CHAPTER 1

Introduction to Pharmacognosy

Definition

- The words "pharmacognosy" and "gnosis" are Greek words that mean "drug" and "knowledge," respectively. J.A. Schmidt (1811) and C.A. Seydler (1815), respectively, initially used it and used it to describe the area of medicine or product that works with crude pharmaceuticals.
- J.A. Schmidt (1759–1809), an Austrian physician, first used the term "pharmacognosy" in his handwritten manuscript, "Lehrbuch der Materia Medica."
- Pharmacognosy today includes research on the physical, chemical, biochemical, and biological characteristics of medications, drug substances, or potential drugs or drug substances derived from natural sources.
- Pharmacognosy, according to the American Society of Pharmacognosy, is the study of the physical, chemical, biochemical, and biological characteristics of drugs, drug substances, or potential drugs or drug substances derived from natural sources, as well as the pursuit of novel drugs derived from these sources.

History of Pharmacognosy

- The interdependence of the biotic and abiotic components of nature makes it a prime example of the remarkable phenomenon of symbiosis.
- There is a complete supply of natural cures for every ailment known to man.
- Because of man's natural curiosity, the knowledge of medications has collected over thousands of years, and as a result, we now have numerous efficient ways to ensure health care.
- The majority of medications utilised in the past came from plants, which served as man's sole chemist for a long time. As long as humans have existed, herbal remedies have a long history.

- The ancient writings, some of which date back thousands of years, indicated that plants were utilised medicinally in China, India, Egypt, and Greece long before the Christian era.
- The Papyrus Ebers scroll, which is around 60 feet long and a foot wide and dates to the sixteenth century before Christ, is one of the most well-known relics still in existence. More than 800 equations and 700 distinct medications make up the majority of the document's material.
- Crude extracts were employed for the majority of the medicinally effective compounds discovered in the nineteenth and twentieth centuries. Since 5000 B.C., numerous medicinal herbs have been used in China.
- Pen-t'sao, a text created by Emperor Shen Nung circa 3000 B.C., is the oldest herbal known to exist. There are 365 medications in it, one for every day of the year. Indians also laboriously examined and categorised the herbs they encountered into categories known as Gunas.
- According to Charaka, fifty groups of ten plants would be sufficient to meet the needs of a typical doctor. Similar to this, Sushrutha categorised 760 herbs into 7 different groups based on some of their shared characteristics. 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 on Ayurveda are Charaka Samhita and Sushrutha Samhita.
- It is well known that the first pharmacist, Galen, kept opium and other painkillers in his apothecary.
- Following that, several daring attempts were undertaken to create mineral salts that may have had the potential to be used as all-purpose therapeutic agents by chemical entrepreneurs like Paracelsus (1493–1541).
- Le'mery reported on the significance of the extraction process and alcohol as an extractant (1645-1715).
- Based on ten years of research, William Withering provided an explanation of some of the medicinal qualities of foxglove leaves in 1785.
- The crude medicines were produced using the percolation procedure. In 1788, the alkaloidal drug calumba was made legal.
- Derosne, a French pharmacist, separated narcotine from opium in 1803.
- Morphine was first isolated from opium by Sertuerner in 1806, and its use in treating pain was later recognised.
- Strychnine 11817, emetine 11817, brucine (1819), piperine (1819), quinine (1820), and colchicine (1820) were isolated over the following several years.

