

PHARMACOGNOSY-I

C. K. KOKATE • A. P. PUROHIT • S. B. GOKHALE



A TEXT BOOK OF
PHARMACOGNOSY-I

FIRST YEAR B. PHARM
GUJART TECHNOLOGICAL UNIVERSITY

S. B. GOKHALE

M. Pharm., A. I. C.

Former co-ordinator
RC Patel Institute of Pharmaceutical Education
Shirpur, Dist. Dhule - 425405 (M.S.)

Dr. C. K. KOKATE

M. Pharm., Ph. D., F.C.A.E.S. (Germany)

President,
Indian Society of Pharmacognosy
and
Vice-chancellor,
Former KLE University,
JNMC Campus, Nehru Nagar,
Belgaum - 590010. (Karnataka)

A. P. PUROHIT

M. Pharm., A. I. C.

Former Asst. Professor and Head,
Department of Pharmacognosy,
B. V.'s Poona College of Pharmacy and Research Centre,
Pune - 411 038. (M.S.)

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PREFACE TO THE THIRD EDITION

The text has been revised thoroughly additional matter also incorporated (like- Isappgol) where so ever it was necessary. We hope students will find it in order.

August 2017

**S. B. GOKHALE
C. K. KOKATE
A. P. PUROHIT**

PREFACE TO THE FIRST EDITION

Gujarat Technological University Ahmedabad, has revised the syllabus of Bachelor of Pharmacy from 2009-10, with introduction of semester system. The subjects and their contents have been updated, taking into consideration the developments in pharmacy profession.

Phytochemical evaluation, modern analytical techniques for screening of herbal drugs, herbal cosmetics, and market products are the new chapters added to the subject Pharmacognosy.

Brief account of plant based industries and information of institutions involved in work of medicinal and aromatic plants in India are the special features that have been incorporated.

We are pleased to introduce Pharmacognosy-I and Pharmacognosy-II by offering every justice to all the features of syllabi and hope the students shall be benefited by our efforts.

We are thankful to publisher Shri Dineshbhai Furia, Shri Jigneshbhai Furai and Staff members of Nirali Prakashan for their co-operation in brining out this book.

February 2013
Basant-Panchmi

S. B. GOKHALE
C. K. KOKATE
A. P. PUROHIT

SYLLABUS

Pharmacognosy – I

B.Pharm Semester – II

1. Definition, history, scope and development of Pharmacognosy.
2. Sources of drugs : Plant, biological, marine, and mineral. Tissue culture as source of drugs.
3. Classification of drugs : Alphabetical, Morphological, Taxonomical, Chemical and Pharmacological.
4. Morphology : Seed, root, stem, leaf, bark wood, flower and fruit. Modification of root and stem. Histology of dicot and monocot root, stem and leaf.
5. Cultivation collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Plant hormones and their applications. Polyploidy, mutation and Hybridization with reference to medicinal plants.
6. Quality control of crude drugs : Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical, biological and other method of evaluation.
7. An introduction to active constituents of drugs and their classification and properties.
8. Systemic pharmacognostic study of the following :
 - (a) Carbohydrates and derived products : Agar, guar gum, acacia, honey, isabgol, pectin, starch, sterculia, tragacanth and sodium alginate.
 - (b) Lipids : Beeswax, castor oil, coca butter, cod liver oil, hydnocarpus oil, sesame oil wool fat, kokum butter, lard, linseed oil, rice bran oil, shark liver oil.



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DEFINITION, HISTORY, SCOPE AND DEVELOPMENT OF PHARMACOGNOSY

HISTORY, DEFINITION AND SCOPE OF PHARMACOGNOSY

NATURE always stands as a golden mark exemplify the outstanding phenomenon of symbiosis. The biotic and abiotic elements of nature are all interdependent. Plants are indispensable to man. The three important necessities of life namely food, clothing, shelter and most of other useful products are supplied to him by the plant kingdom. Nature has provided a complete storehouse of remedies to cure all ailments of mankind. The knowledge of drugs has accumulated over thousands of years as a result of man's inquisitive nature so that today we possess many effective means of ensuring health care.

The human being appears to be afflicted with more diseases than any other animal species. There can be little doubt then that he, very early, sought to alleviate his sufferings from injury and disease by taking advantage of plants growing around him. In the past, almost all the medicines used were from the plants, the plant being man's only chemist for ages. Today, a vast store of knowledge concerning therapeutic properties of different plants has accumulated. All phylla of plants viz. Thallophyta, Bryophyta, Pteridophyta and Spermatophyta, (of which conservative estimates place the total number of known species at approximately 3,35,000) contain species that yield official and unofficial products of medicinal importance. By far, the greatest number of these are derived from plants and include three hundred or more recognised families of Spermatophyta.

