

# EXTRACTION OF NATURAL PRODUCTS USING NEAR-CRITICAL SOLVENTS

Edited by  
M. B. King and T. R. Bott



SPRINGER-SCIENCE+BUSINESS MEDIA, B.V.

# Extraction Of Natural Products With Near Critical Solvents

**Mauricio A Rostagno, Juliana M Prado**



## **Extraction Of Natural Products With Near Critical Solvents:**

**Extraction of Natural Products Using Near-Critical Solvents** M.B. King,T.R. Bott,2012-12-06 The aim of this book is to present the current state of the art of extracting natural products with near critical solvents and to view the possibilities of further extensions of the technique Relevant background theory is given but does not dominate the book Carbon dioxide is the near critical solvent used in most recent applications and inevitably receives prominence In addition to general descriptions and reviews the book contains three chapters by industrial practitioners who describe in detail the operation of their processes and discuss the market for their products Sections on the design of the pressure vessels and pumps required in these processes and on the acquisition of the data required for design are included The costing of the processes is also discussed There is good scope for combining a near critical extraction step with other process steps in which the properties of near critical solvents are utilised for example as a reaction or crystallisation medium and a chapter is devoted to these important aspects It is hoped that the work will be found to contain a great deal of specific information of use to those already familiar with this field However the style of presentation and content is such that it will also be useful as an introduction In particular it will be helpful to those wondering if this form of separation method has anything to offer for them whether they are engineers chemists or managers in industry or in academic or research institutions *Plant Volatile Analysis* Hans F. Linskens,John F. Jackson,2013-06-29 Modern Methods of Plant Analysis When the handbook Modern Methods of Plant Analysis was first introduced in 1954 the considerations were 1 the dependence of scientific progress in biology on the improvement of existing and the introduction of new methods 2 the difficulty in finding many new analytical methods in specialized journals which are normally not accessible to experimental plant biologists 3 the fact that in the methods sections of papers the description of methods is frequently so compact or even sometimes so incomplete that it is difficult to reproduce experiments These considerations still stand today The series was highly successful seven volumes appearing between 1956 and 1964 Since there is still today a demand for the old series the publisher has decided to resume publication of Modern Methods of Plant Analysis It is hoped that the New Series will be just as acceptable to those working in plant sciences and related fields as the early volumes undoubtedly were It is difficult to single out the major reasons for the success of any publication but we believe that the methods published in the first series were up to date at the time and presented in a way that made description as applied to plant material complete in itself with little need to consult other publications Contribution authors have attempted to follow these guidelines in this New Series of volumes Editorial The earlier series of Modern Methods of Plant Analysis was initiated by Michel V **Extraction Optimization in Food Engineering** Constantina Tzia,George Liadakis,2003-07-21 The only comprehensive source on extraction process optimization this book details the installation construction development modeling control and economics of conventional and specialized extraction systems in the food processing industry It supplies case studies for illustration of specific extraction

systems in commercial food production      *Analytical Techniques for Natural Product Research* Satyanshu Kumar, 2015-12-15 Plants are important source of lead molecules for drug discovery These lead molecules serve as starting materials for laboratory synthesis of drug as well a model for production of biologically active compounds Phytochemical processing of raw plant materials is essentially required to optimize the concentration of known constituents and also to maintain their activities Extraction techniques and analytical techniques have played critical roles in phytochemical processing of raw materials Extraction technologies from conventional extraction to green extraction as well as analytical techniques from single technique to hyphenated coupled techniques most frequently used in phytochemistry laboratories are covered in the book      Supercritical Fluid Technology for Drug Product Development Peter York, Uday B. Kompella, Boris Y. Shekunov, 2004-03-23 Interconnecting the fundamentals of supercritical fluid SCF technologies their current and anticipated utility in drug delivery and process engineering advances from related methodological domains and pharmaceutical applications this volume unlocks the potential of supercritical fluids to further the development of improved pharmaceutical products from drug powders for respiratory delivery to drug delivery systems for controlled release      **Lipid Biotechnology** Tsung Min Kuo, Harold Gardner, 2002-01-22 This text presents the latest advances in supercritical fluid technology biocatalysis bioprocess engineering and crop breeding It offers an in depth review of the most recent principles and approaches utilized in the development and design of lipids for cosmetic industrial and pharmaceutical and food products Discussing a variety of lipid ac      *Alternative Solvents for Green Chemistry* Francesca M. Kerton, 2009 Everyone is becoming more environmentally conscious and therefore chemical processes are being developed with their environmental burden in mind This also means that more traditional chemical methods are being replaced with new innovations and this includes new solvents Solvents are everywhere but how necessary are they They are used in most areas including synthetic chemistry analytical chemistry pharmaceutical production and processing the food and flavour industry and the materials and coatings sectors However the principles of green chemistry guide us to use less of them or to use safer more environmentally friendly solvents if they are essential Therefore we should always ask ourselves do we really need a solvent Green chemistry as a relatively new sub discipline is a rapidly growing field of research Alternative solvents including supercritical fluids and room temperature ionic liquids form a significant portion of research in green chemistry This is in part due to the hazards of many conventional solvents e g toxicity and flammability and the significant contribution that solvents make to the waste generated in many chemical processes Solvents are important in analytical chemistry product purification extraction and separation technologies and also in the modification of materials Therefore in order to make chemistry more sustainable in these fields a knowledge of alternative greener solvents is important This book which is part of a green chemistry series uses examples that tie in with the 12 principles of green chemistry e g atom efficient reactions in benign solvents and processing of renewable chemicals materials in green solvents Readers get an overview of the many

