Pharmacognosy/Second Year

Second Semester

Lecture One

Introduction to Pharmacognosy

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This Lecture includes a General introduction to Pharmacognosy and will cover the following:

- Definition and General principles of Pharmacognosy
- Origin and History of Pharmacognosy.
- Development of Pharmacognosy
- New era of Pharmacognosy.
- Scope of Practice.
- Pharmacognostic Scheme

References:

1. A.N.M Alamgir, "Therapeutic Use of Medicinal Plants and their Extracts" Vol 1, Progress in Drug Research 73, DOI 10.1007/978-3-319-63862-1-2, Spring International Publishing AG 2017.
2. W.C Evans, "Trease and Evans' Pharmacognosy" 16 Edition, 2009.
3. Biren N Shah, A.K Seth "Textbook of Pharmacognosy and Phytochemistry" First Edition 2010, ELSEVIER.
4. American Society of Pharmacognosy 2016." http://pharmacognosy.us/what-is-pharmacognosy/
5. Micheal Heinrich, Joanne Barnes, Simon Gibbons and Elizabeth M Williamson "Fundamentals of Pharmacognosy and Phytotherapy "2 Edition; Elsevier 2012.
6. Matthew Jebb "Plant Names" National Botanic Gardens, Glasnevin, Dublin: http://www.glasnetwork.org/downloads/plantnames.pdf Nov 2003.
7. Gurcharan Singh, "Plant Systematics: An Integrated Approach," Science Publishers, 2004

1. Definition and General Principles of Pharmacognosy

Pharmacognosy may be defined as the study of crude drugs obtained from Plants, animals, and mineral kingdom and their constituents. The American Society of Pharmacognosy describes' Pharmacognosy' as the study of the physical, chemical, biochemical, and biological properties of drugs, drug substances, or potential drugs or drugs of natural origin, as well as the search for new drugs from natural sources.

Although most Pharmacognostic studies focus on plants and medicines derived from plants, other types of organisms, such as microbes (bacteria, fungi, etc.), marine organisms, and animals, are also important in Pharmacognosy. It is the science of nature-derived pharmaceuticals and includes studies on crude drugs' structural, physical, chemical, and biological characteristics, their therapeutic use, history, cultivation method, collection, preparation, preservation, and commerce.

Within the field of Pharmacognosy, many diverse and exciting areas are being studied, including:

- The study of the medicinal properties of natural products for drug discovery and understanding how dietary supplements work.
- The development and use of analytical methods for quality control of natural products in the marketplace.
- The study of the use of traditional remedies by native cultures.
- The microscopic evaluation and species verification of medicinal or economically important natural products.
- The use of natural products for specific agricultural purposes, such as natural pesticides or insect anti-feed ants.

- The study of compounds' safety and functional properties in novel foods, food ingredients, and consumer products.
- The cosmetic application of natural compounds or extracts.
- The study and manipulation of genetic biosynthetic pathways to enhance natural or novel compound production.

Other Important definitions related to Pharmacognosy are:

- Medical Ethnobotany: the study of the traditional use of plants for medicinal purposes.
- Ethnopharmacology: the study of the pharmacological qualities of traditional medicinal substances.
- The Study of Phytotherapy: the medicinal use of plant extracts.
- Phytochemistry: studying plant chemicals (including identifying new drug candidates derived from plant sources).
- Zoo-pharmacognosy: the process by which animals self-medicate by selecting and using plants, soils, and insects to treat and prevent disease.
- Marine Pharmacognosy: the study of chemicals derived from marine organisms.

2. Origin and History of Pharmacognosy

The term "Pharmacognosy" was coined for the first time by an Austrian physician, J.A. Schmidt (1759– 1809), in his hand-written manuscript " Lehrbuch der Materia Medica," Published in 1811 after his death and C.A. Seydler used the term in his book on crude drugs " Analectica Pharmacognostica" in 1815.

Pharmacognosy has been derived by merging two Greek words: (a) 'pharmakon' means a drug, and (b) 'gnosis' means knowledge of or 'gignosco' means to acquire

knowledge of. Thus, Pharmacognosy means knowledge of drugs or to acquire knowledge of drugs.