The history of herbal medicines is as old as human civilization. The documents, many of which are of great antiquity, revealed that plants were used medicinally in China, India, Egypt and Greece long before the beginning of the Christian era. One of the most famous surviving remnants is ***Papyrus Ebers***, a scroll some 60 feet long and a foot wide, dating back to the sixteenth century before Christ. The text of document is dominated by more than 800 formulae and 700 different drugs. The drugs such as acacia, castor oil and fennel are mentioned alongwith apparent references to such compounds as iron oxide, sodium chloride, sodium carbonate and sulphur. Most of the medicinally active substances identified in the nineteenth and the twentieth centuries were used in the form of crude extract. In China, many medicinal plants had been in use since 5000 B.C. The oldest known herbal is *Pen-t'sao* written by emperor **Shen Nung** around 3000 B.C. It contains 365 drugs, one for each day of the year. Indians also, worked meticulously to examine and classify the herbs which they came across, into groups called Gunas. **Charaka** made fifty groups of ten herbs each of which, according to him, would suffice an ordinary physician's need. Similarly, **Sushruta** arranged 760 herbs in 7 distinct sets based on some of their common properties. A large portion of the Indian population even today depends on the Indian System of Medicine - **Ayurveda**, '**An ancient science of life**'. The well known treatises in Ayurveda are ***Charaka Samhita*** and ***Sushruta Samhita***.

Following the contribution to medicine by **Hippocrates** "Father of medicine", (460 - 360 B.C.), **Aristotle** (384 - 322 BC), **Dioscorides** (40 - 80 A.D.) **Galen** (131 - 200 A.D.) and the early Arabian physicians, there was a period of approximately 1000 years during which little, if any, progress was made in the medical sciences. The first pharmacist, Galen, was known to have had a number of pain-relieving materials, including opium in his apothecary. For the next few hundred years, the formulations of the medicaments in use changed very little, although some bold attempts were made by chemical entrepreneurs such as **Paracelsus** (1493 -1541) to develop mineral salts which might have had the potential of being universal curative agents. However, throughout this period, the use of herbal extracts for medicinal purposes never lost its place.

