatment of Alzheimer’s disease from *Galanthus nivalis* L. and the important antimalarial agent artemisinin originally derived from the traditional Chinese herb *Artemisia annua* L. In spite of the advent of combinatorial chemistry, the actual number of new drugs reaching the market through purely synthetic efforts has diminished. This has resulted in the revival of interest in natural products and triggered the use of multidisciplinary approaches to drug discovery.

The present second volume of *Plants and Human Health*, edited by Khalid Rehman Hakeem and Munir Ozturk and entitled *Phytochemistry and Molecular Aspects*, presents a wealth of information on bioactive compounds isolated from various medicinal plants and their utility in tackling many diseases. The discussions

range from bioactive substances found in terrestrial medicinal plants and freshwater aquatic plants to edible materials and fungi with antioxidant, anti-inflammatory, antiseptic, antidiabetic, anticataleptic, antiarthritic, sedative, calming, antidiuretic, antimicrobial, antifungal, herbicidal, insecticidal, anticancer, and other activities in various classes of flavonoids, terpenoids, alkaloids, and other classes of natural products. The molecular technologies to identify the function of the genes and the effect of the bioactive compound(s) in medicinal plant(s) to treat patients with various chronic diseases are also presented. Transgenic plants produced through bioengineering represent another exciting area that is comprehensively reviewed.

I would like to congratulate the editors for accumulating such a wealth of useful information in this volume. My compliments also go to the eminent authors who produced an excellent overview of the present exciting frontiers of natural product chemistry.

Atta-ur-Rahman  
International Centre for Chemical and Biological Sciences  
University of Karachi  
Karachi, Pakistan

# Preface

According to Huxley (1881), it is easy to sneer at our ancestors, but it is much more profitable to try to discover why they, who were really not one with less sensible persons than our excellent selves, were led to entertain views which look to us strange. For a better look at our future, we need to understand and look deeply at our past. Ethnobotanist Mark Plotkin says that every time a medicine man dies, it is like a library burning down. We are running a race against time. The information held by our medicine men needs to be pooled up fast for further evaluation by researchers.

The answers to the health problems for humans living during 2000 BC were that for an ear ache eat this root, yet with time the notion changed, and in 1000 AD, the same root was regarded as heathen, and was replaced by prayers. Yet in 1850 AD, people started saying that prayer is superstitious and instead advised the drinking of portions. However, in 1940 AD, that portion was regarded as snake oil, and the trend shifted toward the swallowing of pills. Around 1985 AD, the pills were regarded as ineffective, and people were advised to take antibiotics; ultimately in 2000 AD, the antibiotics were accepted as artificial, and the advice was to eat this root. So *we* started with the root in 2000 BC and ended up with the same root in 2000 AD.

Early anthropological evidence for plant use as medicine is 60,000 years old, as is reported from the Neanderthal grave in Iraq. There are clay tablets in cuneiform dated 2600 BC with plant remedies from the Sumerians, Assyrians, and Akkadians as well as Hittites. The Sumero-Akkadian clay tablets show a collection of  $\approx 40$  plants with vegetal formula pharmacopoeia. The importance of plants as medicine is further supported from Asia (3500 BCE) and Egypt (1500 BCE). Egyptian medicines report on the use of bishop's weeds (*Ammi majus*) to treat vitiligo, a skin condition characterized by a loss of pigments. More recently, a drug (b-methoxypsoralen) has been produced from this plant to treat psoriasis and other skin disorders as well as T-cell lymphoma.

Our second volume deals with phytochemistry and molecular aspects. It describes several secondary metabolic compounds found in plants, many of which provide protection against diseases. High-throughput robotic screens have been developed by industry, and it is possible to carry out 50,000 tests per day in the search for compounds which have action against a key enzyme or a subset of receptors.



Medicinal plant drug discovery continues to provide new and important leads against various pharmacological targets including cancer, HIV/AIDS, Alzheimer's, malaria, and pain. Numerous compounds from tropical rainforest plant species with potential anticancer activity have been identified. Although drug discovery from medicinal plants continues to provide an important source of new drug leads, numerous challenges are encountered including the procurement of plant materials, the selection and implementation of appropriate high-throughput screening bioassays, and the scale-up of active compounds.