- Strychnine was initially isolated from Ignatius beans and then from Nux vomica seeds by the French pharmacologist Pelletier.
- Stan and Otto created a new method of alkaloid extraction in 1852.
- Podophyllotoxin (Kuersten, 18911), cocaine (Neumann, 1860), ouabain (Hardy and Gallows, 1877), pilocarpine (Gerrard and Hardy,1875), ephedrine (Nagai, 1887), and nicotine were all isolated from tobacco leaves during this time period.
- The key discoveries of the 20th century were the isolation of ergometrine, digoxin, reserpine, theophylline, and quinidine.
- In the nineteenth century, the field of study today known as "Pharmacognosy" was known as Materia Medica.
- In the title of his book Analecta Pharmacognostica, German scientist Seydler first used the term "pharmacognosy" in 1815 while researching sarsaparilla.
- The name "pharmacognosy" comes from the Greek words "pharmakon" (drug) and "gignosco" (to acquire the knowledge of).
- Pharmacognosy is a subfield of bioscience that focuses on the analysis of primary or crude pharmaceuticals derived from plant, animal, and mineral sources. It entails knowledge of the history, distribution, cultivation, collection, processing for market and preservation, the study of sensory, physical, chemical, and structural characteristics, and the uses of crude drugs. To put it briefly, it is an objective study of crude drugs from natural sources treated scientifically.
- Swedish systematist Linnaeus (1707–1778), noted for classifying plants, developed the binomial system of plant naming, which is being used today.
- Engler and Prandtl, A.W. Eichler, Bentham and Hooker (1862–1863), and others furthered plant classification (1887-1898).
- G. Mendel's significant findings regarding plant hybrids were published in 1865. The invention of the microscope as a crucial analytical tool was a turning point in botanical research, especially because various processes, such as preparatory cleaning, mounting, and staining, were developed.
- Berg released the initial drug anatomical atlas in 1865. Voehl, Tschirch, and others described the anatomical characteristics of a number of powdered medications later in the century, which proved to be very important, especially at a time when adulteration in both drugs and food products was prevalent. Greenish and Collin created "An Anatomical Atlas of Powdered Vegetable Drugs" in 1904.

- In a nutshell, pharmacognosy serves as a vital link between the basic and pharmaceutical sciences. An essential link between the Ayurvedic and allopathic medical systems is pharmacognosy. It offers a mechanism for dispensing, formulating, and manufacturing crude pharmaceuticals using active ingredients drawn from natural sources in dose forms recognised by the allopathic medical system.

Development of Pharmacognosy to the Current Century

- The history of pharmacognosy development is the development of the use of plants and other natural resources for therapeutic reasons.
- The history of herbalism and the history of food are intertwined because humans have traditionally employed a variety of herbs and spices to season food and ward against infections that cause food-borne illness.
- Through observation, accidental discovery, trial-and-error guesswork, curiosity, and the pursuit of sustenance, among other methods, the ancient people studied the medical characteristics of plants and developed rudimentary medications

Trial-and-error Guesswork

- Trial-and-error guesswork refers to the practise of attempting something and then tossing it aside until it is successful. Ancient people could distinguish between useful and dangerous plants because to this technique.
- When people were nomads who subsisted on wild animal hunting and plant gathering, they employed this clumsy and time taking process for identification of herbs. Plants were employed for healing by ancient people who were guided by instinct, taste, experience, and knowledge. • In the recent years, a number of novel techniques, computer-based technology, and bio mathematical models have replaced the ineffective age-old trial-and-error guesswork method of drug discovery. They dug, dried, chewed, pounded, rubbed, and brewed many of the plants surrounding them and attempted to discover herbal effects through trial-and-error guesswork.

While Searching for Food

- Humans first discovered many of the herbs and spices they use today when looking for plants to utilise as food. Later, they learned that many plants also have medicinal properties.
- For thousands of years, people from all cultures have utilised spices and herbs to improve the flavour and scent of food.

- Early societies also valued the use of spices and herbs for both their culinary and medicinal purposes.
- Numerous spices, herbs, and their components have been shown to possess antibacterial properties in scientific studies since the late nineteenth century.
- The ancient people used the plants and spices they had acquired over time, learning about their virtues as they went along.

Signature of Nature

- The anatomical structures of many naturally occurring plants or their parts superficially resemble those of humans. While looking for and choosing plants for therapeutic usage, the ancient people may have placed stress on specific "signatures" likeness between plant and sick organ.
- These blatant structural resemblances served as the selection standard for therapeutic application. Ancient trademark plants include horsetail, gingko, ginseng, and others. In the past, numerous societies independently established their own versions of this concept. Later, it gained notoriety as the "Doctrine of Signature."
- The Doctrine of Signatures has likely been around for as long as there have been humans who study plants.
- The configuration and structure of a plant influenced early man to use it in the treatment of various diseases, for example, horsetail mimics cartilage and was believed to support the connective tissue, leaves; the cross section of the Ginkgo biloba fruit resembles a brain and today, Ginkgo is used for memory loss; and ginseng root resembles the human body and has been used for thousands of years as a tonic for the entire body.