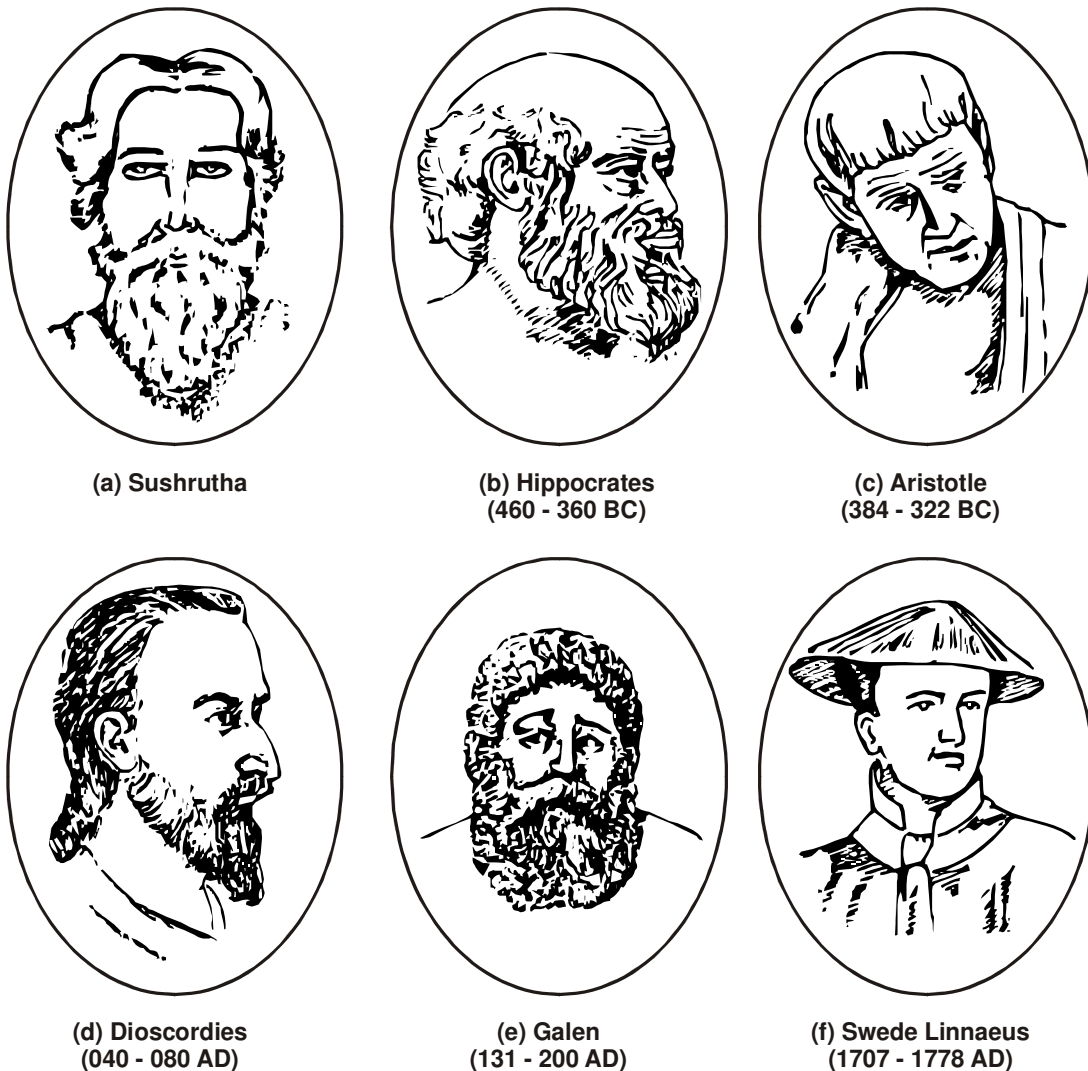


Fig. 1.1: The Great Contributors

The importance of the extraction method and alcohol as an extractant was reported by **Le'mery** (1645-1715). **William Withering** in 1785 published an account of some of the medicinal properties of foxglove leaves based on ten years of experimentation. Percolation process was used for the crude drugs. Calumba, an alkaloidal drug, became official in 1788. In 1803, the French pharmacist, **Derosne** isolated narcotine from opium. In 1806, **Sertuerner** isolated morphine from opium and its role in alleviating pain was recognised. In the next few years, strychnine (1817), emetine (1817), brucine (1819), piperine (1819), quinine (1820) and colchicine (1820) were isolated. The French Pharmacist, **Pelletier** first reported the isolation of strychnine from ignatius beans and later from *nux vomica* seeds. A new extraction process for alkaloid was developed by **Stass** and **Otto** in 1852. Other important discoveries during this period were the isolation of nicotine from tobacco leaves (**Posselt** and **Reimann**, 1828), cocaine (**Neumann**, 1860), ouabain (**Hardy** and **Gallows**, 1877), pilocarpine (**Gerrard** and **Hardy**, 1875), ephedrine (**Nagai**, 1887) and podophyllotoxin (**Kuersten**, 1891). Isolation of ergometrine, digoxin, reserpine, theophylline and quinidine are the significant discoveries of the twentieth century.

In the nineteenth century, the term '**Materia Medica**' was used for the subject now known as "Pharmacognosy". While studying Sarsaparilla, it was **Seydler**, a German scientist, who coined the term "Pharmacognosy" in 1815 in the title of his work "**Analecta Pharmacognostica**". Pharmacognosy is derived from two Greek words viz. *Pharmakon* (a drug) and *Gignosco* (to acquire the knowledge of).

Pharmacognosy may be defined as a branch of bioscience which treats in detail medicinal and related products of crude or primary type obtained from plant, animal and mineral origins. In short, it is an objective study of crude drugs from natural sources treated scientifically and it encompasses the knowledge of the history, distribution, cultivation, collection, processing for market and preservation, the study of sensory, physical, chemical and structural characters and the uses of crude drugs. Pharmacognosy also includes 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, immunizing agents, pesticides, raw materials for the production of oral contraceptives, etc.

Swede Linnaeus (1707 - 1778) the great systematist classified the plants and introduced the system of naming the plants known as the binomial system which is still followed.

