

Review

Emerging Developments in Separation Techniques and Analysis of Chiral Pharmaceuticals

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Abstract: Chiral separation, the process of isolating enantiomers from a racemic mixture, holds paramount importance in diverse scientific disciplines. Using chiral separation methods like chromatography and electrophoresis, enantiomers can be isolated and characterized. This study emphasizes the significance of chiral separation in drug development, quality control, environmental analysis, and chemical synthesis, facilitating improved therapeutic outcomes, regulatory compliance, and enhanced industrial processes. Capillary electrophoresis (CE) has emerged as a powerful technique for the analysis of chiral drugs. This review also highlights the significance of CE in chiral drug analysis, emphasizing its high separation efficiency, rapid analysis times, and compatibility with other detection techniques. High-performance liquid chromatography (HPLC) has become a vital technique for chiral drugs analysis. Through the utilization of a chiral stationary phase, HPLC separates enantiomers based on their differential interactions, allowing for the quantification of individual enantiomeric concentrations. This study also emphasizes the significance of HPLC in chiral drug analysis, highlighting its excellent resolution, sensitivity, and applicability. The resolution and enantiomeric analysis of nonsteroidal anti-inflammatory drugs (NSAIDs) hold great importance due to their chiral nature and potential variations in pharmacological effects. Several studies have emphasized the significance of resolving and analyzing the enantiomers of NSAIDs. Enantiomeric analysis provides critical insights into the pharmacokinetics, pharmacodynamics, and potential interactions of NSAIDs, aiding in drug design, optimization, and personalized medicine for improved therapeutic outcomes and patient safety. Microfluidics systems have revolutionized chiral separation, offering miniaturization, precise fluid control, and high throughput. Integration of microscale channels and techniques provides a promising platform for on-chip chiral analysis in pharmaceuticals and analytical chemistry. Their applications in techniques such as high-performance liquid chromatography (HPLC) and capillary electrochromatography (CEC) offer improved resolution and faster analysis times, making them valuable tools for enantiomeric analysis in pharmaceutical, environmental, and biomedical research.

Keywords: chiral separation; capillary electrophoresis; chiral selectors; chiral drugs; HPLC; NSAID; microfluidics system; monolithic column



Citation: Al-Sulaimi, S.; Kushwah, R.; Abdullah Alsibani, M.; El Jery, A.; Aldrdery, M.; Ashraf, G.A. Emerging Developments in Separation Techniques and Analysis of Chiral Pharmaceuticals. *Molecules* **2023**, *28*, 6175. <https://doi.org/10.3390/molecules28176175>

Academic Editor: Mauricio Alcalde Palacios

Received: 18 July 2023

Revised: 5 August 2023

Accepted: 14 August 2023

Published: 22 August 2023



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1. Introduction

The investigation of medication pharmacokinetics, peptide synthesis, and asymmetric synthesis in organic chemistry are just a few areas where the enantiomer separation of chiral substances is crucial [1]. Typically, chiral separation procedures can be divided into three groups: (i) separations utilizing chiral selectors like cyclodextrin and crown ethers in the operating buffer or mobile phase of high-performance liquid chromatography (HPLC)

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Uwe Gottschalk



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New Developments in Separation Methods Symposium on New Methods of Separation Staff, **Modern Phytochemical Methods** Nikolaus H. Fischer, Murray B. Isman, Helen A. Stafford, 2012-12-06 This volume contains reviews which are based on a symposium given at the 30 meeting of The Phytochemical Society of North America held at Laval University in Quebec City Canada on August 11 15 1990 During the past two decades there have been major new developments in methods which can be applied toward the isolation separation and structure determination of complex natural products Therefore the topic of this symposium *Modern Phytochemical Methods* is a very timely one The organizers of the symposium recognized that it would not be possible to cover in detail all new advances in phytochemical methodology It was therefore decided to emphasize general reviews on recent developments of major separation techniques such as high performance liquid chromatography as well as supercritical fluid chromatography In addition advances in commonly used structure determination methods mainly NMR and MS are reviewed Other topics include methodologies of micro sampling for isolation and analysis of trichome constituents as well as recent breakthroughs on biosynthetic studies of monoterpenes using enriched basal cells of trichomes The volume concludes with a review of quantitative structure activity relationship QSAR studies of biologically active natural products In Chapter I K Hostettmann and his colleagues give a general review of recent developments in the separation of natural products with major emphasis on preparative separations of biologically active plant constituents The authors present a comparison of droplet countercurrent chromatography OCCC with the highly rapid and more versatile centrifugal partition chromatography CPC

