Chapter 1

Definition, History, Scope and Development of Pharmacognosy

INTRODUCTION

Mother nature has provided all the needs of human being including the medicines for better health. It includes a complete cure for almost all the types of ailments of the mankind. The knowledge and the experience accumulated over 1000s of years have given birth to today's modern medicine system. More than 60% of world population, directly or indirectly still uses the natural products for their primary healthcare needs. Nature is a symbiotic complex of the interdependent biotic and abiotic components. In the biotic component, the plants remain indispensable for human life, and provide a complete storehouse of remedies to all human ailments along with animals and other natural components. Very early man sought to alleviate his sufferings from injury and disease by growing plants around him and using them. But today, we have an accumulation of knowledge about the therapeutic properties of different plants. It is estimated that over 3 lakh species of plants yield many products of medicinal importance derived from over 300 families of flowering plants. The plant kingdom still holds many species of plants containing substances of medicinal value which have yet to be discovered and large numbers of plants are constantly being screened for their possible medicinal value.

A large number of crude drugs consist of entire plants or animals like Irish moss and cantharides, of parts of plants or animals like leaflets of senna and thyroid gland, of minerals like kaolin and chalk, of substances derived by extraction from plants or animals like catechu, resins, etc. are included in pharmacognosy. In addition to these, others like fibres and fabrics used for surgical dressings, materials such as diatomite and asbestos used as strainers for filtration and clarification of liquids, substances such as agar, gelatine, wax used as remedial agents and vehicles for the preparation of ointments, culture media, substances like pyrethrum used for the destruction of the insect pests are also included. The earliest books that contained the descriptions of the above materials were referred to as

'*herbals*' while the more recent ones are called the '*materia medica*'. The herbals are represented by '*Ortus Sanitatis*' (the *Garden of Health* – 1491), '*De Historia Stirpium*' (1542) by Leonhart Fuchs and '*A New Herbal*' (1551) by William Turner. *Ortus Sanitatis* contained an account of materia medica of animal, vegetable and mineral kingdoms arranged in an alphabetical order along with the illustrations and were used as a standard textbook of medicine in the 16th century England. It also contained many quotations from the Arabian writings of Rhazes and Avicenna, from the Greek writings of *Dioscorides* and *Galen* and from Roman writings of *Pliny* and *Cato*. *De Historia Stirpium* consisted of vegetable drugs arranged alphabetically with their Latin names and provided reliable descriptions and illustrations with which the medicinal plants could be correctly identified. '*A New Herbal*' was a notable and earliest English herbal of the 16th century which provided a true scientific account of plants. The plants (simples) are arranged alphabetically under their Latin names which replaced 'The Great Herbal' (*Ya Grete Herball*) similar to '*Ortus Sanitatis*'.

Later, an increasing amount of the details were gradually added onto the accounts contained in the earlier textbooks like their action, the preparation and an arrangement based on the accepted botanical and zoological classifications. This can be exemplified by the treatise of Pereira's *Materia Medica* (1839). As such an inclusion of the details became unwieldy; the study on the basis of different points of view was divided into four distinct branches, *viz*. 'Pharmaceutical Chemistry'—dealing with theory and fundamentals of scientific chemistry of the substances of pharmaceutical importance, 'Pharmaceutics' or 'Pharmacy'—dealing with the modes of treatment of chemicals and crude drugs in the preparation of medicines in a form suitable for administration, 'Pharmacodynamics' or 'Pharmacology' (synonymous with the older materia medica, still used under the same name in USA) concerned with the study of responses of organisms when they are subjected to treatment by drugs and 'Pharmacognosy'—dealing with structural, physical, chemical and sensory characters of crude drugs of animal, vegetable and mineral origin including their history, cultivation and collection, and other particulars related to their passage from the producer to the distributor or pharmacist. In the earlier days, the crude drugs were referred to as 'simples' or 'simple drugs' as their occurrence was natural and the terms 'simples' and '*Simplicia*' were used in French books such as Guibourt's '*Histoire des Drogues Simples*' and London pharmacopoeia as a general heading.