different kinds of solvents written in such a way to make the book appropriate to newcomers to the field and prepare them for the green choices available. The book also removes some of the mystique associated with alternative solvent choices and includes information on solvents in different fields of chemistry such as analytical and materials chemistry in addition to catalysis and synthesis. The latest research developments not covered elsewhere are included such as switchable solvents and biosolvents. Also some important areas that are often overlooked are described such as naturally sourced solvents including ethanol and ethyl lactate and liquid polymers including poly ethyleneglycol and poly dimethylsiloxane. As well as these additional alternative solvents being included the book takes a more general approach to solvents not just focusing on the use of solvents in synthetic chemistry. Applications of solvents in areas such as analysis are overviewed in addition to the more widely recognised uses of alternative solvents in organic synthesis. Unfortunately as the book shows there is no universal green solvent and readers must ascertain their best options based on prior chemistry cost environmental benefits and other factors. It is important to try and minimize the number of solvent changes in a chemical process and therefore the importance of solvents in product purification extraction and separation technologies are highlighted. The book is aimed at newcomers to the field whether research students beginning investigations towards their thesis or industrial researchers curious to find out if an alternative solvent would be suitable in their work.

*Food Engineering Interfaces* José Miguel Aguilera, Ricardo Simpson, Jorge Welte-Chanes, Daniela Bermudez Aguirre, Gustavo Barbosa-Canovas, 2010-12-25. The International Conference on Food Engineering is held every four years and draws global participation. ICEF 10 will be held in April 2008 in Chile with the theme of food engineering at interfaces. This will not be a typical proceedings with uneven contributions. Papers will be solicited from each plenary speaker plus two or three invited speakers from each topic and the goal is to publish a book that conveys the interdisciplinary spirit of the meeting as well as covers the topics in depth creating a strong reference work. The idea is to explore how food engineers have to be prepared in years ahead not only to perform in their normal activities but also to engage in new challenges and opportunities that will make the profession more attractive responsive and able to create a larger impact. These challenges and opportunities are within the profession and at interfaces with other areas. A major role of engineers is to incorporate new knowledge into the profession and respond to practical needs. The goal is to explore how food engineers are integrating developments in the basic sciences of physics and chemistry nutrition informatics material sciences genomics and other omics quality and safety consumer behavior and gastronomy. Interfaces with the environment the business sector regulations and export markets are also important to consider.

**Phase Equilibrium Engineering** Esteban Brignole, Selva Pereda, 2013-04-02. In this chapter supercritical fluid extraction and fractionation of natural oil mixtures are presented as an alternative to traditional methods like steam distillation liquid solvent extraction or vacuum distillation. In the search of alternatives to traditional methods the principles of phase equilibrium engineering are followed to analyze the SCF extraction and continuous fractionation of natural products. The

fundamentals of these high pressure technologies which combine the principles of distillation and extractive distillation are presented together with the limitation of simple countercurrent fractionation which in the end justifies the need of external reflux Through several case studies the optimization and solvent selection are analyzed for processes in which the fractionation is driven by the pressure temperature and flow rate of the SCF