New Developments in Nanosensors for Pharmaceutical Analysis Sibel A. Ozkan, Afzal Shah, 2019-05-22 *New Developments for Nanosensors in Pharmaceutical Analysis* presents an overview of developments in nanosensor usage in pharmaceutical analysis thereby helping pharmaceutical companies attain reliable precise and accurate analysis of pharmaceuticals This book presents very simple precise sensitive selective fast and relatively inexpensive methods for pre treatment prior to analysis These methods may be considered for further application in clinical studies and assays The book includes the manufacturing of sensors for pharmaceutical analysis at nano or smaller scales and gives simple and reliable designs for the fabrication of sensors Twelve chapters cover an introduction to the topic immobilization techniques mechanism effect of nanomaterials on structure optical nanosensors for pharmaceutical detection chemical nanosensors in pharmaceutical analysis noble metal nanoparticles in electrochemical analysis of drugs photo electrochemical nanosensors for drug analysis molecularly imprinted polymer based nanosensors for pharmaceutical analysis nanomaterials for drug delivery systems nanomaterials enriched nucleic acid based biosensors nanosensors in biomarker detection and nanomaterials based enzyme biosensors for electrochemical applications Presents nanosensor types synthesis immobilizations and applications in different fields Gives simple repeatable designs for the fabrication of sensors for pharmaceutical analysis Details how to carry out sensitive analysis of

pharmaceuticals using nanosensors Describes how to synthesize and immobilize nanosensors and how nanosensors can be applied in drug assay Proposes innovative ways to optimize pharmaceutical processes with nanosensors **Particle Separation Techniques** ,2022-07-22 Particle Separation Techniques Fundamentals Instrumentation and Selected Applications presents the latest research in the field of particle separation methods This edited book authored by subject specialists is logically organized in sections grouping the separation techniques according to their preparative or analytical purposes and the particle type Along with the traditional and classical separation methods suitable for micron particles an update survey of techniques appropriate for nanoparticle characterization is presented This book fills the gap in the literature of particle suspension analysis of a synthetic but comprehensive manual helping the reader to identify and apply selected techniques It provides an overview of the techniques available to a reader who is not an expert on particle separation yet about to enter the field design an experiment or buy an instrument for his her new lab Presents a resource that is ideal for anyone preparing samples across a variety of fields including pharmaceuticals food science pollution analysis and control agricultural products and more Includes real case examples discussed by leading experts in the field Provides chapters that contain a unique common table that summarizes points of strength and the weaknesses of each technique

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Artificial Intelligence in Process Engineering Michael Mavrovouniotis,2012-12-02 Artificial Intelligence in Process Engineering aims to present a diverse sample of Artificial Intelligence AI applications in process engineering The book contains contributions selected by the editors based on educational value and diversity of AI methods and process engineering application domains Topics discussed in the text include the use of qualitative reasoning for modeling and simulation of chemical systems the use of qualitative models in discrete event simulation to analyze malfunctions in processing systems and the diagnosis of faults in processes that are controlled by Programmable Logic Controllers There are also debates on the issue of quantitative versus qualitative information The control of batch processes a design of a system that synthesizes bioseparation processes and process design in the domain of chemical rather than biochemical systems are likewise covered in the text This publication will be of value to industrial engineers and process engineers and researchers