Izmir, Turkey; Amann, Jordan  
Jeddah, Saudi Arabia

Munir Ozturk  
Khalid Rehman Hakeem

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# Contributors

**Muhammad Aasim** Department of Biotechnology, Faculty of Science, Necmettin Erbakan University, Konya, Turkey

**Siti Nor Akmar Abdullah** Institute of Plantation Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

**Shahid Adeel** Department of Chemistry, Govt. College University, Faisalabad, Pakistan

**Bilal Ahmad** Faculty of Life Sciences, Department of Botany, Aligarh Muslim University, Aligarh, India

**Md Faruque Ahmad** Department of Clinical Nutrition, College of Applied Medical Sciences, Jazan University, Jazan, Kingdom of Saudi Arabia

**Shaik Noor Ahmad** Department of Genetic Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

**Seyid Iftehar Ahmed** Department of Urology, Gazi Mustafa Kemal State Hospital, Ministry of Health, Ankara, Turkey

**Saeed Akhtar** Institute of Food Science and Nutrition, Bahauddin Zakariya University, Multan, Pakistan

**Hesham F. Alharby** Faculty of Science, Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

**Ahmad Ali** Department of Life Sciences, University of Mumbai, Mumbai, Maharashtra, India

**Rayeesa Ali** Faculty of Veterinary Sciences and Animal Husbandry, Division of Veterinary Pathology, Sheri Kashmir University of Agricultural Science and Technology (SKUAST-K), Srinagar, Jammu and Kashmir, India

**R. Ali** Institute of Basic Medical Sciences, Khyber Medical University, Peshawar, Pakistan

**Jameel R. Al-Obaidi** Agro-Biotechnology Malaysia (ABI), C/O MARDI Headquarters, Serdang, Selangor, Malaysia

**Insha Amin** Molecular Biology Lab, Faculty of Veterinary Sciences and Animal Husbandry, Division of Veterinary Biochemistry, Sheri Kashmir University of Agricultural Science and Technology (SKUAST-K), Srinagar, Jammu and Kashmir, India

**Mamoona Amir** Institute of Food Science and Nutrition, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan

**Dorothy D. Anita** Department of Zoology, St. Aloysius College, Mangalore, Karnataka, India

**Khalid Anwar** School of Life Sciences, Jawaharlal Nehru University, New Delhi, India

**Yasir Anwar** Faculty of Science, Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

**Ananthapadmanabha B. Arun** Yenepoya Research Centre, Yenepoya University, Mangalore, Karnataka, India

**Behnaz Aslanipour** Faculty of Engineering, Department of Bioengineering, Ege University, Bornova, Izmir, Turkey

**H. Aziz** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**Allah Bakhsh** Faculty of Agricultural Sciences and Technologies, Department of Agricultural Genetic Engineering, Nigde University, Nigde, Turkey

**Faheem Shahzad Bloch** Faculty of Agricultural and Natural Science, Department of Field Crops, Abant Izzet Baysal University, Bolu, Turkey

**Erdal Bedir** Faculty of Engineering, Department of Bioengineering, Izmir Institute of Technology, Urla, Izmir, Turkey

**Hasene Keskin Çavdar** Faculty of Engineering, Department of Food Engineering, The University of Gaziantep, Gaziantep, Turkey

**Girish Chandran** Department of Studies in Biochemistry, Pooja Bhagavat Memorial Mahajana Education Centre, Post Graduate Wing of SBRR Mahajana First Grade College, Mysuru, Karnataka, India

**Jyoti Bala Chauhan** DOS in Biotechnology, Microbiology and Biochemistry, Pooja Bhagavat Memorial Mahajana Education Centre, Post Graduate Wing of SBRR Mahajana First Grade College, Mysuru, Karnataka, India

**N. Ehsan** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**M. I. Fareed** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**Lynnette R. Ferguson** Discipline of Nutrition and Dietetics, FM & HS, University of Auckland, Auckland, New Zealand

Auckland Cancer Society Research Centre, Auckland, New Zealand

**I. Ghaffar** University College of Pharmacy (UCP), University of the Punjab, Lahore, Pakistan

**Yun Yun Gong** School of Food Science and Nutrition, University of Leeds, Leeds, UK

**A. Gul** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**Derya Gülcemal** Faculty of Science, Department of Chemistry, Ege University, Bornova, Izmir, Turkey

