

HISTORY, DEVELOPMENT & SCOPE OF PHARMACOGNOSY

SIGNIFICANCE OF PLANTS

Nature always stands as a golden mark to exemplify the outstanding phenomenon of **symbiosis**.

- The **biotic (living things) and abiotic elements (water, light, radiation, temperature, humidity, atmosphere, and soil)** of nature are all interdependent.
- The plants are indispensable to man for his life.
- The **three important necessities of life** – food, clothing and shelter and a host of other useful products are supplied to him by the plant kingdom.
- Nature has provided a **complete store house of remedies to cure** all ailments of mankind.
- **The knowledge of drugs has accumulated over thousands of years** as a result of mans inquisitive nature so that today we possess many effective means of ensuring health care.

ORIGIN OF PHARMACOGNOSY

- The vegetable kingdom was already there when man made his appearance on Earth. As man began to acquire **close acquaintance with his environment, he began to know more about plants**, as there were the only curative agents he had.
- As he progressed and evolved, he was not only able to sort on as to which plant served for eating and which did not, but he went beyond and **began to associate curative characteristics with certain plants**, classifying them as painkillers, febrifuge, antiphlogistics, soporific and so on.
- It is like **trial and error** and possibly some deaths in the beginning also, but as it happened antidotes against poisons were also discovered.
- As we shall see later, drug substitutes were also forthcoming.

ORIGIN OF PHARMACOGNOSY

- All these states of affairs indicate that the origin of pharmacognosy, i.e. the **study of natural curative agents** points towards the accent of human beings on mother earth, and its historical account makes it clear that pharmacognosy in its totality is **not the work of just one or two continental areas** but the overall outcome of the steadfast work of many of the bygone civilizations like the **Chinese, Egyptian, Indian, Persian, Babylonian, Assyrian and many more.**
- Many of today's wonderful modern drugs find their roots in the medicines **developed by the tribal traditions** in the various parts of the world.

PHARMACOGNOSY

Plants have universal role in the treatment of diseases in the major systems of medicine.

- The word "Pharmacognosy" derived from the Greek word
- **"Pharmakon"** means a drug, or medicine.
- **"gignosco"** means to acquire knowledge of
- Pharmacognosy is defined as a branch of bioscience which treats in detail medicinal and related products of **crude or primary type** obtained from plant, animal, marine, microbial and mineral origins.
- 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.**
- It 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.**

C.A. Seydler, a medical student of Germany, given the name Pharmacognosy from his doctoral thesis entitled **Analectica Phrmacognostica in 1815.**



The physician **J.A. Schmidt** used this name previously in his book **Lehrbuch der materia medica in 1811** to describe the study of medicinal plants.



CRUDE DRUGS

- Crude drugs are **plants or animals or their parts** which after collection are subjected only to drying or making them into transverse or longitudinal slices or peeling them in some cases.
- They are vegetable or animal drugs that consist of natural substances that have **undergone only the processes of collection and drying**.
- The term natural substances refers to those substances found in nature, such as
- **Whole plants or organs of plants**, e.g. leaves, flowers, seeds, and barks, or vegetable saps, extracts and secretions
- **Whole animals; glands or other animal organs, extracts, secretions**; that have not had changes made in their molecular structure (as found in nature)

CRUDE DRUGS

- Also, means any product that has **not been advanced in value or improved in condition** by grinding, chipping, crushing, distilling, evaporating, extracting, artificial mixing with other substance or by any other process or treatment beyond what is essential to its proper packing and the prevention of decay or deterioration pending in manufacture.
- Crude drugs are used infrequently as therapeutic agents; more often their **chief principles** (derivatives or extractives which contains active constituents) are separated by various means.
- **Sources of Crude Drugs:**
 - Plant sources, e.g. Senna, Digitalis, Datura, Cascara, Cinchona, Clove, Opium, etc.
 - Animal sources, e.g. cochineal, cantharidin, honey, cod liver oil, musk, thyroxin, etc.
 - Marine sources, e.g. sponges, red algae, agar, etc.
 - Mineral sources, e.g. talc, kaolin, kieselguhr, etc.