Mineral Processing S. P. Mehrotra, 1995 **The Mechanization, Automation, and Increased Effectiveness of the Clinical Laboratory** National Institute of General Medical Sciences (U.S.). Automation in the Medical Laboratory Sciences Review Committee, 1971 The Mechanization, Automation and Increased Effectiveness of the Clinical Laboratory National Institute of General Medical Sciences (U.S.), 1971 Physical Cleaning of Coal Y. A. Liu, 2018-01-18 This book provides a detailed account of recent developments in physical coal cleaning methods including Relative density Electrical conductivity Magnetic susceptibility surface chemistry characteristics Handbook of Advanced Chromatography /Mass Spectrometry Techniques Michal Holcapek, Wm. Craig Byrdwell, 2017-09-07 Handbook of Advanced Chromatography Mass Spectrometry Techniques is a compendium of new and advanced analytical techniques that have been developed in recent years for analysis of all types of molecules in a variety of complex matrices from foods to fuel to pharmaceuticals and more Focusing on areas that are becoming widely used or growing rapidly this is a comprehensive volume that describes both theoretical and practical aspects of advanced methods for analysis Written by authors who have published the foundational works in the field the chapters have an emphasis on lipids but reach a broader audience by including advanced analytical techniques applied to a variety of fields Handbook of Advanced Chromatography Mass Spectrometry Techniques is the ideal reference for those just entering the analytical fields covered but also for those experienced analysts who want a combination of an overview of the techniques plus specific and pragmatic details not often covered in journal reports The authors provide in one source a synthesis of knowledge that is scattered across a multitude of literature articles The combination of pragmatic hints and tips with theoretical concepts and demonstrated applications provides both breadth and depth to produce a valuable and enduring reference manual It is well suited for advanced analytical instrumentation students as well as for analysts seeking additional knowledge or a deeper understanding of familiar techniques Includes UHPLC HILIC nano liquid chromatographic separations two dimensional LC MS LCxLC multiple parallel MS 2D GC GCxGC methodologies for lipids analysis and more Contains both practical and theoretical knowledge providing core understanding for implementing modern chromatographic and mass spectrometric techniques Presents chapters on the most popular and fastest growing new techniques being implemented in diverse areas of research *Pharmaceutical Analysis* David C Lee, Michael L. Webb, 2009-02-12 The use of analytical sciences in the discovery development and manufacture of pharmaceuticals is wide ranging From the analysis of minute amounts of complex biological materials to the quality control of the final dosage form the use of analytical technology covers an immense range of techniques and disciplines This book concentrates on the analytical aspects of drug development and manufacture focusing on the analysis of the active ingredient or drug substance It provides those joining the industry or other areas of pharmaceutical research with a source of reference to a broad range of techniques and their applications allowing them to choose the most appropriate analytical technique for a particular purpose The volume is directed at analytical chemists industrial pharmacists organic chemists pharmaceutical chemists and biochemists *Basic*

Concepts Of Analytical Chemistry S M Khopkar, 1998 Analytical Chemistry Has Made Significant Progress In The Last Two Decades Several Methods Have Come To The Forefront While Some Classical Methods Have Been Relegated An Attempt Has Been Made In This Edition To Strike A Balance Between These Two Extremes By Retaining Most Significant Methods And Incorporating Some Novel Techniques Thus An Endeavour Has Been Made To Make This Book Up To Date With Recent Methods The First Part Of This Book Covers The Classical Volumetric As Well As Gravimetric Methods Of Analysis The Separation Methods Are Prerequisite For Dependable Quantitative Methods Of Analysis Therefore Not Only Solvent Extraction Separations But Also Chromatographic Methods Such As Adsorption Partition Ion Exchange Exclusion And Electrochromatography Have Been Included To Keep Pace With Modern Developments The Newly Discovered Techniques Such As Ion Chromatography Super Critical Fluid Chromatography And Capillary Electrophoresis Have Been Included The Next Part Of The Book Encompasses The Well Known Spectroscopic Methods Such As Uv Visible Ir Nmr And Esr Techniques And Also Atomic Absorption And Plasma Spectroscopy And Molecular Luminescences Methods Novel Analytical Techniques Such As Auger Esca And Photo Acoustic Spectroscopy Of Surfaces Are Also Included The Final Part Of This Book Covers Thermal And Radioanalytical Methods Of Analysis The Concluding Chapters On Electroanalytical Techniques Include Potentiometry Conductometry Coulometry And Voltammetry Inclusive Of All Kinds Of Polarography The Theme Of On Line Analysis Is Covered In Automated Methods Of Analysis To Sustain The Interest Of The Reader Each Chapter Is Provided With Latest References To The Monographs In The Field Further To Test The Comprehension Of The Subject Each Chapter Is Provided With Large Number Of Solved And Unsolved Problems This Book Should Be Useful To Those Reads Who Have Requisite Knowledge In Chemistry And Are Majoring In Analytical Chemistry It Is Also Useful To Practising Chemists Whose Sole Aim Is To Keep Abreast With Modern Developments In The Field

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