

Edited by  
Farid Chemat and Jochen Strube

# Green Extraction of Natural Products

Theory and Practice



# Green Extraction Of Natural Products Theory And Practice

**Albert A Gayle**



## **Green Extraction Of Natural Products Theory And Practice:**

**Green Extraction of Natural Products** Farid Chemat, Jochen Strube, 2016-03-11 Extraction processes are essential steps in numerous industrial applications from perfume over pharmaceutical to fine chemical industry Nowadays there are three key aspects in industrial extraction processes economy and quality as well as environmental considerations This book presents a complete picture of current knowledge on green extraction in terms of innovative processes original methods alternative solvents and safe products and provides the necessary theoretical background as well as industrial application examples and environmental impacts Each chapter is written by experts in the field and the strong focus on green chemistry throughout the book makes this book a unique reference source This book is intended to be a first step towards a future cooperation in a new extraction of natural products built to improve both fundamental and green parameters of the techniques and to increase the amount of extracts obtained from renewable resources with a minimum consumption of energy and solvents and the maximum safety for operators and the environment

**Advances in Separation Sciences** Pravin G Ingole, Chaudhery Mustansar Hussain, 2024-11-30 Advances in Separation Sciences Sustainable Processes and Technologies discusses the different separation technologies and their applications in a variety of industrial processes The book lists the pros and cons of the various processes for specialized application and outlines selection criteria to provide readers with the knowledge they need to develop processes and technologies themselves Divided into eight parts chapters cover sustainable perspectives and developments theory and mechanisms of various separation processes advances in sample preparation techniques advances in chromatography advances in membrane technology advances in microfluidics green and sustainable separation sciences and challenges and commercialization In depth and step by step descriptions of the various processes and technologies explanations of their inclusion in modern industry and scales for both experimental and theoretical models are also included Includes new research findings and relates them to industrial applications Identifies new research needs and opportunities Includes both mechanisms and applications Provides fundamental knowledge of separation processes through theories and problems Includes challenges and solutions for the commercialization of separation processes

*Green Extraction Techniques in Food Analysis* Merichel Plaza, María Luisa Marina, 2023-08-11 This book aims to inform readers about the latest trends in environment friendly extraction techniques in food analysis Fourteen edited chapters cover relevant topics These topics include a primer green food analysis and extraction environment friendly solvents such as deep eutectic solvents ionic liquids and supramolecular solvents and different extraction techniques

**Natural Product Extraction** Juliana M Prado, Mauricio A Rostagno, 2022-07-20 Natural products are used by the food pharmaceutical and cosmetics industries and extraction technologies and potential applications for plant extracts are of interest to many industrial sectors Extraction of natural products in an economic and environmentally friendly way is of high importance to all industries involved The second edition of this book presents an updated holistic in depth view of the more environmentally

benign techniques available for the extraction of natural products along with their newest applications and case studies. Conventional and emerging extraction techniques are discussed in detail. New topics include enzymes, pulsed electric energy, and on-line analysis. Written for academics and industrialists working in both natural product extraction and green chemistry, this new edition provides a valuable update on current trends in the field.

**Food Wastes and By-products**  
Rocio Campos-Vega, B. Dave Oomah, Hayde Azeneth Vergara-Castaneda, 2020-02-03. A complete guide to the evolving methods by which we may recover by-products and significantly reduce food waste. Across the globe, one third of cereals and almost half of all fruits and vegetables go to waste. The cost of such waste, both to economies and to the environment, is a serious and increasing concern within the food industry. If we are to overcome this crisis and move towards a sustainable future, we must do everything possible to utilize innovative new methods of extracting and processing valuable by-products of all kinds. Food Wastes and By-products represents a complete primer to this important and complex process. Edited and written by leading researchers, the text provides essential information on the supply of waste and its composition, identifies foods rich in valuable bioactive compounds, and explores revolutionary methods for creating by-products from fruit, vegetable, and seed waste. Other chapters discuss the nutraceutical properties of value added by-products and their uses in the manufacturing of dietary fibers, food flavors, supplements, pectin, and more. This book explains how reconstituted by-products can best be used to radically reduce food waste. Discusses the potential nutraceutical assets of recovered food waste. Covers a broad range of by-product sources such as mangos, cacao, flaxseed, and spent coffee grounds. Describes novel extraction processes and the emerging use of nanotechnology. A significant contribution to the field. Food Wastes and By-products is a timely and essential resource for food industry professionals, government agencies, and NGOs involved in nutrition, agriculture, and food production, and university instructors and students in related areas.