NATURAL PRODUCT

A natural product is a substance **obtained from a natural source.**

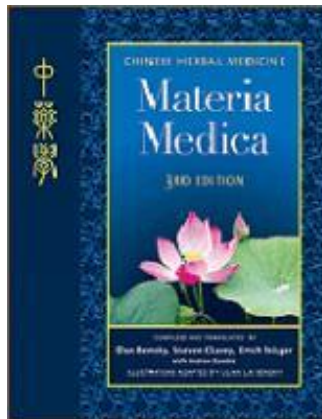
- A crude drug , e.g. Senna, Cascara, Cinchona, etc.
- A galenical preparation of a crude drug e.g. extracts and tinctures,
- A pure compound, e.g. morphine, atropine, digoxin, etc..
- A semithynthetic product, e.g. etoposide, teniposide, hyoscine butyl bromide etc.

USES OF NATURAL PRODUCTS

- As drugs for the **treatment of a wide range of diseases**, e.g. morphine, atropine, digoxin, hormones, antibiotics, etc.
- As pharm. aids in **pharm. industry**, e.g. suspending & emulsifying agents, suppository bases, binders, excipients, sweetening & colouring agents, etc.
- **In cosmetics** as flavouring & colouring agents, etc.
- **In culture media** for the propagation of M.O. in microbiology laboratories & biotechnology.
- **General uses** e.g. in food industries, as dusting powders, as indicators and in perfumery.

PHARMACOPOEIAS

- Government is aiming to standardize the quality, efficacy and safety of drugs in order that many traditional herbs meet legal requirements of different countries.
- Pharmacopoeia is a book **recognized by the government as legal authority for standardization of drugs** eg.
 - British Herbal Pharmacopoeia, 1996.
 - The British Herbal Compendium Vol. 1& 2, 1993.
 - The United States Herbal Pharmacopoeia.
 - German Commission Monographs.
 - The Chinese Herbal Pharmacopoeia.



MONOGRAPH

The **descriptive material** pertaining to any of the drugs in the Pharmacopoeia is known as the monograph.

In the monograph of a crude drug, the following information are generally covered:

English, Arabic, Latin, French names, definition, description, special condition for collection or preparation for the market, identity tests, tests for adulterants, method of assay, special storage requirements, dose, natural or biological origin.

OFFICIAL DRUG is one that is listed and described as being a definite therapeutic agent in the pharmacopoeia.

UNOFFICIAL DRUG is that one that are not recognized in the pharmacopoeia and is used as therapeutic agent.

HISTORY OF PHARMACOGNOSY

- In early period, primitive man went in search of food and ate at random, plants or their parts like tubers, fruits, leaves etc.
- If **no harmful effects** observed, they were taken as **edible materials** and they show **any harmful effects** they were considered as **inedible materials**.
- If it caused diarrhoea it was used as purgative, if it caused vomiting it was used as emetic and if it was found poisonous and death was caused, he used it as arrow poison.
- The knowledge was empirical and was obtained by **trial and error**.
- He used drugs as such or as their **infusions and decoctions**.
- 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.

ANCIENT EGYPT

- **Ebers papyrus** (1500 B.C.), a scroll of feet long and a foot wide has collection of 800 prescriptions, mentioning 700 drugs.
- **Edwin Smith Papyrus** (1600 B.C.), which contains surgical instructions and formulas for cosmetics.
- **Kahun Medical papyrus** (1900 B.C.), deals with health of women, including birthing instructions.
- **Commonly used herbs:** senna, honey, juniper, commin, pomegranate root, pinetar, manna, caraway, coriander, garlic, onion, papyrus, myrrh, etc.



A fragment of Ebers Papyrus

ANCIENT CHINA

- In china, many medicinal plants had been in use since **5000 B.C.**
- The oldest known herbal, ***PenT-sao or Native Herbal***, written by emperor **Shen Nung** around 2700 B.C.
- It contains **365 drugs**, one for each day of the year.
- These were subdivided as follows
 - **120 emperor herbs** of high, food grade quality which are nontoxic and long period of time
 - **120 minister herbs**, some mildly toxic and some not, having stronger therapeutic action to heal diseases
 - **125 servant herbs** that having specific action to treat disease and eliminate stagnation. Most of these being toxic, are not intended to be used daily over a prolonged period of weeks and months.

ANCIENT CHINA

- The most important clinical manual of traditional Chinese medicine is the **Shang Hang Lun** (Treatise on the Treatment of Acute Diseases Caused by Cold) written by **Chang Chung-Ching** (142-220).
- The historical origin of the most important classical herbal formulas present in the above book have become the basis of Chinese and Japanese herbalism (called Kampo).
- With the interest in alchemy came the development of pharmaceutical science and the creation of number of books including **Tao Hong Jing's** (456-356), compilation of Pen T sao describes 730 herbs and classified in six categories.

