CHAPTER 1

Pharmacognosy: Scope and History

Introduction

The term 'pharmacognosy' (combination of two Greek words i.e., *pharmakon* means drug and *gnosis* means knowledge) means "acquiring knowledge of drugs" was coined in 1815 by C. A. Seydler, German medical student in his thesis title "*Analyetica Pharmacognostica*". Pharmacognosy is defined as "*scientific and systematic study of structural, physical, chemical and biological characters of crude drugs along with history, method of cultivation, collection and preparation for the market*".

The American Society of Pharmacognosy defines pharmacognosy as "*the study of the physical, chemical, biochemical and biological properties of drugs, drug substances or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources*". It is also called as study of crude drugs.

Thus pharmacognostical studies of plant drugs involves study of synonyms, vernacular names, biological sources, distribution, morphology, histology, chemistry, qualitative test, various physicochemical tests, pharmacological actions along with commercial varieties, substitutes, adulterants and any other quality control parameters of the drugs.

Scope

- The pharmacognosy has played an important role in the transformation of various basic science subjects. Pharmacognosy has a vital contribution to the advancement of natural and physical science due to advances in technologies of cultivation, purification, identification, characterization of natural drugs.
- Pharmacognosy has enabled to establish a sound knowledge of the vegetable drugs under botany and animal drugs under zoology through taxonomy, breeding, pathology and genetics concepts.
- This knowledge used to improve and modernise cultivation methods of medicinal and aromatic plants to fulfill demand from quality raw material to genetic transformations in plants to get desired characters.
- World Health Organization (WHO) has estimated that 80% of world population depends on herbal medicines for their primary health care. Some of the very famous crude drugs are senna as a purgative, digitalis as a cardiotonic and rauwolfia as an antihypertensive drug. Pharmacognosy explains thorough indepth knowledge of the history, cultivation, collection, quality control, transport, storage and even economic impact of all these crude drugs.
- Pharmacognosy is vital link between pharmacology and medicinal chemistry because it enables isolation of purified natural drugs, converts into medicine and evaluates its therapeutic effects.
- Pharmacognosy links pharmaceuticals and basic science as well as ayurvedic and allopathic system of medicines to each other.
- Pharmacognosy helped to improve plant chemistry (phytochemistry) significantly with the knowledge of extraction. Variety of chemical constituents that are accumulated and synthesized by plants have revolutionized the process of natural drug discovery.
- Novel techniques like "Bioassay Guided Fractionation" helps in the isolation of phytochemicals based on therapeutic potency. This has led to specific use of medicinal constituents or plant parts and its utilization in disease treatment.
- Recently started studies on natural drug-drug, drug-food interactions are avoiding

the untoward effects of severe interactions and hence helping in obtaining the optimal therapeutic outcomes especially for classes like blood thinners, protease inhibitors, cardiac glycosides, immuno suppressants.

- In the pharmaceutical industry, various drugs of botanical origin are used in drug manufacturing process. Knowledge of pharmacognosy surely helps as a research tools in the new drug /dosage form development.
- Recent guidelines for quality control of crude drugs are to assure the identity, purity and consistency of drug substances, efficacy to determine the therapeutic responses, indications, clinical aspects and pharmacological effects, safety to avoid untoward toxic reactions, interactions and contraindications.
- However, this subject is as old as pharmacy and humankind evolution; recently it is evolved as a multi-disciplinary subject focusing many modern disciplines like ethonobotany, ethonopharmcology, phytotherapy, phytochemistry, chemotaxonomy, biotechnology, clinical trials, herbal drug interaction and even novel drug delivery systems like phytosomes rather only botanical and taxonomical descriptions. Recent advances in extraction methods, analytical hyphenated techniques, screening methods continues to hasten major changes in this subject. Modernization of conventional and/or traditional dosage forms is opening doors to "Industrial Pharmacognosy".
- Due to most recent technologies and innovative chemical concepts, many new drugs or drug candidates still originated from natural products or derivatives thereof. Even in this era of nanotechnology, natural drugs are important part of primary health care which is giving pharmacognosy professionals new possibilities to exploit the huge diversity designed and generated by nature.
- Due to rapid growth in demand and popularity of natural products, research has been directed towards patentable drug discovery and development in the field of pharmacognosy.
- There is a shortage of established scientists engaged in pharmacognosy research, which tends to involve subject matter beyond the conventional scientist's knowledge base. Hence, actual secret of opportunities in pharmacognosy research is that only the tip of the iceberg seems to have been discovered yet.