PHARMACOGNOSY–DEFINITION

The term, '*Pharmacology*', may be defined as '*a branch of biology which deals in detail with crude medicinal and related products derived from plant, animal or mineral sources, and is concerned with the responses of the organisms to drugs*

after their administration'. The 'drug' on the other hand, is '*a substance used to modify the physiological system or the pathological state for the benefit of the receiver*'. This is the systematic study of the crude drugs obtained from natural origin like plants, animals and minerals. This involves the detailed study of the drugs obtained through natural sources including the name, habitat, collection, cultivation, macroscopy, microscopy, physical properties, chemical constituents, therapeutic actions, uses and adulterants. The drug science (pharmacology) is divided into three branches, *viz*. '*Pharmacy*' ('*Pharmacy*' is a Greek word which means '*Poison*' or '*Drug*') dealing with the procurement, testing, storage and conversion into suitable medicinal forms of drugs, '*Pharmacodynamics*' concerned with the action of drugs upon the organism and '*Pharmacotherapy*' dealing with the use of drugs in the disease treatment. The drugs may be organic or inorganic and the organic drugs may be synthetic or of biological origin. Pharmacognosy deals with the drugs of biological origin. The term, *Physiopharmcognosy* proposed by Wasicky is a more appropriate name. The American Society of Pharmacognosy defines pharmacognosy as: '*the study of the physical, chemical, biochemical and biological properties of drugs, drug substances or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources*'.

In the 19th century, the term, '*Materia Medica*' was used for '*Pharmacognosy*'. Even though the science of pharmacognosy was practiced since a very early period, the term, '*pharmacognosy*' formed from the Greek words was used for the first time by the Austrian Physician, Johann Adam Schmidt (1811), in his handwritten manuscript '*Lehrbuch der materia medica*', which was posthumously published in Vienna (1811), to describe 'the study of medicinal plants and their properties'. It was in 1815, during his studies with Sarsaparilla, it was Crr. Anotheus Seydler, a German scientist, coined the term, '*pharmacognosy*' in his work, '*Analecta Pharmacognostica*', a small work. The term '*Pharmacognosy*' is derived from two Greek words, '*pharmakon*' meaning a '*drug*' (derived from Latin term—*Droog* meaning 'dried'—when dried plants were commonly used as medicine in the earlier times) and '*gnosis*' meaning '*knowledge*', meaning the '*knowledge of drugs*', as recorded by Dr. K. Ganzinger. Pharmacognosy may be defined as '*the study of those natural substances principally plants that find use in medicine*'. During the 19th century and the beginning of the 20th century, pharmacognosy was used to define the branch of medicine or commodity sciences (*Warenkunde*, in German) which deals with 'the drugs in their crude or unprepared form'. The crude drugs are dried, unprepared material of plant, animal or mineral origin, used for medicine. Such study under the name, '*pharmacognosie*' was first developed in German speaking areas of Europe, while the other language areas often used the older term, '*materia medica*' and in German, the term '*drogenkunde*' (science of crude drugs) is also used synonymously.