**Abdulrahman S. Hajar** Faculty of Science, Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

**Khalid Rehman Hakeem** Faculty of Science, Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

**Md. Mahadi Hasan** Faculty of Science, Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

**Mirza Hasanuzzaman** Faculty of Agriculture, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

**Shahid Hussain** Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan

**Amir Ismail** Institute of Food Science and Nutrition, Bahauddin Zakariya University, Multan, Pakistan

**Anower Javed** Department of Molecular Medicine and Pathology, FM & HS, University of Auckland, Auckland, New Zealand

**Hassan Jaleel** Faculty of Life Sciences, Department of Botany, Aligarh Muslim University, Aligarh, India

**Aruna G. Joshi** Faculty of Science, Department of Botany, The Maharaja Sayajirao University of Baroda, Gujarat, India

**Prasanna Kallingappa** Department of Molecular Medicine and Pathology, FM & HS, University of Auckland, Auckland, New Zealand

Vernon Jenson Unit, FM & HS, University of Auckland, Auckland, New Zealand

**Chi Hsiu-Juei Kao** Discipline of Nutrition and Dietetics, FM & HS, University of Auckland, Auckland, New Zealand

Auckland Cancer Society Research Centre, Auckland, New Zealand

**Mehmet Karataş** Faculty of Science, Department of Biotechnology, Necmettin Erbakan University, Konya, Turkey

**Nishi Karunasinghe** Auckland Cancer Society Research Centre, Auckland, New Zealand

**S. Khalid** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**M. Masroor A. Khan** Faculty of Life Sciences, Department of Botany, Aligarh Muslim University, Aligarh, India

**Sana Khatri** Department of Life Sciences, University of Mumbai, Mumbai, Maharashtra, India

**Khalid Mahmood Khawar** Faculty of Agriculture, Department of Field Crops, Ankara University, Ankara, Turkey

**S. Khushbu** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**Nita Lakra** School of Life Sciences, Jawaharlal Nehru University, New Delhi, India

**Saqib Mahmood** School of Life Sciences, Jawaharlal Nehru University, New Delhi, India

**Gareth Marlow** Experimental Cancer Medicine Centre, Cardiff University, Cardiff, UK

**Avinash Marwal** Department of Biotechnology, Mohanlal Sukhadia University, Udaipur, Rajasthan, India

**Bilal Ahmad Mir** Molecular Biology Lab, Faculty of Veterinary Sciences and Animal Husbandry, Division of Veterinary Biochemistry, Sheri Kashmir University of Agricultural Science and Technology (SKUAST-K), Srinagar, Jammu and Kashmir, India

**Muneeb U. Rehman** Molecular Biology Lab, Faculty of Veterinary Sciences & Animal Husbandry, Division of Veterinary Biochemistry, Sheri Kashmir University of Agricultural Science & Technology (SKUAST-K), Srinagar, Jammu and Kashmir, India

**Ali A. Moosavi-Movahedi** Institute of Biochemistry and Biophysics, University of Tehran, Tehran, Iran

**Umaiyal Munusamy** Institute of Plantation Studies, Universiti Putra Malaysia, UPM, Serdang, Selangor, Malaysia

Centre for Research in Biotechnology for Agriculture (CEBAR), Level 3, Research Management & Innovation Complex, University of Malaya, Kuala Lumpur, Malaysia



**Vijay Naidu** School of Engineering, Computer and Mathematical Sciences, Auckland University of Technology, Auckland, New Zealand

**Radha Pallati** Discipline of Nutrition and Dietetics, FM & HS, University of Auckland, Auckland, New Zealand

**Additiya Paramanya** Department of Life Sciences, University of Mumbai, Mumbai, Maharashtra, India

**Ashutosh R. Pathak** Faculty of Science, Department of Botany, The Maharaja Sayajirao University of Baroda, Gujarat, India

**Muhammad Qaswar** Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan

**Sana Rafi** Department of Applied Chemistry, Govt. College University, Faisalabad, Pakistan

**H. Rashid** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**M. I. Rashid** Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan

**Saiema Rasool** Forest Biotech Lab, Faculty of Forestry, Department of Forest Management, University Putra Malaysia, Serdang, Serdang, Selangor, Malaysia

**Ashish Rawson** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**Fazal-ur Rehman** Department of Applied Chemistry, Govt. College University, Faisalabad, Pakistan

**Muneeb U. Rehman** Molecular Biology Lab, Faculty of Veterinary Sciences and Animal Husbandry, Division of Veterinary Biochemistry, Sheri Kashmir University of Agricultural Science and Technology (SKUAST-K), Srinagar, Jammu and Kashmir, India