The progress achieved in botanical studies during 19th century had a direct influence on Pharmacognosy. Plant classification was further developed by **Bentham** and **Hooker** (1862-1863), **A.W. Eichler** (1883), **Engler** and **Prandtl** (1887-1898). In 1865, **G. Mendel's** important observations on plant hybrids were published. The introduction of the microscope, as an important analytical tool, was a landmark advancement in botanical research, especially due to the development of several techniques: clearing, mounting and staining of the preparations. The *Anatomical Atlas of Crude Drugs* was published by **Berg** in 1865. Later in the century, **Voehl**, **Tschirch** and others reported the anatomical characters of several powdered drugs which proved to be of great significance especially at a period when adulteration in both drugs and food articles was common. '*An Anatomical Atlas of Powdered Vegetable Drugs*' was compiled in 1904 by **Greenish** and **Collin**.

Pharmacognosy as an applied science has played a crucial role 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 as covered under 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 medicinal and aromatic plants. Plant - chemistry (phytochemistry) has undergone significant development in recent years as a distinct discipline. It is concerned with the enormous variety of substances that are synthesised and accumulated by plants and the structural elucidation of these substances. The technology involving extraction, purification and characterisation of pharmaceuticals from natural sources is a significant contribution to the advancement of natural and physical sciences. The knowledge of chemotaxonomy, biogenetic pathways for formation of medicinally active primary and secondary metabolites, plant tissue culture and other related fields is essential for complete understanding of Pharmacognosy. The basic knowledge of biochemistry and chemical engineering is essential for development of collection, processing and storage technology of crude drugs.

Pharmacognosy is an important link between Pharmacology and Medicinal Chemistry. As a result of rapid development of phytochemistry and pharmacological testing methods in recent years, new plant drugs are finding their way into medicine as purified phytochemicals, rather than in the form of traditional galenical preparations. The knowledge of pharmacology is essential for understanding action of drugs on animals and the human system. Pharmacognosy is the infrastructure on which depends evolution of novel medicines, as it is seen that several crude drugs are utilized for preparation of galenicals or as sources of therapeutically significant substances that cannot be synthesised economically. Further, the crude drugs also provide essential intermediates for final synthesis of active compounds. Phytopharmaceuticals or synthetic drugs derived from phytochemicals have to be ultimately incorporated in suitable dosage form which involves the knowledge of dispensing and preparative pharmacy, pharmaceutical technology and analysis.

In a nutshell, Pharmacognosy is an important bridge between the pharmaceutical and basic sciences. Pharmacognosy is a vital link between Ayurvedic and Allopathic systems of medicines. It provides a system wherein the active principles of crude drugs derived from natural origin can be dispensed, formulated and manufactured in dosage forms acceptable to allopathic system of medicine.

TRADITIONAL INDIAN SYSTEMS OF MEDICINE

1. Ayurveda:

The system of Ayurveda-Ancient Science of Life-originated in India about 3000 years ago. It is one of the oldest systems of medicine identified exclusively with ancient Indian civilization and dealing with both preventive and curative aspects of life. The principles of positive health and therapeutic measures embedded in this system relate to mental, physical, social and spiritual welfare of human beings. Ayurveda encompasses the knowledge of Kayachikitsa (Internal medicine), Kaumarbhritya (Paediatrics), Trahchikitsa (Psychological medicine), Shalakya Tantra (Otorhinolaryngology and Ophthalmology), Shalya Tantra (Surgery) Agada Tantra (Toxicology), Rasayana Tantra (Geriatrics) and Vajikarana Tantra (Eugenics and Aphrodisiacs).

The Pharmacopoeia of Ayurveda consists of more than 8000 recipes made of natural drugs derived from herbal, mineral, animal and marine sources. These are used singly or in combinations and in varied forms such as decoctions, infusions, distillates, extracted juices, powders, pills, tablets, syrups, fermented liquids, bhasmas, medicated oils etc.

2. Unani System of Medicine

The roots of this system go deep to the times of the well known Greek philosopher **Hippocrates** who is credited with it. **Aristotle Golen** (384 - 322 BC) Greek - Philosopher "*Father of natural history*" made valuable contributions to it. This system of Greek origin was further carried to Persia (Iran), where it has been improved by Arabian physicians.

This system is based on two theories viz. the Hippocratic theory of four humours and the Pythagorean theory of four proximate qualities. The four humours are blood, phlegm, yellow bile and black bile while the four qualities are the states of living human body like hot, cold, moist and dry. They are represented as earth, water, fire and air. The Greek ideas were put by Arabian physicians as seven working principles (*Umur-e-Tabia*) and included elements, temperaments, humours, organs, life, spirit, energy and actions. They believed that these principles are responsible for the body constitution and its health, as well as, the diseased conditions.

