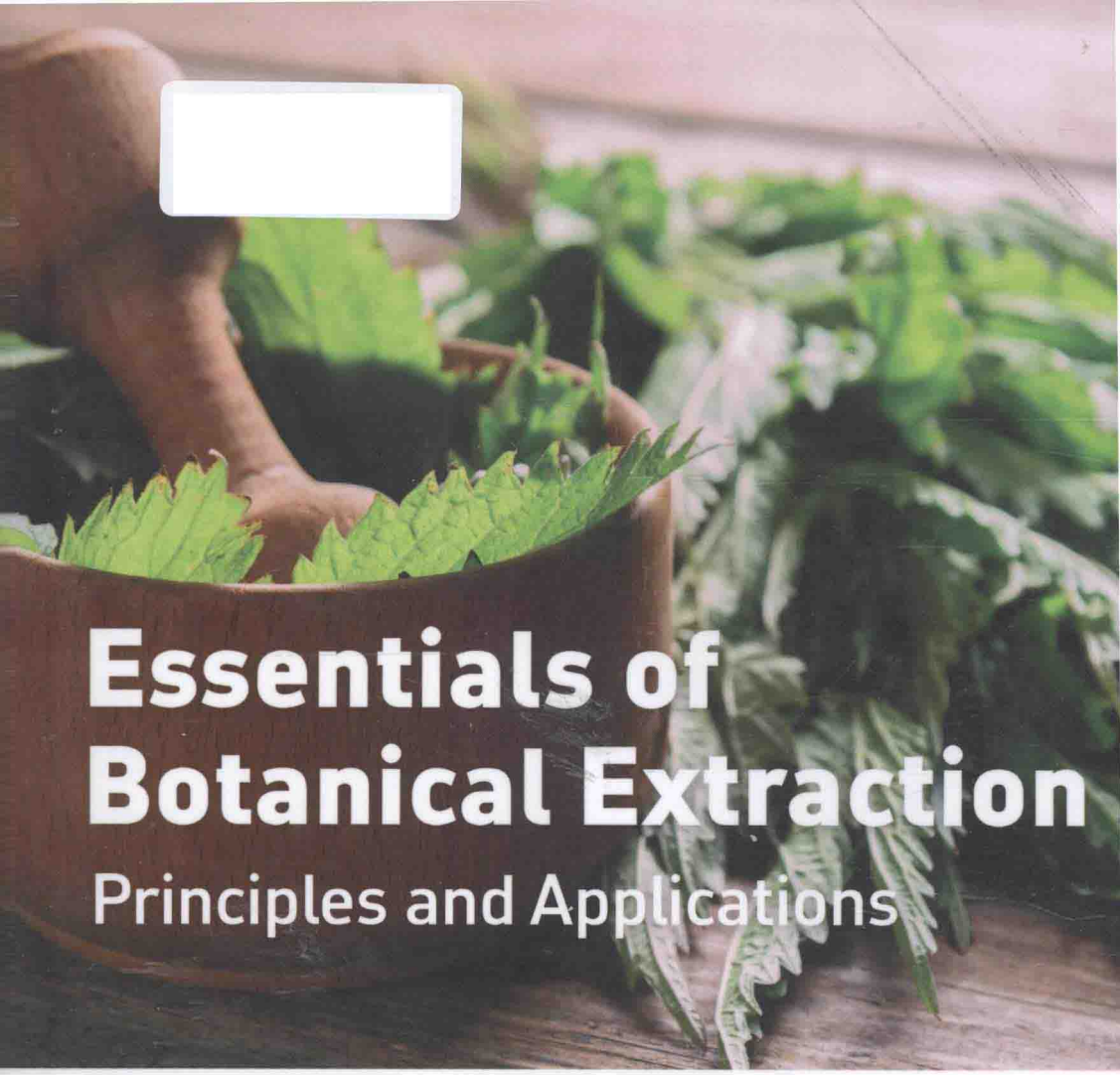

Essentials of Botanical Extraction

Principles and Applications

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Foreword by Sarker

I am absolutely delighted to learn that Dr Subhash C. Mandal, a distinguished scientist in the area of Pharmacognosy and Phytotherapy, and two other learned coauthors from his team have presented us with a useful reference book that encompasses various principles and applications associated with botanical extraction.

As the title, **Essentials of Botanical Extraction – Principles and Applications**, implies, this book integrates insights regarding several conventional and modern extraction methods pertinent to extraction of botanicals, and demonstrates the importance of the choice of appropriate extraction methods for drug discovery and development from botanical sources. It also covers various mathematical models and chemometric aspects in relation to extraction. This book is replete with several practical examples, suitable diagrams and figures, and is easy to follow.