Pharmacognosy began in ancient times by searching for natural medicaments, including plants, animals, and minerals from the surrounding environment. So, it was linked with the healthcare activities of the most primitive human race of the remote past. Healing herbs and other natural elements existed long before the existence of people on earth, and they had only discovered their curative power.

Historical sites in Iraq show Neanderthals used yarrow, marshmallow, groundsel, centaury, ephedra, muscary, etc., herbs more than 60,000 years ago. The people of the early days tried to alleviate their sufferings or illnesses by using plants as medicinal plants that were growing in the surroundings, and their innovation of medicinal properties of plants was not based on any scientific method or the knowledge of the chemical constituents of plants. The ancient people explored the medicinal properties of plants throughout the ages, discovered crude drugs, and acquired knowledge of Pharmacognosy in many ways, including trial-and-error, guesswork, observation, accidental discovery, curiosity, search for food, etc.

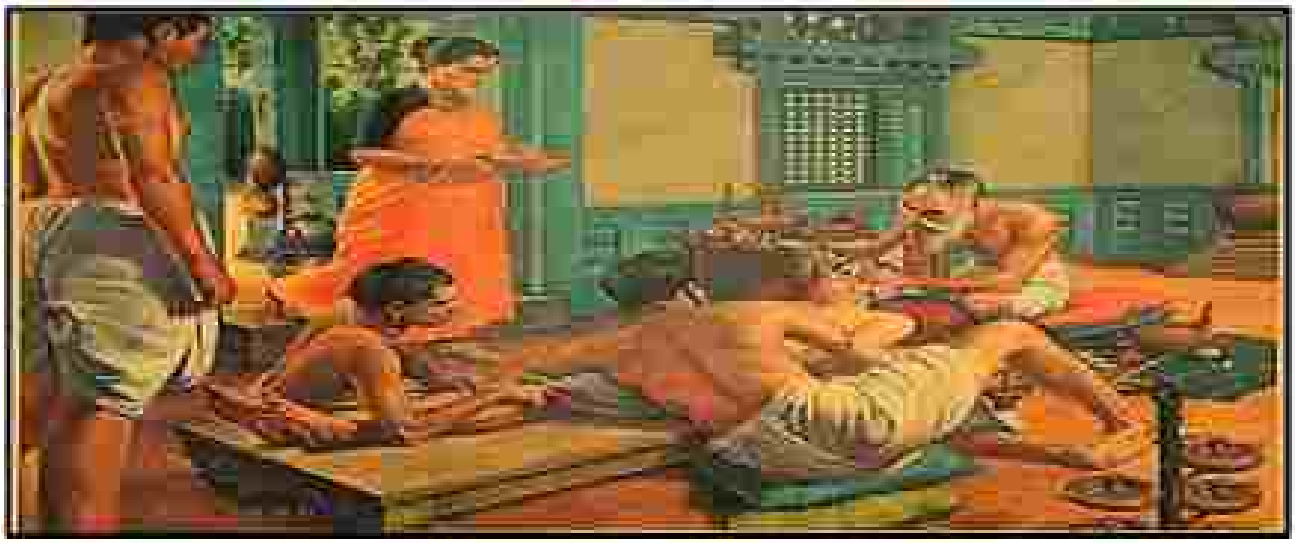
- In the course of time, ancient people acquired a considerable volume of knowledge about drugs and drug applications through their health-related and other activities. Subsequently, a group of people emerged in each ancient community that acquired expertise in collecting, testing, and treating diseases. These people were the prehistoric or early 'Medicine Men.' They transferred this secret knowledge only to their trusted successors of successive generations, who gradually increased the volume of knowledge about drugs and their uses. Initially, the acquired knowledge was transferred from generation to generation verbally or by using signs and symbols. As civilization progressed, knowledge was transferred and recorded in writing. This included:

- The Egyptian Papyrus Ebers c. 1600 B.C., a collection of 800 prescriptions mentioning 700 drugs.
- Baked clay tablets (some 660 cuneiform tablets c. 650 B.C from Ashurbanipal's library at Nineveh, now in the British Museum, refer to drugs well-known today).
- Parchments.
- Manuscript herbals.
- Printed herbals (invention of printing 1440 A.D).
- Pharmacopoeias and other works of reference (first London Pharmacopoeia, 1618; first British Pharmacopoeia, 1864).
- And most recently, electronic storage of data.