Stone (minerals)

grasses and trees

grains

Insects and animals

fruits and vegetables

named but not used.

ANCIENT CHINA



ANCIENT INDIA

In India knowledge of medicinal plants is very old, and medicinal properties of plants are described in **Rigveda and in Atharvaveda** (3500-1500 B.C.) from which Ayurveda has developed.

The basic medicinal texts in this world region – The ayurvedic writings or treatises can be divided into three main ones

Charaka Samhita, Susruta Samhita, Astanga Hridayam Samhita

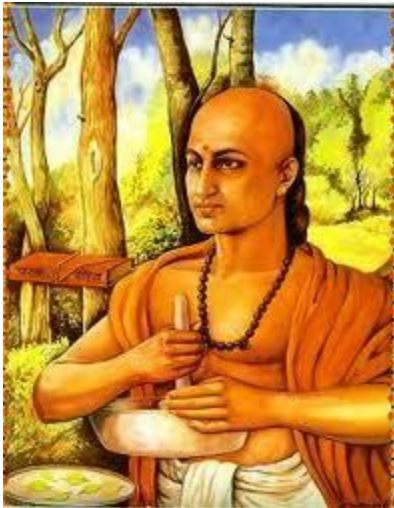
and three minor ones

Sarangadara Samhita, Bhava Prakasa Samhita, Madhava Nidanam Samhita.

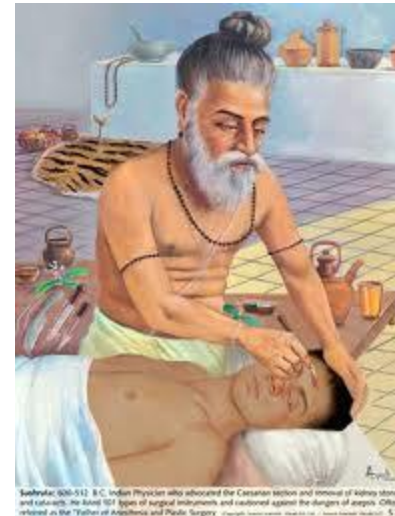
A large portion of Indian population even today depends on the Indian system of medicine – **Ayurveda, An ancient science of life.**

ANCIENT INDIA

- **Charaka** made 50 groups of 10 herbs each of which, according to him, would suffice an ordinary physicians need.
- **Sushrutha** arranged 760 herbs in 7 distinct sets based on some of their common properties.



Charaka



Sushrutha: 600-500 B.C. Indian Physician who advocated the Caesarian section and removal of kidney stones and cataracts. He listed 102 types of surgical instruments and cautioned against the dangers of atropin. Often referred as the 'Father of Abdominal and Plastic Surgery'. <http://www.ancientindia.org> 5/2

Sushrutha

ANCIENT GREECE AND ROME

Greek scientists contributed much to the knowledge of natural history.

- **Hippocrates** (460-370 B.C.), is referred as father of medicine and is remembered for his famous oath which is even now administered to doctors.
- **Aristotle** (384-322 B.C.), a student of Plato was a philosopher and is known for his writing on animal kingdom.



Hippocrates



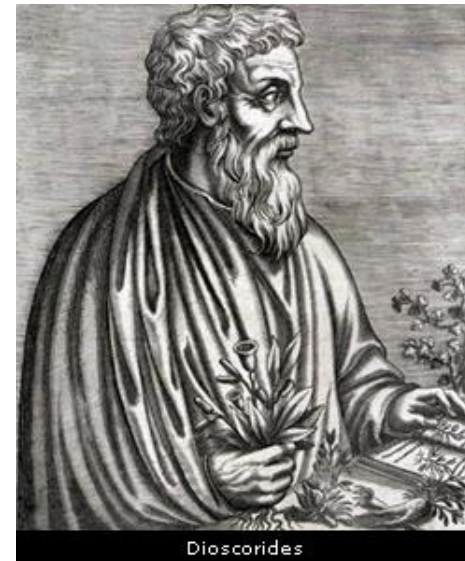
Aristotle

ANCIENT GREECE AND ROME

- **Theophrastus** (370-287 B.C.), a student of Aristotle, wrote about plant kingdom. Known as **Father of Pharmacognosy**
- **Dioscorides**, a physician who lived in the first century A.D., described medicinal plants, some of which like belladonna, ergot, opium, colchicum are used even today. He has Written the book De Materia Medica



Theophrastus



Dioscorides

ANCIENT GREECE AND ROME

- **Pliny** wrote 37 volumes of natural history
- **Galen** (131 A.D.) devised methods of preparations of plant and animal drugs, known as galenicals, in his honour.
- **Paracelsus Aureolus** (1493-1541) – Swiss Physician to develop mineral salts which might have had the potential of being universal curative agents.