The book comprises 10 well-written chapters, starting with a basic introduction (Chapter 1) and ending with Chapter 10, which covers aspects of profiling crude extracts for rapid identification of bioactive compounds. Although the book mainly focuses on various extraction technologies and methods, it also incorporates chapters on various related matters—for example, Chapter 6 deals with identification strategies of phytochemicals. The profundity of this book relies on the fact that the authors have perfectly utilized their own experience and knowledge in this area of research, and also captured contemporary relevant literature. This book is certainly a valuable addition to currently available classical well-known books in this area, e.g., Phytochemical Methods (By J.B., Harborne), and Natural Products Isolation (Eds: Sarker, S.D. and Nahar, L.).

It is my pleasure to provide this foreword and to recommend this valuable book to all, experienced or novice, who have been involved in research with botanicals.

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Foreword by Verpoorte

"What you see is what you extract"

Recently we wrote an editorial for a special issue of Phytochemical Analysis on metabolomics with the above mentioned title (Choi and Verpoorte, 2014). In fact the extraction is the most crucial step in any process concerning analysis and isolation of natural products as well as in the use of medicinal plants as such. This book deals with all the aspects involved from harvesting to possible final analyses of the extracts in quite a comprehensive way. In biochemistry and molecular biology, extraction plays a major role for which highly standardized methods are used and in case of the latter field even standard kits are used for DNA and RNA extraction. Genomics, transcriptomics and proteomics are built upon such a solid basis. Unfortunately such an extraction platform does not exist for small molecules, because in contrast with the mentioned omics, where the targeted macromolecules have similar physical properties, the small molecules cover a very wide range of chemo-diversity and thus of physico-chemical properties. As a result there is no single extraction method that can be applied to extract all small molecules from a biological sample. This is a major factor hampering the development of public databases for metabolomics. What solvent to choose is a major concern, as none is able to extract both polar water soluble compounds. Moreover, poorly soluble compounds will be present in an extract at saturation level, but that does not allow a proper quantitation, as the real amount present in the plant could be of higher magnitudes. This book is a rich source of all relevant information to help developing the right protocol for an extraction, from micro to macro scale. But it even goes a step further as it also takes in consideration the preextraction steps. To develop an optimal extraction for any application, one has to deal with many interconnected variables. To be able to deal with such complexity it is necessary to use design of experiment software; the book indeed introduces this approach as an important research tool. Also methods to analyze the extracts for the presence of various phytochemicals are reviewed. So I think the authors did a great job in covering all these aspects; this book will be an indispensable standard work for any person and any laboratory interested in studying natural products, not only in plants, but in any organism!

Prof. Dr Rob Verpoorte
Natural Products Laboratory, IBL, Leiden University
The Netherlands

Preface

Today when different chromatographic methods can provide high resolution of complex mixtures of almost every matrix, from gases to biological macromolecules, and detection limits down to few nanograms or below, the whole advanced analytical process still can be wasted if an unsuitable sample preparation or extraction method has been applied before the sample reaches the chromatographic system. A poorly prepared botanical extract is sufficient to jeopardize even the most powerful chromatographic detection system. The first step in the qualitative and quantitative analysis of medicinal plant constituents is the "extraction" and it is an important step in studies involving the discovery of bioactive compounds from plant materials. Unfortunately, even though most of the research in medicinal plants begins with extraction, but still today not much attention has been paid to this crucial step. Most people in the world perform botanical extraction every day, without bothering about it, when they make a cup of tea, coffee, or other beverage made with hot water or milk. Even scientists working with medicinal plants often carry out extraction as a casual step considering it as only a necessary step toward the more exciting stages of fractionation and isolation and thus the entire focus shifts toward the greed of ending up with a new compound.

A few moments spent thinking about extraction is amply rewarded when one considers what is happening and how this affects the constituents and their amounts in the extract obtained. If extraction is not performed judiciously the subsequent work and results obtained are misleading and this creates a shaky foundation for further studies utilizing them. Moreover, just immediately after extraction another question that comes haunting to the natural product scientists is regarding the postextraction operations which ultimately pave the way for a new bioactive(s). In such a situation dependency on serendipity is heavily relied upon.

The 10 major chapters of this book which is an amalgamation of our research experience will address these issues; trying to explore natural products research from a different prospective so that the dependency on serendipity is reduced and the same can be turned into planned happenstance. The book for the first time tries to link chemometric strategies to the science of optimized and robust botanical extractions. Through this book, we also have tried to show how technology and environment can complement each other by bringing to the readers the principles and applications of green extraction technologies so that

with the advancement of science and technology we still can keep the earth a better place to live in for our future generations.

We humbly seize this opportunity to express our sincere thanks to different national and international funding agencies to support us in our journey of natural products research with the aim to find a magical silver bullet against human sufferings. We are also thankful to our respective organizations for their continuous infrastructural and scientific support. Sincere thanks are due to our research team members. Finally we express our deep gratitude to our family members for being supportive in times of stress in compiling this book.

Subhash C. Mandal
Vivekananda Mandal
Anup Kumar Das

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