Similar records exist for:

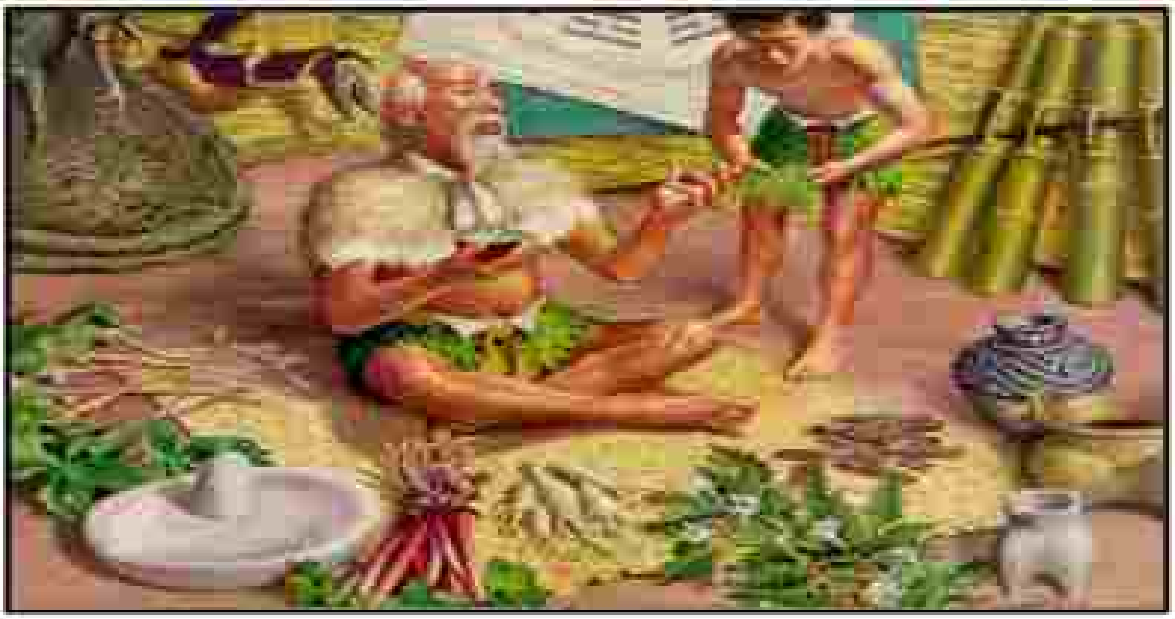
- **Ayurvedic medicine** (Ayurveda 2500–600 B.C)

The term "Ayurveda" combines the words "ayur" (life) and " veda" (Science or knowledge). Ayurveda is one of the oldest systems of medicine in Ancient India.



- **Chines Medicine**

The Chinese pharmacopeia, "Pen T Sao," written by Shen Nung (about 2700 B.C.), appears to be the oldest pharmacopeia on earth; it describes 365 drugs. The ancient Chinese doctors are now regarded as pioneers in the use of herbal preparations.



- **Unani Medicine and Islamic Medicine (Greco-Arabic system of medicine)**

Greek scientists contributed much to the knowledge of natural history, and the Arabs improved this. The theoretical framework of Unani medicine was based on the teachings of Hippocrates (460–377 B.C.), who is referred to as the 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 known for his writing on the animal kingdom, considered authoritative even in the twentieth century.