Animal's Instinctive Discrimination between Toxic and Palatable Plants

- Animals can automatically distinguish between poisonous and appetising plants to survive in an unpredict environment. Ancient people observed animal behaviour closely and discovered that sick animals used some herbs that they ordinarily avoid.
- Ancient people were able to select medicinally beneficial plants by carefully and intimately observing the instinctual behaviour of animals.
- Many other animals, such as birds, bees, cats, dogs, elephants, elk, lizards, and different carnivores, are also known to consume medicinal

plants for self-medication, according to growing scientific evidence. Examples include chimpanzees eating Aspilia shrub and pith of Veronia plant to remove parasitic worms from the intestinal lining (zoopharmacognosy).

- This technique is still used by scientists today to separate active components from therapeutic plants.

Accidental Discovery/Fortuitous Accidents

- Plants have been used as medicines since antiquity, and some of these plants may have been unintentionally found (unexpected discoveries by accident).
- By mistake, a South American discovered the antimalarial medication quinine from Cinchona bark (also known as quina-quina by native people), and the antibiotic penicillin from Pencillium mould.
- The unintentional findings are known as drug serendipity (finding of one thing while looking for something else).
- There are several instances of therapeutic plants and their components being discovered by accident.
- Cannabis has been used medicinally for at least 5000 years, although Cannabis sativa's medicinal uses were only discovered by accident. Cannabis is a potent medical plant well-known for its hallucinogenic qualities.
- Serendipitous or accidental discoveries have led to some of the most significant medical advancements of our time, including the smallpox vaccine, insulin and its application in the treatment of diabetes, X-rays, and Viagra.
- People of all times have used plants as their primary source of food, shelter, and medicine.
- Since 5000 BC, medicinal herbs have been used in China. The oldest pharmacopoeia known to exist is thought to be the Chinese "Pen T'sao," which was composed by Shen nung around 3000 BC. It listed 365 medications.
- The "Pen T'sao Jing Ji Zhu", composed by Tao Hong Jing (456–536 AD), contains 730 herbs in six categories, including minerals, grasses and trees, insects and animals, fruits and vegetables, and grains.
- The Indian subcontinent was known among ancient civilizations as a rich source of medicinal herbs. The ancient medicine of classical antiquity known as Ayurveda (Ayur means life, veda means the study of, i.e., life, knowledge), has codified almost 8000 herbal medicines.

- Based on four Hindu Vedas (e.g., the Rig, the Sama, the Yajur, and the Atharva Vedas) that were compiled/written in ancient Sanskrit between 6000 and 4000 BC, Ayurveda underwent major development during the Vedic period. Out of them, the Atharva Veda and the Rig Veda are some of the earliest written records regarding the medical knowledge and practises that served as the foundation of the Ayurveda system. The Rig Veda is the oldest written book that has been maintained in a library.
- 67 species of medicinal plants were described in the Rig Veda, 81 in the Yajur Veda, and 290 in the Atharva Vaveda. Characteristics and applications of 1100 and 1270 species, respectively, were covered in the Charak Samhita and the Sushrut Samhita.
- The greater triad, which includes the Astanga Sangraha, the Charaka Samhita, and the Sushruta Samhita, is composed of key texts in ayurveda and was authored by Charaka, Sushruta, and Vagbhata, respectively.
- Sushruta Samhita later provided details on a large number of the plants (700), minerals (64), and animal preparations (57) utilised in Ayurveda.
- Following the construction of state hospitals for Ayurveda in various regions of the nation, Ayurveda is currently well integrated into the Indian national healthcare system.
- On papyrus, the ancient Egyptians recorded their medical practises and procedures. The use of papyrus as a writing surface dates back to antiquity. Papyrus is a thick type of paper manufactured from the pith of the papyrus plant (Cyperus papyrus).
- For centuries after Theophrastus, the first systematic treatment of the botanical world—Historia Plantarum—remains crucial for both herbalists and botanists. Greek herbalist Krateus (100 BC) wrote a text on therapeutic plants with illustrations. His impact can be seen in Dioscorides' De Materia Medica and other writings. Dioscorides, the founder of pharmacognosy, was a Roman army medical officer and pharmacognosist who investigated therapeutic plants wherever he went. In 78 AD, he released five volumes of "De Materia Medica," a work on pharmacopoeia.
- Galen's considerable study on the four basic characteristics and the humours enabled pharmacists to more accurately adjust their prescriptions for each patient's particular symptoms. The idea of Galen formed the basis of both allopathic and homeopathic systems of medicine practiced today (Sofowora 1982).
- As pharmacy and medicine developed gradually, pharmacognosy served as their foundation. Brunfels (1488–1534) grouped herbs in an