PHARMACOGNOSY–HISTORY

The history of herbal medicine is as old as human civilisation. The primitive man, who went in search of food, ate at random the plants or plant parts like leaves, fruits, seeds, roots, tubers, etc. He categorised them as edible (for food) if he found no ill effects after eating, and inedible if he was subjected to any ill effect and according to the nature of the symptoms observed, he used them to cure the diseases. For example, a plant was used as a purgative, if it caused diarrhoea, as an emetic, if it caused vomiting, as an arrow–poison if it caused death. This knowledge was obtained as a trial and error. He used these drugs as infusions and decoctions. The results were passed on from generation to generation and knowledge was added on in the same way. The antiquity documents reveal that the plants were used as medicine in China, India, Egypt and Greece long before the Christian era. The Egyptians were familiar with the medicinal properties of plants and animals in addition to human anatomy and embalming the dead and preserving their bodies as mummies. The earliest reference to the use of the medicinal herbs and a cure for disease as well as the method of embalming the dead was described in the most famous manuscript of '*Papyrus Ebers*', an ancient book (150 BC), 60 feet long and 1 foot wide scroll found in one of the mummies dating back to 16th century BC. It contained 800 formulae and 700 different drugs such as acacia, castor oil, fennel, iron oxide, sodium chloride, sodium carbonate and sulphur. The ancient Egyptians documented their knowledge about medicine on paper made from *Cyperus aquaticus*, commonly called *Papyrus*, or *Aquatic sage*. *Papyrus Ebers* (around 1500 BC), *Berlin Papyrus, Edwin Smith Smith Papyrus, Kahum Medicak Papyrus* are some of the oldest handbooks which contain the information of illness and treatments. In ancient Egypt and Mesopotamia, clay tablets were used to document the knowledge of drugs which date back to 3000 BC. The people in the prehistoric times used plants quite intuitively for food, shelter and even curing their many bodily disorders and thereby kept their health in perfect state of fitness and lived a long-life. The medicinal plants played a very important role from times immemorial. The medicinal properties of plants were almost certainly known to the Chinese as long ago as 5000 BC although not until the Egyptians in the reign of Khufu around 4500 BC had documentary proof of the exploitation of such materials is seen. The oldest known herbal is *Pen-tsao* written by the Emperor Shen Nung around 3000 BC. It contained 365 drugs, one for the each day of a year. The Ayurvedic texts of the Indian Healers (of Ancient India) around 1000 BC list many hundreds of plant extracts and their use for medicinal and spiritual purposes. The information about the drugs of Ancient India was documented in several Ayurvedic texts which still exist (such as *Atharvaveda, Charak Samhita, Sushrut Samhita, Madhav Nidan* and *Bhava Prakash*).

Greeks also contributed much to the knowledge of natural history. About 4000 BC, Hippocrates (460–370 BC), the '*Father of Medicine*', rejected magico-ritual treatment of the disease and advocated that medicine was a science and not a myth. Following Hippocrates, Aristotle (384–322 BC), a student of Plato and a philosopher, wrote authoritatively on animal kingdom. Theophrastus (30–287 BC), a student of Aristotle, wrote in detail about the plant kingdom and Dioscorides (40–80 AD), a physician described medicinal plants like belladonna, ergot, opium and colchicum which are in use even today. Pliny wrote natural history in 37 volumes and Galen (131–200 AD), the first pharmacist, devised '*galenicals*', the methods of preparation of the plant and animal drugs. He was also known for a number of pain relieving preparations including opium. The early Arabians have also contributed much to herbal medicine. Paracelsus (1493–1541) developed mineral salts as potential curative agents. The early writings on the clay tablets by the Sumarians show that their medicines included opium, liquorice, thyme and mustard. Babylonians used senna, saffron, coriander, cinnamon, garlic, etc. in their medicinal concoctions, wines, and poultices. A perusal of ancient Sanskrit texts dating back to the vedic periods reveal that Indians have a sound knowledge of '*Vrikshayurveda*', the '*science of medicinal plants*'. Varahamihira in his '*Brihatsamhita*' and '*Agnipurana*' and Sarangadhara in his '*Vrikshayurveda*' have dealt with the subject in a greater detail. Parasara, Uddalaka and Yajnavalkya have also written on '*Vrikshayurveda*'. Atreya (1st century AD), a famous medical practitioner, wrote '*Atri Samhita*'. During the middle ages, the knowledge of medicinal plants was further developed by the European monks who studied and grew drug plants and also translated the Arabic herbals. The Central and South American natives also possessed extensive knowledge of the indigenous traditional herbs. One important inclusion is *Uncaria tomentosa* (*Una de Gato* or Cat's Claw herb) from the Peruvian rain forest which has become very popular in USA as an immune-stimulant. *Prunus africana* (pygeum) beneficial for the prostate gland was discovered from native Africans, tea tree oil from the leaves of *Melaleuca* tree was discovered from the Australian aborigines and was used by the British soldiers as an antiseptic during World War II and *Morinda citrifolia* (noni), an immune-stimulant and *Piper methysticum* (Kava kava) were discovered from the natives of South Pacific.