The two great Persian Muslim physicians, Al-Razi (850– 925 AD) and Ibn Sina (980– 1037 AD), constructed an imposing edifice in the Islamic era. By

enriching the original Greek system of medicine, these two scientists laid down the foundation stone of modern Western medicine. Al-Razi and Ibn Sina are ever remembered for their famous books 'Kitab al-Mansuri' and 'Al-Kanun,' respectively, and they were used as important textbooks throughout Europe until the sixteenth– seventeenth centuries. The Al-Kanun of Ibn Sina was known for its systematic experimentation, physiological study, discovery of infectious and sexually transmitted diseases, quarantine method to limit the spread of infectious diseases, experimental medicine, clinical trials, and method of diagnosis of diseases. It includes descriptions of some 760 medicinal plants and their related medicine. Ibn Altabari (770– 850 AD), Al Zahrawi (930– 1013), Ibn Al Haitham (960– 1040), Ibn al-Nafi s (1213– 1288), Ibn Khaldun (1332– 1395), and many other Arabs were famous for their contribution toward the development of herbal medicine in the Middle Ages. Based on the Greek system, the ancient Arab physicians contributed enormously to the development of modern medicine.

In addition to the above-recorded information, there is a wealth of knowledge concerning the medicinal, narcotic, and other properties of plants that are still transmitted orally from generation to generation by tribal societies, particularly those of tropical Africa, North and South America, and the Pacific countries. These areas contain the world's greatest number of plant species not found elsewhere. With the westernization of so many of the peoples of these zones, there is a pressing need to record local knowledge before it is lost forever. In addition, with the extermination of plant species progressing at an alarming rate in certain regions, even before plants have been botanically recorded, much less studied chemically and pharmacologically, the need arises for increased efforts directed toward conserving gene pools.

3. Development of Pharmacognosy

Even up to the beginning of the twentieth century, Pharmacognosy was more of a descriptive subject akin mainly to botanical science, and it consisted of identification of drugs both in entire and powdered conditions and concerned with their history, commerce, collection, preparation, and storage.

In 1803, a new era in the history of medicine began-the era of pure compound isolation, when morphine was isolated from opium. Subsequently, other compounds such as strychnine (1817), quinine and caffeine (1820), nicotine (1828), atropine (1833), and cocaine (1855) were isolated from different plant sources. During the nineteenth century, Pharmacognosy was the most important pharmaceutical discipline, and the chemical structures of many of the isolated compounds were determined.

In the twentieth century, the discovery of important drugs from the animal kingdom and microorganisms, particularly hormones and vitamins, has become a very important source of drugs. In the 2nd half of the twentieth century, thin layer Chromatography (TLC), gas chromatography (GC), high-pressure liquid chromatography (HPLC), and spectrometric methods (MS, NMR) were introduced in Pharmacognostic analysis and search for new biologically active compounds in plants. In vitro system, bioassay was added at the end of the twentieth century, and during this period, many antibiotic and antitumor principles from natural sources were discovered as:

- Isolation of penicillin in 1928 by William Fleming and large-scale production in 1941 by Florey and Chain.
- Isolation of Reserpine from Rauwolfia roots and confirming its hypotensive and tranquilizing properties.
- Isolation of Vinca alkaloids, especially vincristine and Vinblastine. Vincristine was found useful in the treatment of Leukemia. These alkaloids

also have anticancer properties.

- Steroid hormones like progesterone were isolated by partial synthesis from diosgenin and other steroid saponins by Marker's method. Cortisone and hydrocortisone are obtained from progesterone by chemical and microbial reactions.

The development of modern Pharmacognosy took place through by simultaneous application of disciplines like organic chemistry, botany, genetics, biochemistry, biosynthesis, Pharmacology, and modern methods and techniques of analytic chemistry. Thus Pharmacognosy is not any one of these fields per se but seeks to embrace them in a unified whole for the better understanding and utilization of medicinal plants.

4. New era Of Pharmacognosy

Pharmacognosy, as an interdisciplinary subject, admits collaborative research between scientists of different disciplines, and pharmacognosists can be a valuable bridge between specialists and have much to offer to help pharmaceutical knowledge of phytomedicines advance. In the past nineteenth century, synthetic drugs have been replacing gradually plant-derived drugs (except antibiotics and antitumor drugs). Due to the development of experimentation with molecules and progress in biotechnology, biochemistry, molecular biology, and research on metabolism, new perspectives appeared for natural products that renewed interest in natural resources, leading to the high-level development of the subject.