alphabetical list with drawings in his initial work in botany. Bock (1498–1554) continued Brunfels' work in a more scientific manner and created the groundwork for Linnaeus by classifying plants for the first time into herbs, shrubs, and trees. He provided detailed descriptions of the plants in his herbal, creating the first example of phytography. At least 100 new plants that were not previously mentioned in the writings of Dioscorides, Pliny, and Galen were added by Fuchs (1501–1577 AD) to his herbal. A well-known herbalist of the sixteenth century, Mattioli (1500–1577 AD), included numerous herbs from the New World in his formulations.

- The 'Doctrine of Signatures' was a concept long held by herbalists before it was introduced by well-known German alchemist and herbalist Paracleus (1493–1541). The doctrine of signatures is the concept that everything was created by God with a sign (a signature), and that the sign served as a clue as to why it was made.
- The term "Pharmacognosy" was originally used by Austrian J.A. Schmidt (1759-1809) in a manuscript that was posthumously published in 1811, and it was used by German C.A. Seydler in his book in 1815 to cover medications with plant origins.
- Microscopy was first used in pharmacognosy in the nineteenth century to check the quality of unprocessed medications, and for many years, pharmacognosy was restricted to the study of crude drugs.
- The discovery of significant medications from the animal world and microbes, in particular hormones and vitamins, have become a highly important source of drugs in the twentieth century.
- Thin layer chromatography (TLC), gas chromatography (GC), high-pressure liquid chromatography (HPLC), and spectrometric approaches (MS, NMR) were developed for pharmacognostical analysis and the search for novel physiologically active chemicals in plants in the second half of the 20th century. Due to the variety of qualities that plants possess as well as their lack of harmful side effects, many alternative doctors in the twenty-first century use herbalism in modern medicine.

Scope of Pharmacognosy

- Early on (between the nineteenth and second part of the twentieth centuries), pharmacognosy was created as a descriptive botanical discipline. At the moment, plant-based medications are being studied and produced within the context of contemporary medicine.
- The discovery, characterization, manufacture, and standardisation of natural medicines have all benefited from pharmacognosy.

- As a result, pharmacognosy has a wide range of applications and encompasses the scientific study of medical goods such as excipients, enzymes, vitamins, antibiotics, insecticides, and allergies (e.g., coloring, flavuring, emulsifying and suspending agents, diluents etc)
- The progress of numerous science departments has benefited greatly from the pharmacognosy.
- Pharmacognosy includes plant taxonomy, plant breeding, plant pathology, and plant genetics, and by using this knowledge, one can enhance the cultivation techniques for both medicinal and aromatic plants. Pharmacognosy also gives a sound understanding of the vegetable drugs under botany and the animal drugs under zoology.
- Plant chemistry, or photochemistry, has significantly improved nowadays. This encompasses a wide range of chemicals that plants both collect and manufacture.
- A crucial contribution to the progress of physical and natural science. This has been accomplished by the development of pharmaceutical collection, processing, and storage technologies through the use of cutting-edge cultivation, purification, and identification techniques for natural pharmaceuticals. Chemical engineering and biochemistry concepts have also played a role in this.
- It establishes a crucial connection between pharmacology and medicinal chemistry; it also imparts knowledge of chemotaxonomy and biogenetic pathways for the synthesis of acute components. Pharmacognosy is crucial for the development of new medicines since crude medications are used to make galanicals or as a source of therapeutically active metabolites.
- Newly discovered plant drugs are converting into medicine as purified phytochemicals. Substances that are synthesised are ultimately created in appropriate dosage forms, sometimes using the raw drugs as intermediaries.
- To put it simply, pharmacognosy plays a key role in bridging the gaps between pharmaceuticals, basic research, and the allopathic and ayurvedic medical systems.

Pharmacognosy is the science of the active ingredients of unprocessed medications, and it can aid in dosage form manufacture, dispensing, and formulation. The full understanding of pharmacognosy will also be helpful in understanding the current industrial trend. The pharmaceutical departments, innovative medication delivery methods, and other departments can all be used as research instruments to enhance healthcare infrastructure globally.