The evidence for the knowledge of medicinal plants in India is very old as the medicinal properties of plants for a wide range of purposes were described in Rigveda and Atharvaveda, during 3500–1500 BC from which the science of Ayurveda developed. They have been in fact used in a continuous unbroken tradition for over 4 millennia. '*Rig veda*', the oldest repository of human knowledge written between 4500 and 1500 BC mentions the use of 67 plants for the therapeutic use and '*Yajurveda*' enlists 81 plants whereas the '*Athrva veda*' written during 1200 BC describes 290

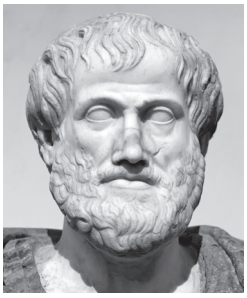
plants of medicinal value. In Ayurveda, the well known treatises are '*Charaka Samhitha*' (900 BC) which dealt with mostly plants wherein 500 medicinal plants were described in 50 groups of 10 herbs each sufficing the ordinary needs of a physician and '*Sushrutha Samhitha*' (600 BC) in which surgery was also included contained 760 medicinal herbs in 7 distinct sets on the basis of their common properties.

Pharmacognosy was more a descriptive science even up to the beginning of the 20th century which made a rapid stride thereafter. A century ago, the objective of pharmacognosy was limited primarily to the recognition of crude plant and animal drugs and their sources. The pharmacist then was concerned with the procurement of drugs and manufacturing galenical preparations from them. The species of *Capsicum* did not enter the European pharmacognosy until Columbus and his crew encountered them on the island of Hispanola, the modern Greater Antilles (1494). Garcia da Orta (1563) of the Portuguese Colonial Services practiced medicine and studied pharmacognosy with particular reference to the plants of Southern Indian peninsula and tropical medicine. During the rule of Ming Dynasty (1368–1644), a monumental work on materia medica, 'Compendium of Materia Medica' (*Bencao Gangmu*) was compiled by a doctor and a pharmacist, Li Shizhen and published in 52 volumes (1590). It contained the details of 1892 drugs, 1160 pictures and 11096 prescriptions and was a multidisciplinary book of botany, pharmacognosy, pharmacology and therapeutics. The importance of alcohol in the extraction of medicines was reported by Le'mery (1645–1715). W. Withering (1785) published an account of the medicinal properties of foxglove leaves. Derosne, the French Pharmacist (1803), isolated narcotine from opium. Serttuerner (1806) isolated morphine from opium and recognised its role in alleviating pain. In the coming years (1817–1820), strychnine, emetine, brucine, piperine, quinine and colchicine were isolated. Pelletier, the French Pharmacist, was the first to report the isolation of strychnine from Ignatius Beans and later from seeds of *Nux vomica*. Martius (1825) delivered the first lecture on pharmacognosy. Dr King (1835) developed a resinous *Cimicifuga* alcohol-based extract which he called cimicifugin (macrotin), which was the first resinous concentrates of Eclectics and described the obstetric uses. Stass and Otto (1852) developed a new extraction process for the alkaloids. Posselt and Reimann (1828) isolated nicotine from the leaves of tobacco, Neumann (1860) isolated cocaine, Hardy and Gallows (1867) isolated ouabain, Gerrard and Hardy (1875) isolated pilocarpine, Nagai (1887) isolated ephedrine and Kuersten (1891) isolated podophyllotoxin. Other significant discoveries in the 20th century are the isolation of ergometrine, digitoxin, reserpine, theophylline and quinidine. The first laboratory manual on pharmacognosy, '*Pharmacy and Prescription Writing*', was published in 1902 as its second edition. The first published American Materia Medica, '*Therapeutics and Pharmacognosy*' (1919) lists lemon as the primary citrus plant to have