The multidisciplinary characteristics of Pharmacognosy are becoming more and more prominent as many new areas of research and study, such as Molecular Pharmacognosy, Genomic Pharmacognosy, Clinical Pharmacognosy, Neuro Pharmacognosy, and Industrial Pharmacognosy, are emerging in modern Pharmacognosy with time.

5. Scope of Practice

The scope of Pharmacognosy is broad in the field of pharmacy. Pharmacognostic studies include natural product molecules, especially the secondary metabolites, which are useful for their medicinal, ecological, gustatory (that distinguishes sweet, sour, bitter, and salty taste properties in the mouth), or other functional properties. In the early part of the nineteenth century, During the last half of the twentieth century, Pharmacognosy evolved from being a descriptive botanical subject to one having a more chemical focus embracing a broad spectrum of disciplines, including botany, zoology, Ethnobotany, marine biology, microbiology, herbal medicine, chemistry, biotechnology, Phytochemistry, Pharmacology, Pharmaceutics, Clinical pharmacy, Pharmacy practice, etc.; today, it is a highly interdisciplinary science.

At the beginning of the twenty-first century, Pharmacognosy teaching in academic pharmacy institutions has been given new relevance because of the explosive growth in the use of herbal medicines. Pharmacognosy is undergoing major change and herbal drugs are researched and formulated in the modern framework of medicine instead of galenical preparations or conventional dosage. Pharmacognosy now embraces a wide range of diverse techniques, and the recent progress in extraction, chromatography, hyphenated techniques, screening of natural product, biotechnology, etc., has opened new avenues and lines for pharmacognosist to enhance natural product research. Herbs can be turned into products now, and Pharmacognosy is playing active role in the discovery, characterization, production, and standardization of natural drugs.

Thus, the 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.

Although Pharmacognosy is principally concerned with plant materials, a small number of animal products are traditionally encompassed within the subject; these include such items as beeswax, gelatin, wool fat, vitamins, etc. Other natural products such as antibiotics, hormones, and others may or may not be involved, depending on the teaching practice of a particular institution. Marine organisms, both plant and animal, with potent pharmacological actions are receiving increasing attention in the search for new drugs. Materials having no pharmacological action, which are of interest to pharmacognosists, are natural fibers, flavoring, and suspending agents, colorants, disintegrants, stabilizers, and filtering and support media. Other areas with natural associations with the subject are poisonous and hallucinogenic plants, allergens, herbicides, insecticides, and molluscicides.

Coincident with the increasing attractiveness of alternative (complementary) therapies and the tremendous range of herbal products now generally available to the public, many countries have put regulatory requirements covering medicinal herbs in place to control the quality of these products. Monographs are now available on many such drugs, giving descriptions, tests for identity and purity, and assays of active constituents. These monographs are being compiled by several bodies (see below). In this respect recognition should be given to the pioneering production of the British Herbal Pharmacopoeia, first produced in 1974 with the latest volume in 1996.

Pharmacognosy is also important in those countries that have their own systems of medicine in which plants are important components. Many crude drugs, once generally categorized as herbal remedies, are now following Continental European practice, described in the British Pharmacopoeia (BP). Chromatographic, chemical, and physical tests, together with assay procedures, are given for many drugs for which there was no quantitative evaluation of the chemical constituents. Quality control is paramount, as the demand for and the possibility of substitution

has increased. The upsurge in the marketing of Chinese and Asian traditional medicines worldwide, for which there is a need for adequate control, adds a further dimension to Pharmacognosy.

Traditional herbalism has been officially regarded as a method of alternative medicine in many parts of the world, especially in some developed countries (e.g., the USA and the UK). Traditional Chinese Medicine has been in use in Chinese hospitals. The World Health Organization estimated that 80% of people worldwide rely on herbal medicines for some of their primary health care.