**Zed Rengel** UWA School of Agriculture and Environment, The University of Western Australia, Perth, WA, Australia

**Muhammad Riaz** Institute of Food Science and Nutrition, Bahauddin Zakariya University, Multan, Pakistan

**Yawar Sadiq** Faculty of Life Sciences, Department of Botany, Aligarh Muslim University, Aligarh, India

**S. Santhi** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**Asfia Shabbir** Faculty of Life Sciences, Department of Botany, Aligarh Muslim University, Aligarh, India

**B. Shankar Naik** Department of P.G. Studies and Research in Applied Botany, Bio-Science Complex, Kuvempu University, Shimoga, Karnataka, India

Department of Biology, Govt Science College, Chikmagalur, Karnataka, India

**Iffat-Ara Sharmeen** Department of Biochemistry, School of Life Sciences, Independent University, Dhaka, Bangladesh

**Suvarna J. Shreelalitha** Department of Biotechnology, St. Aloysius College, Mangalore, Karnataka, India

**S. R. Smitha Grace** Department of Studies in Biotechnology, Pooja Bhagavat Memorial Mahajana Education Centre, Post Graduate Wing of SBRR Mahajana First Grade College, Mysuru, Karnataka, India

**Kandikere R. Sridhar** Department of Biosciences, Mangalore University, Mangalore, Karnataka, India

**N. M. Sudheep** Department of Plant Science, School of Biological Sciences, RST Campus, Central University of Kerala, Kerala, India

**Jin Sun** School of Food Science and Technology, Jiangnan University, Wuxi Shi, China

**C. K. Sunil** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**Prabhavathi Supriya** Department of Biosciences, Mangalore University, Mangalore, Karnataka, India

**K. Sureshkumar** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**F. Taghavi** Institute of Biochemistry and Biophysics, University of Tehran, Tehran, Iran

Faculty of Biological Science, Tarbiat Modares University, Tehran, Iran

**Khanh Tran** Department of Molecular Medicine and Pathology, FM & HS, University of Auckland, Auckland, New Zealand

**Moin Uddin** Botany Section, Women's College, Aligarh Muslim University, Aligarh, India

**Syeda Azeem Unnisa** Department of Environmental Science, UCS, Osmania University, Hyderabad, Telangana, India

**Venkatesh Vaidyanathan** Discipline of Nutrition and Dietetics, FM & HS, University of Auckland, Auckland, New Zealand

Auckland Cancer Society Research Centre, Auckland, New Zealand

**S. Venu** Indian Institute of Food Processing Technology, Thanjavur, TN, India

**Alice Wang** Discipline of Nutrition and Dietetics, FM & HS, University of Auckland, Auckland, New Zealand

Auckland Cancer Society Research Centre, Auckland, New Zealand

**Muhammad Zafar-ul-Hye** Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan

**Khalid Mahmood Zia** Department of Applied Chemistry, Govt. College University, Faisalabad, Pakistan

**Muhammad Zuber** Department of Applied Chemistry, Govt. College University, Faisalabad, Pakistan

## About the Editors



**Munir Ozturk** PhD, DSc has served at the Ege University, Izmir, Turkey, for 50 years in different positions. He is currently “Vice President of the Islamic World Academy of Sciences.” He has received fellowships from the Alexander von Humboldt Foundation, Japanese Society for Promotion of Science, and the National Science Foundation of the USA. Dr. Ozturk has served as chairman of the Botany Department and founding director of the Centre for Environmental Studies, Ege University, Izmir, Turkey; a consultant fellow, Faculty of Forestry, Universiti Putra Malaysia, Malaysia; and distinguished visiting scientist, ICCBS, Karachi University, Pakistan. His fields of scientific interest are plant ecophysiology, medicinal and aromatic plants, conservation of plant diversity, biosaline agriculture and crops, pollution, and biomonitoring. He has published 42 books, 68 book chapters, and 190 papers in international and national journals.



**Khalid Rehman Hakeem** PhD is an associate professor at King Abdulaziz University, Jeddah, Saudi Arabia. He completed his PhD (botany) from Jamia Hamdard, New Delhi, India, in 2011. Dr. Hakeem has worked as a postdoctorate fellow in 2012 and fellow researcher (associate professor) from 2013 to 2016 at Universiti Putra Malaysia, Selangor, Malaysia. His speciality is plant ecophysiology, biotechnology and molecular biology, plant-microbe-soil interactions, and environmental sciences. Thus far, he has edited

and authored more than 25 books with Springer International, Academic Press (Elsevier), etc. He has also to his credit more than 110 research publications in peer-reviewed international journals, including 40 book chapters in edited volumes with international publishers.