Herbal Nutraceuticals

Products and Processes

Edited by
Santosh Kumar Upadhyay
Sudhir Pratap Singh

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Dr. Santosh Kumar Upadhyay is currently working as an assistant professor of Botany at the Panjab University, Chandigarh, India. He has been working in the field of Plant Biotechnology for more than 16 years. His present research focuses in the area of functional genomics for stress tolerance. He is involved in the bio-prospecting and characterization of various important proteins from plant biodiversity, and defense and stress signaling genes in bread wheat. His research group has developed a pool of vital genes and long noncoding RNAs associated with abiotic and biotic stress tolerance and signaling in plants. He has also established the method for genome editing in bread wheat using CRISPR-Cas system and developed a tool SSinder for CRISPR target site prediction. His research contribution led to the publication of more than 70 research papers in leading journals of international repute. Further, there are more than five national and international patents, 50 book chapters, and 12 books in his credit. In recognition of his substantial research record, he has been awarded NAAS Young scientist award (2017–2018) and NAAS-Associate (2018) from the National Academy of Agricultural Sciences, India, INSA-Associate Fellow (2023), and INSA Medal for Young Scientist (2013) from the Indian National Science Academy, India, NASI-Young Scientist Platinum Jubilee Award (2012) from the National Academy of Sciences, India, and Altech Young Scientist Award (2011). He has also been the recipient of the prestigious DST-INSPIRE Faculty Fellowship (2012) and SERB-Early Career Research Award (2016) from the Ministry of Science and Technology, Government of India. Dr. Upadhyay also serves as a member of the editorial board and reviewer of several peer-reviewed international journals.

Dr. Sudhir Pratap Singh is currently Professor at the Department of Industrial Biotechnology, Gujarat Biotechnology University, Gandhinagar, Gujarat, India. He has been working in the area of molecular biology and biotechnology for more than a decade. Currently, his primary focus of research is gene mining, biocatalyst engineering, and characterization of novel enzyme variants for the production of high-value functional biomolecules from low-cost feedstock. He has generated metagenomic data resources from diverse ecological niches and ethnic food samples and has characterized novel genes encoding enzyme variants with desirable catalytic properties for the biosynthesis of functional sugar molecules such as D-allulose, turanose, trehalose, and trehalulose. Further, he has achieved enzymatic production of prebiotic molecules, such as fructooligosaccharides, glucooligosaccharides, 4-galactosyl-Kojibiose, xylooligosaccharides, levan, dextran, type III resistant starch, etc. Prof. Singh has published more than 75 research articles (SCI) and 8 books (edited). Further, he has 12 patents (granted) to his credit as an inventor. He has been conferred the TATA Innovation Fellowship (DBT, Govt. of India), Professor SB Chincholkar Award (BRSI), Young Scientist Award (IBA), SBS-MKU Genomics Award (BRSI), and Professor Hira Lal Chakravarty Award (ISCA, DST, Govt. of India). His team was awarded Gandhian Young Technological Innovation Award (SRISTI) in 2019. He is a life member of the National Academy of Sciences, India. Further, Prof. Singh is the Fellow of the National Academy of Agricultural Sciences (FNAAS) and the Fellow of the International Society of Energy, Environment, and Sustainability (FISEES).

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Preface

Nutraceuticals are nutritive pharmaceuticals of health significance. It could be fortified food product or dietary supplement. Nevertheless, the health benefits of nutraceuticals are over and above the basic nutritional function. The recommended level of consumption of nutraceuticals not only maintains good health but also functions against life-style-related acute and chronic metabolic disorders. Thus, nutraceutical bioactive molecules help in disease prevention and promote optimal health, quality, and longevity of life. The medical uses of nutraceuticals in disease like depression, stress, cardiovascular and gastrointestinal disorders, cancer, cholesterol, obesity, and diabetes have been intensively studied. These bioactive molecules of high value are obtained from natural biosphere resources. Nutraceuticals can be derived from animals, plants, microorganisms, and fungal sources. Herbal bioactives comprise a variety of phytochemicals like polyphenols, alkaloids, terpenoids, and derivatives thereof. Many traditional literatures support the utilization of herbs as natural remedies to handle the metabolic and physiological disorders. Herbs may be categorized into food, medicinal, and poisonous types, according to the active and functional constituents they harbour.

The current book entitled "Herbal Nutraceuticals: Products and Processes" enlisted the numerous important herbal nutraceuticals from different plants sources including horticultural and agricultural important crops, as well. The book started with the overview of herbal nutraceuticals and covered diverse aspects of their application for the human health. Various chapters included in the book described the medicinal importance of various herbal constituents as alternative medicines, their importance in health benefits in the modern day life style, their antidiabetic and anticarcinogenic potentials, and antioxidant properties. In addition, the nutraceutical potential of various cereals, pseudo cereals, legumes, fruits, and oils have been specifically discussed in various chapters. It is a well-known truth that nothing is absolutely beneficial in the world. The positive and negative implications are associated with each substance. And therefore, at the end chapters describing the safety concern and toxicity evaluation have been included. Overall, *Herbal Nutraceuticals: Products and Processes* is a comprehensive book for the diverse knowledge and application for human health benefits.