Pliny



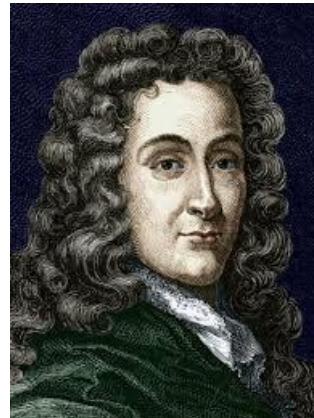
Galen

HISTORY OF PHARMACOGNOSY – EARLY MODERN ERA

- **Le'mery** - 1615-1715 - The importance of the extraction method and alcohol as an extractant was reported
- **William withering** - in 1785 published some of the medicinal properties of foxglove leaves based on ten years of experimentation.
- Calumba, an alkaloidal drug, became official in 1788.
- **Derosne** – french pharmacist in 1803 isolated narcotine from opium.
- **Sertuerner** – isolated morphine from opium and its role in alleviating pain was recognized.



William withering



Le Mery



Derosne

DEVELOPMENT OF PHARMACOGNOSY

- In the next few years, strychnine (1817), emetine (1817). Brucine (1819), piperine (1819), quinine (1820) and colchicine (1820) were isolated.
- **Pelletier** – french pharmacist, reported the isolation of strychnine from ignatius beans and later from nux vomica seeds in 1818.
- **Stass and Otto** – a new extraction process for alkaloid was developed in 1852.
- **Posselt and Reimann** – isolated nicotine from tobacco leaves in 1828.
- **Neumann** – isolated cocaine in 1860.
- **Hardy and Gallows** – isolated ouabain in 1877.
- **Gerrard and Hardy** – isolated pilocarpine in 1875.
- **Nagai** – isolated ephedrine in 1887.
- **Kuersten** – isolated podophyllotoxin in 1891.
- 20th Century - Isolation of ergometrine, digoxin, reserpine, theophylline and quinidine are the significant discoveries

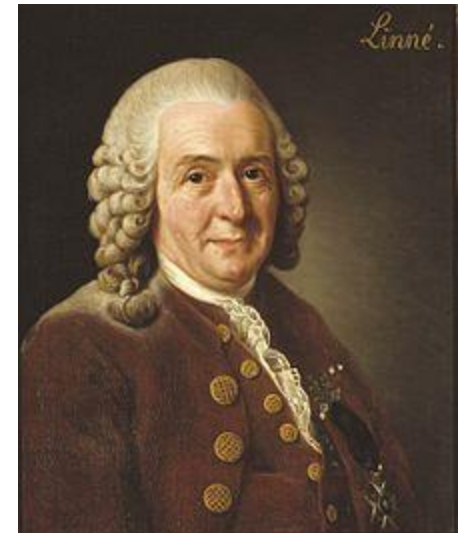
BINOMIAL SYSTEM OF CLASSIFICATION

Nomenclature: The binomial system was founded by the Swedish biologist Linnaeus. In this system,

The first name: Start with a capital letter denotes the **genus**,

Second name denotes the **species**.

Carolus Linnaeus (1707- 1778) Swedish botanist and explorer. He studied botany at Uppsala university and explored Swedish Lapland. He is the first to develop principles for defining genera and species of organisms and to create a uniform system for naming them, [binomial nomenclature](#).



BINOMIAL SYSTEM OF CLASSIFICATION

Genus and species name is followed by author's name who first described the species or variety.

e.g ***Artemisia cina* Berg., Caryophyllos**

Sometimes, **species name is derived from author's name**, e.g. the species of *Cinchona* named after Charles Ledger, who brought its seeds from Brazil in 1865, is known as *Cinchona ledgeriana*.