**Valorization of Agri-Food Wastes and By-Products**  
Rajeev Bhat, 2021-08-25. Valorization of Agri Food Wastes and By Products: Recent Trends, Innovations, and Sustainability Challenges addresses the waste and by-product valorization of fruits and vegetables, beverages, nuts, and seeds, dairy, and seafood. The book focuses its coverage on bioactive recovery, health benefits, biofuel production, and environmental issues, as well as recent technological developments surrounding the state of the art of food waste management and innovation. The book also presents tools for value chain analysis and explores future sustainability challenges. In addition, the book offers theoretical and experimental information used to investigate different aspects of the valorization of agri food wastes and by-products. Valorization of Agri Food Wastes and By Products: Recent Trends, Innovations, and Sustainability Challenges will be a great resource for food researchers, including those working in food loss or waste, agricultural processing, and engineering, food scientists, technologists, agricultural engineers, and students and professionals working on sustainable food production and effective management of food loss, wastes, and by-products. Covers recent trends, innovations, and sustainability challenges related to food wastes and by-products valorization. Explores various recovery processes, the functionality of targeted

bioactive compounds and green processing technologies Presents emerging technologies for the valorization of agri food wastes and by products Highlights potential industrial applications of food wastes and by products to support circular economy concepts      Design and Processing of Green Materials Md. Faiyazuddin,Meghraj Suryawanshi,2025-07-16 This book offers a comprehensive view of the creation and use of natural polysaccharides by integrating sustainability bioengineering and green materials in a unique way With an in depth coverage it includes a thorough analysis of natural polysaccharides delving into their synthesis characteristics and range of emerging technology applications as well as guidance to researchers and practitioners who aim to reduce environmental effects by highlighting eco friendly design concepts and sustainable manufacturing techniques Highlighting the potential and adaptability of natural polysaccharides ranging from eco friendly packaging materials to medicinal innovations such as tissue engineering and drug delivery systems this book provides useful information on the practical applications of natural polysaccharides in the real world encouraging creativity and problem solving through case studies and practical examples      Water Extraction of Bioactive Compounds Herminia Dominguez,Maria Jesus Gonzalez Munoz,2017-09-20 Water Extraction of Bioactive Compounds From Plants to Drug Development draws together the expert knowledge of researchers from around the world to outline the essential knowledge and techniques required to successfully extract bioactive compounds for further study The book is a practical tool for medicinal chemists biochemists pharmaceutical scientists and academics working in the discovery and development of drugs from natural sources The discovery and extraction of bioactive plant compounds from natural sources is of growing interest to drug developers adding greater fuel to a simultaneous search for efficient green technologies to support this Particularly promising are aqueous based methods as water is a cheap safe and abundant solvent Water Extraction of Bioactive Compounds From Plants to Drug Development is a detailed guide to the fundamental concepts and considerations needed to successfully undertake such processes supported by application examples and highlighting the most influential variables Beginning with an introduction to plants as sources of drugs the book highlights the need for a move towards both more rational and greener techniques in the field and presents multiple innovative water based strategies for the discovery and extraction of bioactive constituents of botanicals A broad range of available techniques are reviewed including conventional and pressurized hot water extraction techniques intensified processes such as microwave assisted ultrasound assisted processes and enzyme assisted extraction and processes using combined techniques Covers the theoretical background and range of techniques available to researchers helping them to select the most appropriate extraction method for their needs Presents up to date and cutting edge applications by international experts Highlights current use and future potential for industrial scale applications Offers a thorough introduction to plants as sources of drugs highlighting strategies for the discovery of novel bioactive constituents of botanicals      *Exploring Natural Phenolic Compounds - Recent Progress and Practical Applications* ,2025-07-30 Phenolic compounds have received considerable attention from the scientific