The Unani system of medicine aims at treating the cause of disease and not its symptoms. For this purpose, thorough history of the patient is recorded in addition to his pulse, urine and stool examinations. The diseased condition is considered to be due to the imbalance between humours and accordingly, treatment is given. The drugs are polyherbal formulations and their collective effect is considered.

Unani system of medicine is called by various names in different parts of world such as Arab medicine, Greco-Arab medicine, Loniah medicine, Islamic medicine and also Oriental medicine.

Unani-medicines: Madar, fufal, Gilo, Kabab chini, Karanj, Kulthi, Lodh, Qust, Sana, Tagar, Zeera, Siyah.

3. Homeopathic System of Medicine

In comparison to other traditional systems of medicine, Homeopathy is a newer one and has been developed in the eighteenth century by **Samuel Hahnemann** - a German physician and chemist. He proposed that the cause of disease itself can be used for its treatment. Hahnemann put forth the Law of Similars which says that like cures like (*Similae similibus curentur*). With this principle, he showed that cinchona can produce the symptoms of malaria. He succeeded in getting relevant results with a large number of extracts prepared from plants, animals and minerals. He compiled all these observations in what is called '*The Organon of Medicine*.'

In the homoeopathic system, the drug treatment is not specified, but the choice of drug depends on symptoms and the clinical condition of the patient. This is based on the concept of proving and prover. In a healthy person called prover, the symptoms created by different doses of drug extracts are noted which is called proving, and it specifically considers physical, mental and emotional changes of the prover. Consequently, these symptoms are compared with a patient with similar symptoms and accordingly, same type of extract is given for treatment. During the treatment, the

drug extracts are extremely diluted, which is believed to cause potentiation and enhancement of curative effect. The drugs are extracted in the form of mother tincture, which is further diluted in terms of decimal or centesimal potencies. Various medicinal plants used in homeopathy are:

Table 1.1: Sources of occurrence of Homeopathic medicines

Vegetable drugs	Animal drugs	Minerals and metals
Arnica, Belladonna, Marigold, Chamomile, Colchicum, Hemlock, Hyoscyamus, Hypericum, Ipecacunha, Lycopodium, Opium, Ergot, Thuja, Aconite, Nux vomica	Honeybees, Calcium carbonate, Cantharis	Arsenic oxide, Barium carbonate, Calcium phosphate, Kalashisa, Mercuric chloride, Antimony tartrate, Sulphur, Copper, Aluminium, Phosphorus, Platinum

4. Siddha System of Medicine

The term ' Siddha ' means achievement and ' Siddhars ' were saintly personalities, who attained proficiency in medicine through practice of Bhakti and Yoga. This is the system of pre-vedic period identified with Dravidian culture and it is largely therapeutic in nature. Like Ayurveda, this system believes that all objects in universe are made up of five basic elements namely, earth, water, sky, fire and air. The identification of causative factors of diseases is done through pulse reading, colour of body, study of voice, urine examination, status of digestive system and examination of tongue. The literature of Siddha system is mostly in Tamil.

Few natural drugs used in Siddha system of medicine are:

Abini	:	(Papaver – somniferum),
Alari	:	(Nerium – Indicum),
Ethi :		(Strychnous – Nux vomica),
Gomathi	:	(Datura – stramonium),
Haikalli	:	(Ephorbia – nerifolia),
Rotha Polam	:	(Aloe – barbadensis)

5. Naturopathy and Yoga

Naturopathy is not merely a system of treatment, but also a way of life, which is based on laws of nature. The attention is particularly paid to eating and living habits, adoption of purificatory measures, use of hydrotherapy, mud packs, baths, massage etc.

The system of Yoga is as old as Ayurveda. The eight components of Yoga are restraint, observance of austerity, physical postures, restraining of sense organs, breathing exercises, contemplation, meditation and samadhi. Yoga exercises have potential in improvement of better circulation of oxygenated blood in the body, restraining the sense organs, improvement of social and personal behaviour and induction of tranquility and serenity in the mind.



SOURCES OF NATURAL DRUGS

As mentioned earlier pharmacognosy deals with the study of crude-drugs (Natural drugs) obtained from natural sources, i.e. plants, animals and minerals.

Considering the fast developments in modern technology, natural drugs are also obtained now from marine source and by tissue-culture technique. Which can be illustrated as under.

Table 2.1 indicates occurrence of crude drugs according to the source of their origin.

(1) Animal, (2) Vegetable, (3) Mineral, (4) Marine, (5) Tissue-culture technique.