*Advances in Technologies for Producing Food-relevant Polyphenols* Jose Cuevas Valenzuela, Jose Rodrigo Vergara-Salinas, Jose Ricardo Perez-Correa, 2016-09-19 The growing concern for human wellbeing has generated an increase in the demand for polyphenols secondary plant metabolites that exhibit different bioactive properties This increasing demand is mainly due to the current applications in the food industry where polyphenols are considered essential for human health and nutrition *Advances in Technologies for Producing Food relevant Polyphenols* provides researchers scientists engineers and professionals involved in the food industry with the latest methodologies and equipment useful to extract isolate purify and analyze polyphenols from different available sources such as herbs flora vegetables fruits and agro industrial wastes Technologies currently used to add polyphenols to diverse food matrices are also included This book serves a reference to design and scale up processes to obtain polyphenols from different plant sources and to produce polyphenol rich foods with bioactive properties e g antioxidant antibacterial antiviral anticancer properties of interest for human health and wellbeing

*Laboratory Handbook for the Fractionation of Natural Extracts* Peter Houghton, Amala Raman, 2012-12-06 This laboratory manual will be welcomed by all research scientists involved in the extraction fractionation and isolation of compounds from natural materials especially those working with plants The book is clear and concise and features practical exercises to illustrate the techniques described in every chapter It will provide an invaluable research reference tool for those scientists investigating the potential benefits of ethnomedicine and the properties of chemicals isolated from natural flora

**Food Engineering Handbook, Two Volume Set** Theodoros Varzakas, Constantina Tzia, 2014-12-12 Food Engineering Handbook Two Volume Set provides a stimulating and up to date review of food engineering phenomena It also addresses the basic and applied principles of food engineering methods used in food processing operations around the world Combining theory with a practical hands on approach this set examines the thermophysical properties

**Food Engineering Handbook** Theodoros Varzakas, Constantina Tzia, 2014-11-24 Food Engineering Handbook Food Process Engineering addresses the basic and applied principles of food engineering methods used in food processing operations around the world Combining theory with a practical hands on approach this book examines the thermophysical properties and modeling of selected processes such as chilling freezing and dehydration A complement to Food Engineering Handbook Food Engineering Fundamentals this text Discusses size reduction mixing emulsion and encapsulation Provides case studies of solid liquid and supercritical fluid extraction Explores fermentation enzymes fluidized bed drying and more Presenting cutting edge information on new and emerging food engineering processes Food Engineering Handbook Food Process Engineering is an essential reference on the modeling quality safety

and technologies associated with food processing operations today

### **High Pressure Technologies in Biomass**

**Conversion** Rafał M. Łukasik, 2017-03-20 Bringing researchers and industrialists up to date with the latest advances in green high pressure technologies

**Food Process Engineering and Technology** Zeki Berk, 2018-02-13 Food Process Engineering and Technology Third Edition combines scientific depth with practical usefulness creating a tool for graduate students and practicing food engineers technologists and researchers looking for the latest information on transformation and preservation processes and process control and plant hygiene topics This fully updated edition provides recent research and developments in the area features sections on elements of food plant design an introductory section on the elements of classical fluid mechanics a section on non thermal processes and recent technologies such as freeze concentration osmotic dehydration and active packaging that are discussed in detail Provides a strong emphasis on the relationship between engineering and product quality safety Considers cost and environmental factors Presents a fully updated adequate review of recent research and developments in the area Includes a new full chapter on elements of food plant design Covers recent technologies such as freeze concentration osmotic dehydration and active packaging that are discussed in detail

Novel Food Processing Technologies Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, 2004-11-30 Reflecting current trends in alternative food processing and preservation this reference explores the most recent applications in pulsed electric field PEF and high pressure technologies food microbiology and modern thermal and nonthermal operations to prevent the occurrence of food borne pathogens extend the shelf life of foods and improve

*Supercritical Fluids Technology in Lipase Catalyzed Processes* Sulaiman Al-Zuhair, Hanifa Taher, 2018-10-08 Enzymes are currently used in various industries most commonly in food detergents and pharmaceuticals production Lipases are hydrolytic enzymes that demonstrate great potential as an alternative to conventional catalysts in a number of industrial applications A complete understanding of enzymes and their proteins structure and environmental behavior can greatly aid in the further development of industrial applications Supercritical Fluids Technology in Lipase Catalyzed Processes provides basic information about enzymes their sources reaction kinetics and main industrial applications The book focuses in lipases their main sources structure and features with an emphasis on their specificity and interfacial activity and presents proven techniques for isolating extracting and purifying Comprised of six compact chapters this comprehensive guide introduces Immobilization techniques and immobilized lipases that allow repeated use which is essential from an economic point of view Different bioreactor configurations using immobilized lipases The latest information on the available technologies in lipolytic reactions The advantages of nonaqueous media in biochemical synthesis over aqueous and solvent free systems Material on the use of lipases in nonaqueous media to overcome the drawbacks usually encountered with the use of conventional chemical catalysts The use of supercritical fluids SCFs as a green alternative reaction medium Factors affecting the physical properties of lipases in this medium and hence their activity and stability A case study using supercritical carbon dioxide SC CO<sub>2</sub> for

biodiesel production Novel cutting edge technology using immobilized enzymes to reduce the overall production cost