community due to their presence in plants and other natural sources as well as their antioxidant antimicrobial and anti-inflammatory properties which have led to increasing interest in functional foods the pharmaceutical sector agriculture and sustainable materials This book presents the reader with several chapters on the most recent achievements in the extraction identification and application of phenolic compounds from natural sources It explores both conventional and emerging technologies such as green extraction methods and nanotechnology while addressing challenges related to bioavailability stability and industrial integration The book presents an integrated approach to transforming agro industrial by products into high value phenolic rich ingredients with a specific focus on modern extraction technologies eco friendly preparative processes and a promising perspective for applications Provided by leading experts from a broad spectrum of disciplines including natural product chemistry food science biotechnology and applied sustainability this book is an excellent tool for researchers students and professionals seeking to understand the diverse and effective bioactive compounds and their emerging applications in various industries

**The Application of Green Solvents in Separation Processes** Francisco Pena-Pereira, Marek Tobiszewski, 2017-02-28 The Application of Green Solvents in Separation Processes features a logical progression of a wide range of topics and methods beginning with an overview of green solvents covering everything from water and organic solvents to ionic liquids switchable solvents eutectic mixtures supercritical fluids gas expanded solvents and more In addition the book outlines green extraction techniques such as green membrane extraction ultrasound assisted extraction and surfactant mediated extraction techniques Green sampling and sample preparation techniques are then explored followed by green analytical separations including green gas and liquid capillary chromatography counter current chromatography supercritical fluid chromatography capillary electrophoresis and other electrical separations Applications of green chemistry techniques that are relevant for a broad range of scientific and technological areas are covered including the benefits and challenges associated with their application Provides insights into recent advances in greener extraction and separation processes Gives an understanding of alternatives to harmful solvents commonly used in extraction and separation processes as well as advanced techniques for such processes Written by a multidisciplinary group of internationally recognized scientists

**Analytical Sample Preparation With Nano- and Other High-Performance Materials** Rafael Lucena, M. Soledad Cárdenas Aranzana, 2021-10-23 Analytical Sample Preparation With Nano and Other High Performance Materials covers advanced sample treatment techniques and the new materials that can be used to boost their performance The evolution of sample treatment over the last two decades has resulted in the development of new techniques and application of new materials This is a must have resource for those studying advanced analytical techniques and the role of high performance materials in analytical chemistry The book explains the underlying principles needed to properly understand sample preparation and also examines the latest materials including nanomaterials that result in greater sensitivity and specificity The book begins with a section devoted to all the various sample preparation techniques and then

continues with sections on high performance sorbents and high performance solvents Combines basic fundamental principles and advanced concepts and applications for a comprehensive treatment of sample preparation with new materials Defines nano and other high performance materials in this context including carbon nanoparticles inorganic nanoparticles ionic liquids supramolecular solvents and more Includes discussion of all the latest advancements and new findings in both techniques and materials used for proper sample preparation      **Towards Sustainability in the Wine Industry by**

**Valorization of Waste Products** Patricia Joyce Pamela Zorro Mateus, Siby Inés Garcés Polo, 2023-08-01 This volume in our Sustainability Contributions through Science and Technology series reviews the use of alternative green technologies pressurized liquid and super critical fluid extractions for grape biomass valorization Environmental sustainability and circular economy are discussed in relation to agro industrial waste in the winemaking industry The waste contaminates water and soil and in large quantities it has been related to bad odors a high content of organic matter in water and greenhouse gas emissions over the entire winemaking industry Here the authors illustrate how green extraction of commercially valuable substances can be scaled up at an industrial level Features Reports on waste valorization in the winemaking industry and converting the waste into more useful products including oils antioxidants and other valuable materials Explores research which contributes to environmental sustainability and circular economy in the winemaking industry Describes other ways to reduce the ecological footprint of the wine industry such as using less fertilizer more benign pesticides and reduction of water footprint Proposes options for a potential wine waste biorefining Reviews alternative uses of agro industrial wine wastes as sources of additives for the food cosmetic and pharmaceutical industries      *Drying of Herbs, Spices, and*