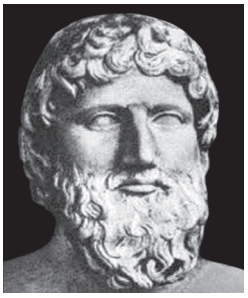
the medicinal properties and citric acid in the lemon juice is a very useful therapy. It is mentioned that lemon juice can be used in the treatment of malaria and some cases of chronic rheumatism and gout in addition to prevention of scurvy and to control postpartum.

Jakob Schleiden (1857) discovered that various types of Sarsaparilla root can be distinguished by means of their endodermal cells. Since then, drug histology was recognised as an important means of detecting impurities and adulterants in the crude drugs. Commerce made more foreign drugs available and the adulterants also became more common. With the rise of drug houses, drugs became available not only in whole form but also in cut and powdered from. The powders could not be identified with certainty by visual inspection only and as a result, the identification of some drugs and the testing of their purity became much more complicated.

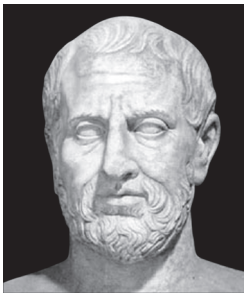
The period between 1930 and 1960 refers to the development of modern pharmacognosy by the simultaneous application of any disciplines as well as the methods and techniques of analytical chemistry like chromatography and spectrophotometry. During this period, many substances were isolated and elucidated from plants. These included the isolation of penicillin by W. Fleming (1928) and its large scale production by Florey and Chain (1941),



Aristotle



Plato



Theophrastus

Dioscorides

Hippocrates

Pliny—the Elder

Galen

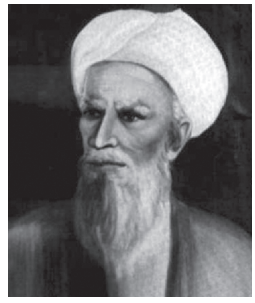
Charaka

Sushrutha

Paracelsus

Leonhart Fuchs

Avicenna



Rhazes

William Turner

John Gerard

Otto Brunfels

Emperor Shen Nung

Li Shizhen-Physician

isolation of reserpine and confirmation of its tranquilising properties, isolation of vincristine and vinblastine with proven anticancerous properties and many steroid hormones. As such, this period was referred to as the antibiotic age due to isolation and studies of other active antibiotics like streptomycin, chloramphenicol, tetracycline, etc. During 1980–1990s, new plant drug development programmes are traditionally undertaken by random screening or ethnobotanical approach.

PHARMACOGNOSY–SCOPE AND DEVELOPMENT

Pharmacognosy encompasses the knowledge of the history, distribution, cultivation, collection, processing and preservation, the study of sensory, physical, chemical and structural characters and the use of crude drugs. It also includes the study of other materials used in pharmacy such as suspending, disintegrating and flavouring agents, filtering aids, etc. and substances like antibiotics, allergens, hallucinogenic and poisonous plants, immunising agents, pesticides, raw materials for the production of oral contraceptives, etc.