In Germany, about 600– 700 plant-based medicines are available and are prescribed by some 70% of German physicians. Many alternative physicians in the twenty-first century incorporate herbalism in modern medicine due to the diverse abilities plants have and their low number of side effects.

With the increase in interest in medicinal plants worldwide, there are now many publications covering regional areas of the globe, and several bodies have implemented research and published monographs on medicinal herbs. The aim has been to set standards for quality, efficacy, and safety so that the many traditional herbs meet legal requirements. The following are of note:

- German Commission E Monographs
- ESCOP (European Scientific Cooperative for Phytotherapy)
- American Herbal Pharmacopeia
- WHO Monographs
- USP Monographs

In addition, some journals—for example, Planta Medica, Journal of Ethnopharmacology, Phytochemistry, and Journal of Natural Products—periodically contain reviews on some aspects of medicinal plants. Other journals containing research papers of Pharmacognostic interest are Natural Product Research and Natural Product Sciences. A series of multi-author books, handbooks, and dictionaries provide in-depth coverage of major medicinal plants.

6. Pharmacognostic Scheme

Describing drugs systematically is known as a Pharmacognostic scheme, which includes the following headings:

- **Biological Source**

This includes the biological names of plants or animals yielding the drug and the family to which it belongs. Botanical names include genus and species. Often some abbreviations are written after the botanical names of the biologist responsible for the classification, for example, Acacia arabica Willd. Here, Willd indicates the botanist responsible for the classification or nomenclature. According to the biennial theory, the botanical name of any plant or animal is always written in italic form, and the first letter of a genus always appears in a capital later. The biological source also includes the family and the part of the drug used. For example, the biological source of senna is, "Senna consists of dried leaflets of Cassia angustifolia Delite; belonging to family Leguminosae."

In the upcoming lectures, we will explain the nomenclature system for plants.

- **Geographical Source**

Geographical sources include the areas of cultivation, collection, and drug transport routes.

- **Cultivation, Collection, and Preparation**

These are important to mention as they are responsible for the quality of a drug.

- **Morphological Characters**

The length, breadth, thickness, surface, color, odor, taste, shape, etc., are covered under the heading morphological characters in organized drugs. In contrast, if the drug is unorganized, organoleptic properties (color, odor, taste, and surface) should be mentioned.

The upcoming lectures will cover the differences between organized and unorganized drugs.

- **Microscopical Characters**

This is one of the important aspects of pharmacognosy, as it helps establish the correct identity of a drug. Under this heading, all the detailed microscopical characters of a drug are described.

- **Chemical Constituents**

The most important aspect that determines the intrinsic value of a drug to which it is used is generally described under this heading. It includes the chemical constituents present in the drug. These kinds of drugs are physiologically active.

- **Uses**

It includes the drugs' pharmaceutical, pharmacological, and biological activity or the diseases in which it is effective.

- **Substituents**

The drug that is used during the non-availability of the original drug is known as a substituent. It has the same type of physiological active constituents; however, the percentage quantity of the drug available may be different.

- **Adulterants**

With the knowledge of the diagnostic characters of drugs, the adulterants can be detected. One should have the critical knowledge of substances known to be potential adulterants. Most of the time, the adulterants are completely devoid of physiologically active constituents, leading to quality deterioration. For example, mixing buffalo milk with goat milk is a substitution, whereas mixing water in the milk is adulteration. In the first case, goat milk is a substitute, and in the second case, water is adulterant.

- **Chemical Tests**

The knowledge of chemical tests becomes more important in unorganized drugs whose morphology is poorly defined.

Practice Question

1. Define The Followings:
    - Ethnopharmacology
    - Pharmacognosy
    - Study of Phytotherapy
    - Marin Pharmacognosy
    - Zoo-pharmacognosy
2. What is meant by Ayurvedic medicine?
3. Explain how pharmacognosy developed from a descriptive botanical science to a more advanced science with multidisciplinary science.
4. Explain New era Of Pharmacognosy
5. Explain the Scope of Pharmacognosy

The End of Lecture One