Table 2.1: Occurance of crude drugs according to the source of their origin

Animal	Vegetable	Mineral	Marine	Tissue culture technique
Beeswax	Kokum butter	Bentonite	Agar-agar	Shikonin
Cantheride	Pectin	Kieselguhr	Chitin	Atropine
Cochineal	Starch	Kaolin	Sadium alginate	Berberine
Gelatin	Peppermint	Paraffins	Cod liver oil	Camptothecin
Honey	Cardamom	Talc	Shark liver oil	Diosgenin
Lactose	Vanilla	Calamine	Spongosine	Seopalumine
Spermaciti	Turmeric	Fuller's earth	Polytoxin	Valtropine
Lanolin	Saffron	Asbestos	Cycloedesmol	
Musk	Guargum	Paraffins	Ara-C	
Suet	Orange oil	Chalk	Tetradotoxin	
Lard	Agar	Shilajit		
Shellac				

(1) Drugs obtained by synthetic methods do not come under the preview of pharmacognosy.

(2) All types of animals i.e. insects, snakes, civets, mammals even human being (for blood) is also used for isolation of natural drugs.

(3) Similarly, all parts of plants like seeds, fruits, flowers, barks, woods, leaves are utilized as source of crude drugs.

(4) The tissue culture has a special advantages that natural compounds can be produced under controlled environmental conditions independents of soil conditions and changes in climatic conditions. The cells of any plants tropical or temperate can be multiples to yield specific metabolites produced by them.



Chapter 3...

CLASSIFICATION OF CRUDE DRUGS

INTRODUCTION

The crude drugs obtained from different natural sources are used in treatment of wide spectrum of diseases. For their adequate study, it is necessary to arrange them in scientific and systematic manner. Their huge number and varied occurrence make it difficult to put them in a uniform pattern.

For pharmacognostic study, crude drugs can be arranged in one of the following classes.

1. ALPHABETICAL CLASSIFICATION

Either the Latin names or English names of drugs are considered for this purpose of classification. This classification is adopted by the following books.

1. British Pharmacopoeia (English).
2. British Pharmaceutical Codex (English).
3. United States Pharmacopoeia (English).
4. Pharmacopoeia Internationalis (Latin).
5. Indian Pharmacopoeia (English).
6. British Herbal Pharmacopoeia (English).

However, this type of classification does not help in distinguishing the drugs from plants, animals or mineral sources and also does not indicate whether they are norganiz or norganized.

2. TAXONOMICAL CLASSIFICATION

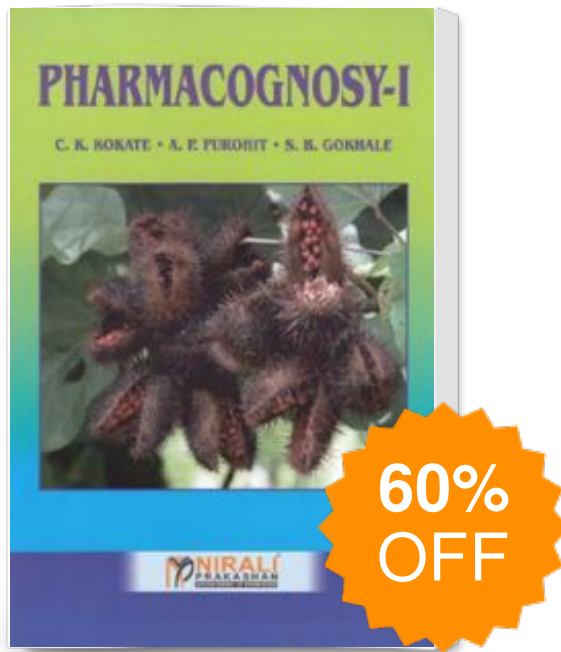
It is a type of biological classification and restricted mainly to crude drugs from plant source. It indicates the phylum, class, sub-class, order, family, genus and species of the crude drugs. It is criticized for its failure to norganiz the norganiz or norganized nature of crude drugs in their morphological studies. The taxonomical system of classification can be elaborated further as follows (Table 3.1).

Table 3.1: Illustration of Taxonomical Classification

Class	Order	Family	Drugs
I. Gymnospermae	-	Ephedraceae	Ephedra
II. Angiospermae			
Subclass:	-	Graminae	Rice, Wheat, Maize
Monocotyledonae		Liliaceae	Aloe, colchicum

(3.1)

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