CHAPTER 2

Classification of Crude Drugs

Many pharmacological advances nowadays are based on plant-based medical practices healing. Plant-based medicine is still used by almost four billion people worldwide to treat a variety of maladies, particularly in underdeveloped nations. The invention of novel phytotherapeutic chemicals relies heavily on using plants as crude pharmaceuticals. Plants play an ubiquitous role in treatment of diseases across all medical systems. The traditional use of plants can be traced back to prehistoric times, such as Mesopotamia, where the healing virtues of plants, as well as the time of harvest, preparation method, and therapeutic function of the plant in question, were passed down from generation to generation.

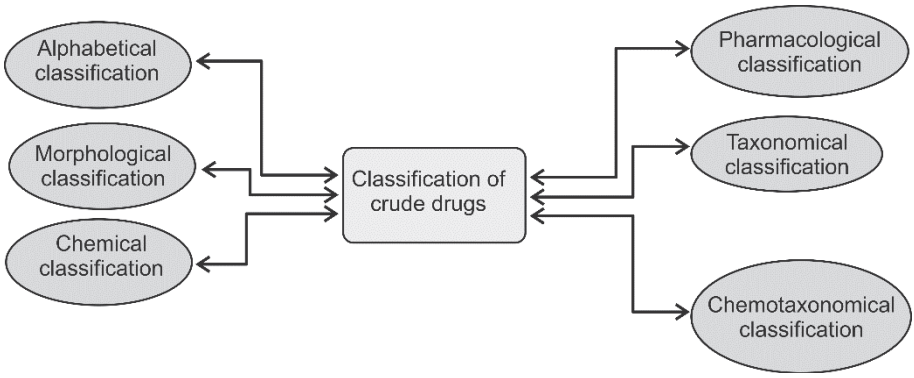
Crude medications are unaltered natural formulations of plants, animals, fungus, microbes, or minerals intended to prevent or treat illness or disease. Traditional pharmacopoeias describe the formally used crude medications in traditional medicine, with around 85 percent derived from plants and 15 percent shared in a ratio of 2:1 for minerals and animal components, respectively. The pharmacopoeia may list crude medications and categories them using various criteria, such as morphological, taxonomic, alphabetical, medicinal activity, or active compounds discovered inside them.

Broadly, plant crude pharmaceuticals can be classed according to their morphology, which might be organised or disorganised. Organized crude pharmaceuticals are preparations prepared from the full organ of the plant, where it contains a specific plant tissue, and utilized for therapy, such as leaves, roots, flowers, or seeds used to treat a specific condition.

The term ‘crude drug’ is generally applied to the products from plant and animal origin found in a raw material. Also the term ‘crude drug’ is referred in relation to the natural product that has not been advanced in value or improved in condition by any process or treatment.

Crude drugs are further classified into organized drugs and unorganized drugs based upon morphology. The main drawback of morphological classification is there is no co-relation of chemical constituents with the therapeutic actions.

In Pharmacognosy, the crude drugs are classified into:



1. **Alphabetical Classification:**
   - In this classification the drugs are arranged in alphabetical order from A to Z according to their particular language.
   - In European Pharmacopoeia, the arrangement of drugs are according to their names in both 'Latin' and 'English'.
   - In United States Pharmacopoeia, British Pharmacopoeia, Indian Pharmacopeia, the drugs were arranged in 'English'.
   - It is a simple system as referring drugs will be at ease.
   - This system of classification is a failure as the crude drugs were not categorized regarding its chemical nature, biological activity or medical uses of drugs.

   Example:

   Agar, Benzoin, Cinchona, Dill, Ergot, Fennel, Gentian, Hyoscyamus, Ipecac, Jalap, Kurchi, Liquorice, Myrrh, Nux-vomica, Opium, Podophyllum, Quassia, Rauwolfia, Senna, Uncaria gambier, Vasaka, Wool fat, Yellow bees wax, Zedoary.

2. **Taxonomical Classification:**
   - In this system the crude drugs are arranged according to taxonomical features of the plant. The drugs are arranged according to their taxonomical classification - phylum, order, family, genus and species.
   - This classification is purely on botanical concepts and restricted mainly to crude drugs from plant source.
   - It will provide a detail description about genus and species of plants along with their taxonomical features.