*Medicinal Plants* Ching Lik Hii, Shivanand S. Shirkole, 2023-09-28 Drying is a key operation in processing of many plant based foods and medicines for the purpose of preservation and retention of key attributes and active compounds Therefore it is essential to select suitable drying techniques to ensure a product is processed under optimal operating conditions Drying of Herbs Spices and Medicinal Plants presents processing aspects of these three major global agricultural commodities It offers an insight into the drying and product quality of herbs spices and medicinal plants such as drying characteristics equipment selection physiochemical analyses quality improvement product development storage and shelf life as well as future developments Offers the latest information on drying and processing technologies research and development Summarizes various drying techniques their advantages and limitations industrial applications and simple design methods Presents guidelines for dryer selection Links theory and practice Envisages future trends and demands Featuring chapters from expert authors in both industry and academia this book is an important resource for those working in the chemical food processing pharma and biotech industries especially those focused on the drying of plants for food and medicinal applications

**Process Design, Integration, and Intensification** Mahmoud El-Halwagi, Dominic C. Y. Foo, 2019-05-27 With the growing emphasis on enhancing the sustainability and efficiency of industrial plants process integration and intensification

are gaining additional interest throughout the chemical engineering community. Some of the hallmarks of process integration and intensification include a holistic perspective in design and the enhancement of material and energy intensity. The techniques are applicable for individual unit operations, multiple units, a whole industrial facility or even a cluster of industrial plants. This book aims to cover recent advances in the development and application of process integration and intensification. Specific applications are reported for hydraulic fracturing, palm oil milling processes, desalination, reactive distillation, reaction network, adsorption processes, herbal medicine extraction, as well as process control.

*Emerging Methods for Oil Extraction from Food Processing Waste* Prem Prakash Srivastav, Sangeetha Karunanithi, 2024-09-13. *Emerging Methods for Oil Extraction from Food Processing Waste* is a comprehensive and cutting edge exploration of sustainable oil extraction practices catering to professionals and researchers in food science. The book spanning 13 insightful chapters intricately reviews the extraction of oil from food processing by products including pomace and surplus raw materials. It specifically focuses on emerging non thermal technologies offering valuable insights into improving oil extraction rates. The discussions encompass factors influencing extraction rates and suggest processing conditions based on various extraction methods and raw materials. In addition to providing a nuanced understanding of conventional and novel extraction techniques, the text delves into the diverse applications of the extracted oil ranging from food preservation to fortification and fat replacement. Notably, it covers advanced processing techniques for enhancing oil stability, bioavailability and bioactivity through emulsion and encapsulation methods. Addressing crucial commercial aspects, the text explores economic feasibility, safety considerations and consumer acceptability, providing a holistic perspective for successful industrial adaptation. Authored by global specialists, each chapter offers in depth scientific reports and critical analyses, making this volume an indispensable resource for continuous research and advancement in the dynamic field of food processing.

**Chemistry and Chemical Technologies in Waste Valorization** Carol Sze Ki Lin, 2018-08-13. The series *Topics in Current Chemistry Collections* presents critical reviews from the journal *Topics in Current Chemistry* organized in topical volumes. The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology, medicine and materials science. The goal of each thematic volume is to give the non specialist reader, whether in academia or industry, a comprehensive insight into an area where new research is emerging, which is of interest to a larger scientific audience. Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole. The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed. The coverage is not intended to be an exhaustive summary of the field or include large quantities of data, but should rather be conceptual, concentrating on the methodological thinking that will allow the non specialist reader to understand the information presented. Contributions also offer an outlook on potential future developments in the field.

div Chapters  
Sonocatalysis: A Potential Sustainable Pathway for the Valorization of Lignocellulosic Biomass and Derivatives  
Valorisation of