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Plants Based Nutraceuticals: An Overview

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1.1 Introduction

The term nutraceuticals evolved from a combination of nutrition and pharmaceuticals and was coined by Stephen De Felice in 1989. According to him, nutraceuticals are food commodities or fractions that grant health benefits and clinical advantages (Durazzo et al. 2020). The word nutraceuticals, is not so popular worldwide and is many of time it is confused by the term dietary supplements, which is an important need for the health of humankind. However, in-depth studies of both terms manifest some root differences, such as the fact that nutraceuticals are prominent in treating several illnesses besides being important dietary supplements (Bommakanti et al. 2023). US FDA is usually not in favor of the term nutraceuticals, which is generally denoted as food-emerged derivatives with some other values specified by the elementary nutritional fractions that exist in that specific food item. Another misleading term for nutraceuticals is functional food, which can be described as any food being synthesized or manufactured employing scientific intelligence, with or without competent information on why or how it is being used (Tsiaka et al. 2022).

Moreover, when functional food helps to manage and treat ailments other than anemia, it is categorized as a nutraceutical (Jalgaonkar et al. 2019). These incorporate a large variety of products, including dietary supplements, genetically altered products, isolated nutrients, plant products, and processed cereals. Modifications in lifestyle patterns bring about influential changes in the everyday dietary regime that may lead to the emergence of newly developed lifestyle abnormalities such as type-2 diabetes and obesity. Other than these, cardiac disorders, namely stroke and ischemic heart dysfunction, are the most common reasons for mortality in the entire world. Nutraceuticals are reported as appropriate medications for these factors to cure such lifestyle

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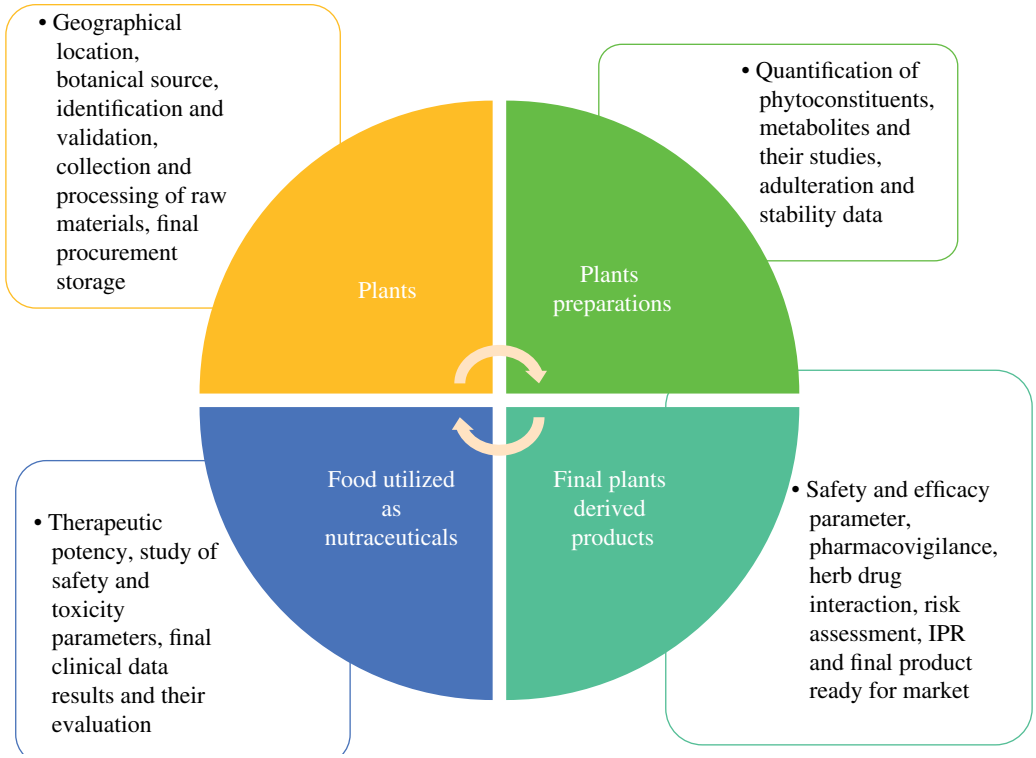

Figure 1.1 Identification and validation of plant-based nutraceuticals. *Source:* Mukherjee et al. (2016); Donno (2020).

abnormalities, hence attaining worldwide acceptability expeditiously. Besides these lifestyle abnormalities, nutraceuticals are utilized for the cure of various types of clinical manifestations, namely hypercholesteremia, allergic problems, sleep disorders, inflammations, immunodeficiencies, depressive situations, malignancies conditions, hypertension, cardiovascular diseases (CVDs), and anemic disorders (Jalgaonkar et al. 2019; Tsiaka et al. 2022).

It can be suggested that nutraceuticals have very efficacious and potent outcomes and marvelous health benefits that make them crucially attractive to consumers. In the last few years, the significance and importance of plant-based nutraceuticals have evolved, and the development of nutraceutical has revealed that it is crucial for human beings to have sound health considerations for better wellness and fitness. This work focuses mainly on the therapeutically active medicinal phytoconstituents derived from various parts of plants worldwide to cure and prevent various ailments. These phytochemicals obtained from plants could be used as nutraceuticals, further exploring their numerous remedial benefits and the theme behind their remarkable and valuable impacts on human health (Figure 1.1) (Mohammad and Imran 2019; Shahidi 2012).

1.2 Historical Background Behind Nutraceutical Investigations

The father of current remedies, Hippocrates (460–377 BC), suggested the root stone for modern-time nutraceuticals via the fabled quote, "Let food be thy medicine and medicine by the food." He was recognized as the founder of the idea that specific foods could also be a remedy for curing and controlling a disorder besides the drug moieties (Nwosu and Ubaoji 2020). Roman physician Galen