- This classification has demerits as some the entire plants will not be used for therapeutic purpose but only particular parts of the plant have been processed systematically.
- This system fails because the chemical nature of active constituents and therapeutic significance of crude drugs is not considered to classify the drugs

Examples:

The taxonomical classification of Glycyrrhiza glabra

Phylum - Spermatophyta
Division - Angiospermae
Class - Dicotyledons
Order - Rosales
Family - Leguminosae
Genus - Glycyrrhiza
Species - Glycyrrhiza glabra

The taxonomical classification of Atropa belladonna:

Phylum - Spermatophyta
Division - Angiospermae
Class - Dicotyledons
Order - Tubiflorae
Family - Solanaceae
Genus - Atropa, Hyoscyamus, Datura
Species - Hyoscyamus niger, Datura stramonium, Atropa belladonna

3. Morphological Classification:

- The crude drug is categorized into organized and unorganized forms.
- The organized drugs of a plant are classified as leaves, flower, fruit, bark, root etc.,
- The unorganized drugs are dried latex, gums, extracts etc.,
- This classification is very easy in practical approach especially when the chemical nature of the drug is not known.

Example:

Seeds - Nux-vomica
Leaves - Senna
Barks - Cinchona

Woods	-	Quassia
Roots	-	Rauwolfia
Rhizomes	-	Turmeric
Flower	-	Saffron, Clove
Fruit	-	Coriander, Fennel
Whole plant	-	Ephedra, Ergot, Belladona
Dried latex	-	Opium, Papin
Resins	-	Balsam of Tolu, Myrrh
Gums	-	Acacia, Tragacanth, Guar gum
Dried juices	-	Aloe, Red gum
Dried extracts	-	Gelatin, Agar, Curare

4. Chemical Classification:

- Crude drugs are categorized based on chemical constituents present in the drug to which the pharmacological/therapeutic activity of drug is concerned.
- In this classification, the drugs are made easy to study if it contains a known chemical constituents.
- The different originated drugs will be under similar chemical category.

Examples:

Alkaloids	-	Datura, Vasaka, Vinca, Lobelia
Glycosides	-	Cascara, Senna, Digitalis
Tannins	-	Catechu, Myrobalan, Ashoka
Volatile oil	-	Clove, Eucalyptus, Cinnamon
Lipids	-	Castor oil, Beeswax, Arachis oil
Carbohydrates and derived products	-	Acacia, Agar, Honey, Guar gum, Tragacanth, Starch
Resins	-	Colophony, Jalap
Vitamins and hormones	-	Yeast, Shark liver oil, Insulin, Oxytocin
Proteins and enzymes	-	Gelatin, Papain, Casein, Trypsin

5. Pharmacological Classification:

- The crude drugs are grouped according to pharmacological activity (Therapeutic action) due to the presence of chief active constituents present in the crude drug.
- No morphological, taxonomical features or chemical relationships is considered.
- They can be classified on the basis of therapeutic or pharmacological effect even no ideal on chemical constituents present in it

Example:

Drugs acting on Gastro-intestinal tract:

Carminatives	-	Dill, Mentha, Cardamom
Emetics	-	Ipecac
Purgatives	-	Senna, Castor oil
Bulk laxatives	-	Agar, Banana
Anti-amoebic	-	Kurchi, Ipecac

Drugs acting on Respiratory System:

Expectorants	-	Liquorice, Ipecac, Vasaka
Antiexpectorants	-	Stramonium leaves
Antitussives	-	Opium
Bronchodilators	-	Ephedra

Drugs acting on Cardio-Vascular System:

Cardio tonics	-	Digitalis, Squill
Antihypertensives	-	Rauwolfia
Vaso-construction	-	Ergot

Drugs acting on CNS:

Central analgesics	-	Opium
CNS stimulant	-	Coffee
CNS-depressants	-	Hyoscyamus, Belladonna, Opium
Hallucinogenic	-	Cannabis, Poppy

Drugs acting as Anti-malarial:

Cinchona, Artemisia

6. Chemotaxonomical Classification:

- In this system, the crude drugs are classified based on taxonomical status and the type of chemical constituents present in it. As the type of chemical constituents are meant to the characteristic features of Phylum.
- To classify the drugs under this classification a detailed investigation of distribution of chemical compounds among different plants categorized under phylum i.e., biosynthesis related compounds in a series of related plants.
- This classification is mainly focused on chemotaxonomy of secondary metabolites possessing pharmaceutical significance viz., alkaloids, glycosides, flavonoids, etc.