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Foundations and Advances in Pharmaceutical Sciences

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PREFACE

Pharmaceutical sciences continue to evolve through the integration of natural product research, drug design, formulation development, and pharmacological evaluation. The increasing complexity of healthcare demands a multidisciplinary understanding of medicines, from their origin and development to their therapeutic application and regulatory evaluation. This book, *Integrated Pharmaceutical Sciences: From Natural Sources to Therapeutic Applications*, was prepared to provide a concise and structured overview of major domains within pharmaceutical sciences.

The book presents fundamental and applied concepts related to pharmacognosy, pharmaceutics, pharmaceutical chemistry, and pharmacology in an integrated manner. Each chapter has been designed to provide clear academic content with emphasis on practical relevance, recent developments, and current pharmaceutical approaches. Topics included range from natural drug sources and phytochemicals to novel drug delivery systems, toxicological screening, regulatory aspects, nanotechnology, and personalized medicine.

This book is intended for undergraduate and postgraduate students, researchers, and academic professionals seeking a compact interdisciplinary resource in pharmaceutical sciences. The contributors have aimed to maintain scientific accuracy while presenting the material in a concise and accessible format.

We hope this book will contribute to academic learning and encourage further exploration in the field of pharmaceutical sciences.

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Chapter – 2

Natural Sources of Drugs

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2.1. Introduction

Natural products form the foundation of pharmaceutical sciences and drug discovery. A natural product is a chemical compound or substance produced by a living organism found in nature. The term refers more specifically to secondary metabolites. Primary metabolites, such as amino acids, carbohydrates, and lipids, maintain basic life functions. Secondary metabolites are non-essential for basic survival but provide evolutionary advantages, including defence against predators, attraction of pollinators, and competitive inhibition of competing species. These secondary metabolites possess specific pharmacological activities in humans.

The isolation of morphine from *Papaver somniferum* (opium poppy) by Friedrich Sertürner in 1804 initiated the modern era of natural product pharmacology. Before this event, medical practitioners relied on crude extracts, tinctures, and powders. The ability to isolate, purify, and quantify active pharmaceutical ingredients (APIs) allowed for precise dosing and reproducible therapeutic outcomes. Following morphine, chemists rapidly isolated other active compounds, including quinine from *Cinchona* bark, caffeine from *Coffea arabica*, and atropine from *Atropa belladonna*.

Despite the advent of high-throughput screening and combinatorial chemistry in the late 20th century, natural products remain central