
Preface

Plants consistently synthesize, accumulate, and use a bewildering range of secondary metabolites as a part of their overall defense strategy. Many of these metabolites have been used around the world as medicines for various human health problems. In fact, more than 80% of the world's population relies on plants for principle health care. Nearly half of the medical prescriptions in the developed world are of plant origin.

In recent years the quest for quality of life and a common belief that plants are “natural and therefore safe” has paved the way for a wider acceptance of plant-based medicines worldwide. International trade in medicinal plants has become a major force in the global economy and the demand is increasing in both developed and developing countries. Thus, the continued rise in consumer demand for plant-based medicines and the expanding world population have resulted in indiscriminate harvest of wild species of medicinal plants. As well, a reduction of natural habitats for medicinal plants has placed many wild species in danger of extinction. The impact of rapid climate changes may also have an adverse effect on wild-plant species leading to the loss of useful genetic material. Most medicinal plants are harvested from the wild and the traditional agricultural and horticultural practices have not been developed even for most commonly used medicinal plant species.

The quality and consistency of the products are the most challenging issues facing the plant-based medicines. The production of medicinal metabolites in plants is affected by plant genotype, growth environment cultivation, harvesting, processing, and distribution. Medicinal plant preparations may also be contaminated with microbes and soil contaminants such as heavy metals, herbicides, pesticides, and other agricultural chemicals which can cause qualitative and quantitative changes in the levels of medicinal metabolites. The widespread occurrence of chemical variability and compromised quality of medicinal plants remain the major factors in inconsistent results of clinical trials of plant-based medicines. New regulations are currently being developed internationally to ensure consistency, safety and efficacy of plant-based medicines as well as how they are developed, manufactured, and marketed. Clearly, there is an imminent need for the development of new technologies and production approaches to improve the overall strategy of medicinal plant production to comply with up-coming legal regulations.

In vitro cell culture and controlled environment production systems offer an excellent opportunity for the selection and season-independent propagation of elite lines with specific, consistent levels of medicinal metabolites with minimum contamination. Additionally, the plant materials produced by in vitro techniques allow efficient application of the emerging analytical methods—such as metabonomics—for complete chemical profiling which has enormous potential for the discovery of new medicinal compounds.

Traditional breeding programs for medicinal plants are generally difficult to establish primarily due to lack of defined chemistry of medicinal components. Little knowledge of the genetic regulation of pathways of potential bioactive molecules further compounds this problem. In vitro techniques such as somaclonal variation, chemical mutagenesis, haploidy, protoplast fusion, and genetic transformation are applicable to create novel

germplasm. The impact of these techniques is perhaps greatest in the improvement of medicinal plants since the resulting genetic diversity may open avenues for the discovery of new medicinal metabolites and treatments. Furthermore, the genetic manipulation of plant cells and organs has great advantages for producing secondary metabolites and other bioactive natural products. Together with the tools of chemical and genomic analyses, the in vitro culture methods hold the key to fundamental research on the biochemical and molecular basis of the mode of action of plant-based medicines. This book provides a detailed step-by-step description of protocols for the establishment of in vitro cultures of important medicinal plants, their mass multiplication in a controlled environment, and step-wise secondary metabolite analysis, genetic transformation, large-scale metabolite production in a bioreactor, and molecular markers. The role of altered microgravity in plant metabolite production is also described. In addition, many of these protocols will provide a basis for much needed efforts of in vitro germplasm conservation or cryopreservation of medicinal plant species at the brink of extinction as well as efforts to protect them from the adverse impact of rapid climatic changes. This book will certainly appeal to graduate and post graduate students, researchers, biotechnologists, industry, government agencies, and could be used as a text book.

This book contains 31 book chapters, divided into five sections. Section I contains 16 chapters describing step-wise protocols for micropropagation and chemical analysis of secondary compounds of different medicinal plants. Section II contains five chapters which address the transgenic approach for producing secondary metabolites. Section III contains two chapters which cover molecular markers/microsatellites. Section IV has six chapters which address biotransformation, bioreactors, and metabolomics. Finally, section V contains two review chapters describing plant secondary metabolites in altered microgravity and role of biotechnology in producing anti-cancer compounds. Each chapter has been peer reviewed and revised accordingly.

We appreciate the time and effort that all reviewers have put into the development of these chapters which aided in improving the quality of the material presented herein. We extend our most sincere thanks to the staff of Humana Press for giving us the opportunity to present this book to our audience.

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