BINOMIAL SYSTEM OF CLASSIFICATION

The species name is usually chosen to indicate certain characteristics of the plant:

Striking characteristic of the plant

- ❖ *Cassia acutifolia* (sharp pointed leaflets)
- ❖ *Cassia angustifolia* (narrow leaflets)
- ❖ *Glycyrrhiza glabra* (glabrous – smooth)
- ❖ *Atropa belladonna* (bella – beautiful, donna – lady)

Characteristic colour

- ❖ *Piper nigrum* (black)
- ❖ *Digitalis lutea* (yellow)
- ❖ *Digitalis purpurea* (purple)
- ❖ *Brassica nigra* (black)

An aromatic plant (certain aroma)

- ❖ *Myristica fragrans* (nice aroma)
- ❖ *Caryophyllus aromaticus* (refers to aroma)

BINOMIAL SYSTEM OF CLASSIFICATION

Geographical source

Hydrastis Canadensis (growing in Canada)

Tamarindus indica (growing in India)

Pharmacological activity:

Papaver somniferum (inducing sleep)

Strychnos nux-vomica (causing vomiting)

Ipomoea purga (purgative action)

The **generic name may indicate certain characters of the plant:**

e.g. *Atropa* means fate who cuts the thread of life

Glycyrrhiza means gluco = sweet, riza = root,

Linum, *Linea* = thread)

FURTHER PROGRESS

The progress achieved in botanical studies during 19th century had a direct influence on pharmacognosy.

Bentham and Hooker – plant classification was further developed in 1862-1863.

G. Mendel – important observations on plant hybrids were published in 1865.

The introduction of microscope, as an important analytical tool, was a landmark advancement in botanical research, especially due to the development of several techniques like clearing, mounting and staining of the preparations.

Berg – anatomical atlas of crude drugs was published in 1865.

Voehl and Tschirch – 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.

Greenish and Collin – an anatomical atlas of powdered vegetable drugs was compiled in 1904.

DEVELOPMENT OF PHARMACOGNOSY – MODERN ERA

- The development of modern pharmacognosy took place later during the period 1934-1960 by simultaneous application of disciplines like organic chemistry, biochemistry, biosynthesis, pharmacology and modern methods and techniques of analytical chemistry including paper, thin layer and gas chromatography and spectrophotometry.
- The substances from the plants were isolated, their structures elucidated and pharmacological active constituents studied.

MODERN DEVELOPMENT OF CRUDE DRUGS

Some of the important aspects of the natural products that led to the modern development of drugs and pharmaceuticals are as follows:

- Isolation of phytochemicals
- Structure activity relationship
- Drugs obtained by partial synthesis of natural products
- Natural products as models for synthesis of new drugs
- Drugs of direct therapeutic uses
- Biosynthetic pathways
- Progress from 1960 onwards
- Technical products
- Pharmaceutical aids
- Discovery of new medicines from plants – nutraceutical use versus drug development

SCOPE OF PHARMACOGNOSY

- Crude of drugs of natural origin that is obtained from plants, animals and mineral sources and their active chemical constituents are the core subject matter of pharmacognosy.
- These are also used for the treatment of various diseases besides being used in cosmetic, textile and food industries.
- First half of 19th century – herbal mixtures, extracts and juices
- Second half of 19th century – pure active constituents.
- Today applied science of pharmacognosy has a far better knowledge of the active constituents and their prominent therapeutic activity on the human beings.
- Just like terrestrial germplasm, investigators had also diverted their attention to marine flora and fauna, and wonderful marine natural products and their activities have been studied.

SCOPE OF PHARMACOGNOSY

- Genetic engineering and tissue culture biotechnology have already been successful for the production of genetically engineered molecules and biotransformed natural products, respectively.
- Crude drugs and their products are of economical importance and profitable commercial products.
- When these were collected from wild sources, the amount collected could only be small and the price commanded was exorbitantly high.
- Many of the industrially important species which produced equally large economic profits are cultivated for large scale crop production.
- Drug plants, standardized extracts and therapeutically active pure constituents have become a significant market commodity in the international trade.

SCOPE OF PHARMACOGNOSY

- In the light of these glorious facts, scope of pharmacognosy seems to be enormous in the field of medicine, bulk drugs, food supplements, pharmaceutical necessities, pesticides, dyes, tissue culture biotechnology, engineering and so on.
- The pharmacognosist would serve in various aspects as follows
 - Academics
 - Private industry
 - Government
- Undoubtedly, the plant kingdom still holds large number of species with medicinal value which have yet to be discovered.
- A lot of plants were screened for their pharmacological values like hypoglycemic, hepatoprotective, hypotensive, etc.
- Pharmacognosists with a multidisciplinary background are able to make valuable contributions in the field of phytomedicines