Supercritical Fluids Technology in Lipase Catalized Processes outlines the main industrial applications of common enzymes and discusses relevant challenges and innovations emerging in the field Alternative Solvents for Green Chemistry

Francesca Kerton, 2009-02-13 Everyone is becoming more environmentally conscious and therefore chemical processes are being developed with their environmental burden in mind This also means that more traditional chemical methods are being replaced with new innovations and this includes new solvents Solvents are everywhere but how necessary are they They are used in most areas including synthetic chemistry analytical chemistry pharmaceutical production and processing the food and flavour industry and the materials and coatings sectors However the principles of green chemistry guide us to use less of them or to use safer more environmentally friendly solvents if they are essential Therefore we should always ask ourselves do we really need a solvent Green chemistry as a relatively new sub discipline is a rapidly growing field of research Alternative solvents including supercritical fluids and room temperature ionic liquids form a significant portion of research in green chemistry This is in part due to the hazards of many conventional solvents e g toxicity and flammability and the significant contribution that solvents make to the waste generated in many chemical processes Solvents are important in analytical chemistry product purification extraction and separation technologies and also in the modification of materials Therefore in order to make chemistry more sustainable in these fields a knowledge of alternative greener solvents is important This book which is part of a green chemistry series uses examples that tie in with the 12 principles of green chemistry e g atom efficient reactions in benign solvents and processing of renewable chemicals materials in green solvents Readers get an overview of the many different kinds of solvents written in such a way to make the book appropriate to newcomers to the field and prepare them for the green choices available The book also removes some of the mystique associated with alternative solvent choices and includes information on solvents in different fields of chemistry such as analytical and materials chemistry in addition to catalysis and synthesis The latest research developments not covered elsewhere are included such as switchable solvents and biosolvents Also some important areas that are often overlooked are described such as naturally sourced solvents including ethanol and ethyl lactate and liquid polymers including poly ethyleneglycol and poly dimethylsiloxane As well as these additional alternative solvents being included the book takes a more general approach to solvents not just focusing on the use of solvents in synthetic chemistry Applications of solvents in areas such as analysis are overviewed in addition to the more widely recognised uses of alternative solvents in organic synthesis Unfortunately as the book shows there is no universal green solvent and readers must ascertain their best options based on prior chemistry cost environmental benefits and other factors It is important to try and minimize the number of solvent changes in a chemical process and therefore the importance of solvents in product purification extraction and separation technologies are highlighted The book is aimed at newcomers to the field whether research students beginning investigations towards their



thesis or industrial researchers curious to find out if an alternative solvent would be suitable in their work      **Natural Product Extraction** Mauricio A Rostagno, Juliana M Prado, 2015-10-09 Natural products are sought after by the food pharmaceutical and cosmetics industries and research continues into their potential for new applications Extraction of natural products in an economic and environmentally friendly way is of high importance to all industries involved This book presents a holistic and in depth view of the techniques available for extracting natural products with modern and more environmentally benign methods such as ultrasound and supercritical fluids discussed alongside conventional methods Examples and case studies are presented along with the decision making process needed to determine the most appropriate method Where appropriate scale up and process integration is discussed Relevant to researchers in academia and industry and students aiming for either career path Natural Product Extraction presents a handy digest of the current trends and latest developments in the field with concepts of Green Chemistry in mind      *Fruit and Vegetable Phytochemicals* Laura A. de la Rosa, Emilio Alvarez-Parrilla, Gustavo A. Gonzalez-Aguilar, 2009-10-13 Fruit and Vegetable Phytochemicals Chemistry Nutritional Value and Stability provides scientists in the areas of food technology and nutrition with accessible and up to date information about the chemical nature classification and analysis of the main phytochemicals present in fruits and vegetables polyphenols and carotenoids Special care is taken to analyze the health benefits of these compounds their interaction with fiber antioxidant and other biological activities as well as the degradation processes that occur after harvest and minimal processing

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