Biowastes for the Production of Green Materials Using Chemical Methods and Green and Sustainable Separation of Natural Products from Agro Industrial Waste Challenges Potentialities and Perspectives on Emerging Approaches are available open access under a Creative Commons Attribution 4.0 International License via link [springer.com](https://www.springer.com) Green Approaches in Medicinal Chemistry for Sustainable Drug Design Bimal Banik, 2024-05-31 Extensive experimentation and high failure rates are a well recognized downside to the drug discovery process with the resultant high levels of inefficiency and waste producing a negative environmental impact Sustainable and Green Approaches in Medicinal Chemistry 2e reveals how medicinal chemistry can play a direct role in addressing this issue After providing essential context to the growth of green chemistry in relation to drug discovery the book goes on to identify a broad range of practical techniques and useful insights revealing how medicinal chemistry techniques can be used to improve efficiency mitigate failure and increase the environmental benignity of the entire drug discovery process Drawing on the knowledge of a global team of experts Sustainable and Green Approaches in Medicinal Chemistry Second Edition encourages the growth of green medicinal chemistry and supports medicinal chemists drug discovery researchers pharmacologists and all those in related fields across both academia and industry in integrating these approaches into their own work This second volume of the second edition includes the development of nanoparticles and nanocomposites as well as the application of ultrasound and microwave induced methods studies solventless synthesis defines the role of steroids studies reactions in aqueous solution identifies enzyme mediated reactions investigates ionic liquids and deep eutectic solvents explores natural products investigates solid supports realizes the effects of salts focuses on combinatorial chemistry develops one pot methods analyzes multi component reactions investigates dipole moment values and examines computer assisted methods Highlights the need for adoption of sustainable and green chemistry pathways in drug development Reveals risk factors associated with the drug development process and the ways sustainable approaches can help address these Identifies novel and cost effective green medicinal chemistry approaches for improved efficiency and sustainability **Digital Twins** Christoph Herwig, Ralf Pörtner, Johannes Möller, 2021-04-25 This is the first of two volumes that together provide an overview of the latest advances in the generation and application of digital twins in bioprocess design and optimization Both processes have undergone significant changes over the past few decades moving from data driven approaches into the 21st century digitalization of the bioprocess industry Moreover the high demand for biotechnological products calls for efficient methods during research and development as well as during tech transfer and routine manufacturing In this regard one promising tool is the use of digital twins which offer a virtual representation of the bioprocess They reflect the mechanistics of the biological system and the interactions between process parameters key performance indicators and product quality attributes in the form of a mathematical process model Furthermore digital twins allow us to use computer aided methods to gain an improved process understanding to test and plan novel bioprocesses and to efficiently monitor them This book explains the mathematical structure of digital twins their

development and the model's respective parts as well as concepts for the knowledge driven generation and structural variability of digital twins Covering fundamentals as well as applications the two volumes offer the ideal introduction to the topic for researchers in academy and industry alike *Innovative Food Processing Technologies* Kai Knoerzer, Pablo Juliano, Geoffrey W Smithers, 2016-06-29 Innovative Food Processing Technologies Extraction Separation Component Modification and Process Intensification focuses on advances in new and novel non thermal processing technologies which allow food producers to modify and process food with minimal damage to the foodstuffs The book is highly focused on the application of new and novel technologies beginning with an introductory chapter and then detailing technologies which can be used to extract food components Further sections on the use of technologies to modify the structure of food and the separation of food components are also included with a final section focusing on process intensification and enhancement Provides information on a variety of food processing technologies Focuses on advances in new and novel non thermal processing technologies which allow food producers to modify and process food with minimal damage to the foodstuffs Presents a strong focus on the application of technologies in a variety of situations Created by editors who have a background in both the industry and academia **Evidence-Based Validation of Herbal Medicine** Pulok K.

Mukherjee, 2022-07-12 Evidence Based Validation of Herbal Medicines Translational Research on Botanicals brings together current thinking and practice in the characterization and validation of natural products The book describes different approaches and techniques for evaluating the quality safety and efficacy of herbal medicine particularly methods to assess their activity and understand compounds responsible and their probable underlying mechanisms of action This book brings together the views expertise and experiences of scientific experts in the field of medicinal plant research hence it will be useful for researcher who want to know more about the natural lead with their validation and also useful to exploit traditional medicines Includes state of the art methods for detecting isolating and performing structure elucidation by degradation and spectroscopic techniques Highlights the trends in validation and value addition of herbal medicine with different scientific approaches used in therapeutics Contains several all new chapters on topics such as traditional medicine inspired drug development to treat emerging viral diseases medicinal plants in antimicrobial resistance TLC bio profiling botanicals as medicinal foods bioprospecting and bioassay guided isolation of medicinal plants immunomodulators from medicinal plants and more

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