This branch is the oldest of all pharmacy science, and is critical in the development of different disciplines of science. A pharmacognosist should possess a sound knowledge of the terms used to describe the vegetable and animal drugs in botany and zoology respectively. The knowledge of plant taxonomy, plant breeding, plant pathology and plant genetics is helpful in the development of cultivation technology for the medicinal and aromatic plants. Phytochemistry has undergone significant development in recent years as a separate discipline, and is concerned with an enormous variety of substances that are synthesised and accumulated by the plants as well as their structural elucidation. The extraction, isolation, purification, and characterisation of a variety of phytochemicals from the natural sources are important for the advancement of the medicine system. In addition, the knowledge of chemotaxonomy, the biogenetic pathways (for the formation of medicinally active primary and secondary metabolites), plant tissue culture and other related fields is also essential for the complete understanding of this branch of science. Similarly, one should have the basic knowledge of the biochemistry and chemical engineering for the development of collection, processing and storage technology of the crude drugs.

At present, this interdisciplinary branch of science is concerned with problems such as the biogenesis of drug products, drug resistance, mutation and adaptation as well as the effect of the environment on organisms of drug production. Because of a wider scope, it shares ground with other branches of sciences like chemistry, biochemistry, physiology, enzymology, food technology, bacteriology, and other fields of specialisation like taxonomy, anatomy, morphology, plant physiology, genetics, biochemistry,

phytochemistry, microbiology and several others. It also supplies the general information to the pharmacists. Because of these reasons, pharmacognosy has become a discipline of increasing significance.

Nowadays, this has become a kind of multidisciplinary subject which embraces phytochemistry, analytical pharmacognosy, pharmacotherapy, medicinal plant biotechnology, herbal formulations and nutraceuticals. *Zoopharmacognosy* is a branch of pharmacognosy which involves the observation of the animal behaviour for the discovery and the development of new drugs. At present, drugs from the natural origin are studied, formulated and regulated in the framework of allopathy.

REVIEW QUESTIONS

1. Essay and Short Answer Questions

1. What is 'pharmacognosy'? Write an account of its historical development.
2. Write an account of the history, development and the scope of 'pharmacognosy'.
3. Define 'pharmacognosy'. What is its scope in the studies of drug development? Discuss the development of pharmacognosy in recent years.

2. Choose the Correct Alternative

1. The term 'pharmacognosy' was first used by: [ ]
   a. Theophrastus b. JA Schmidt
   c. K Ganzinger d. Wasicky
2. The term 'pharmacognosy' was coined by: [ ]
   a. Gannzinger b. Guibourt
   c. Seydler d. Leonhart Fuchs
3. The medicinal properties of Foxglove leaves were first published by: [ ]
   a. Lémery b. Derosne
   c. Withering d. Serttuerner
4. Ephedrine was isolated by: [ ]
   a. Posselt and Reimann b. Hardy and Gallows
   c. Stass and Otto d. Nagai
5. Cocaine was isolated by: [ ]
   a. Neumann b. Kuersten
   c. Hardy d. Reimann

3. Fill in the Blanks:

1. The earliest reference of the use of the herbs and a cure for the disease was .....
2. The oldest known herbal written by Shen Nung (3000 BC) was .....

3. The mineral salts were developed as potential curative agents by .....
4. ..... isolated morphine from opium and recognised its role in pain alleviation.
5. The isolation of strychnine from Ignatius Beans was first reported by .....

4. True or False Statements:

1. Diatomite is used as a strainer for filtration and clarification of liquids. [True/False]
2. *Ortus Sanitatis* was not a standard textbook of medicine in England during the 16th century. [True/False]
3. The earliest English herbal of the 19th century was *A New Herbal*. [True/False]
4. Pharmacology deals with the study of responses of the organisms during treatment. [True/False]
5. In the olden days, the crude drugs were called *simples*. [True/False]

5. Match the following:

1. Leonhart Fuchs	[ ]	a. *A New Herbal*
2. CA Seydler	[ ]	b. *Physiopharmacognosy*
3. Wasicky	[ ]	c. *De Historia Stirpium*
4. Hippocrates	[ ]	d. *Analecta Pharmacognostica*
5. William Turner	[ ]	e. *Father of Medicine*