History

History of pharmacognosy is as old as mankind. Human being came to know medicines from nature itself. Table 1.1 is explaining various historical developments which together contributed to the progress of Pharmacognosy. Various traditional systems of medicines from different corners of world also played vital role in development of pharmacognosy.

Table 1.1 Scientists and their work in the development of Pharmacognosy

Name	Profession	Work	Period
Hippocrates *Father of Medicine*	Greek scientist	Studied human anatomy and Physiology	460-360 B.C
Aristotle *Father of Biology*	Greek Philosopher	Animal kingdom	384-322 B.C.
Theophrastus *Father of Botany*	Greek Philosopher	Plant kingdom	370-287 B.C.

Table 1.1 *Contd...*

Name	Profession	Work	Period
Pedanius Dioscorides	Greek physician	*De Materia Medica* book is compilation of several plants	78 A.D.
Gaius Plinius Secundus or Pliny the Elder	Roman naturalist	Encyclopedic work entitled *Naturalis Historia*	25-70 A.D.
Aelius Galenus or Claudius Galenus or Galen	Greek pharmacist	Galenical Pharmacy	131–200 A.D.
Carl Linnaeus *Father of Taxonomy*	Swedish botanist	Binomial classification	1753
C A Seydler	German scientist	Coined word *Pharmacognosy*	1815
Sir Joseph D. Hooker	British botanist	Plant nomenclature	1817-1911
George Bentham	English botanist	Plant nomenclature	1800-1884
Charles Darwin	English naturalist	Evolutionary theory	1809-1882
Friedrich Sertürner	German chemist	Isolated first alkaloid morphine from opium	1804
Mikhail Tsvet	Russian scientist	Separation of plant pigments by chromatography	1900

Alternative Systems of Medicine

Ayurveda System

It is about 5000 year old system of medicine native to India. It is holistic system of medicine which considers whole body while treating disease and not just a diseased part of body. Ayurveda has thousands year's evidence based history so it can be just complete system rather alternative system or complementary system. Ayurveda is a Sanskrit word which means (*Ayur*-life and *veda* – to gain knowledge or science) science of life. Ayurveda deals with different types of plants, minerals and animal products. Charak samhita by Charak includes the principle components or theory of Ayurveda. Sushrut samhita edited by Sushrut is about the surgical treatments in Ayurveda.

***Theory and principles*:** Ayurveda involves following fundamental principles:

- **Triguna:** Satva (good), Raja (aggressive), Toma (dullness)
- **Tridosha:** (Kapha- lubrication, Vata-respiration and Pitta-metabolism),
- **Panchshil:** (Rasa : Therapeutically active substances, Guna : Quality Virya : Active principle and potency, Vipaka : The end product of digestion, Prabhava : Actual effect of drug on body),
- **Panch Mahabhuta:** (earth, water, sky, fire and air),
- **Saptadhatu** [(Rasa (Plasma), raktam (Blood), mamsa (Muscles), meda (Fat), asthi (Bone), majja (Bone marrow and nerves), shukra (Reproductive fluid or Semen)] and triguna i.e. *Satva* (good), *raja* (aggressive), *toma* (dullness)

***Diagnosis*:** When non-equilibrium between any of above principles causes to person suffers from diseases. Ayurveda cures the cause of disease by considering to mental, physical, social and spiritual welfare of human beings. Observation of body color, tongue, nail, eyes, pulse and investigation of

blood, urine and fecal matter is criteria of diagnosing actual cause of disease.

***Treatment*:** Panchakarma is an important treatment in Ayurveda which includes snehan (massage), swedan (steam), vaman (vomit), virechan (expulsion) and basti (medicated enemas). The medicines are given in the form of powder (churna, bhasma), liquid (asava, arishta and taila), semisolid (leha or paka) and tablets (gutika, vati). Treatment of ayurveda involves use of drugs obtained from plant, animal and mineral sources. Dosage forms of ayurveda are powders (churna), bhasma (oxides of metals), quath (extracts), gutika (pills), lep (ointment), asava and arishtha (alcohol containing liquids) or taila (medicated oils). There are eight branches of Ayurveda:

1. Kayachikitsa (internal medicine)
2. Kumarbhritya (pediatrics)
3. Trachchikitsa (psychology medicine)
4. Shalakya Tantra (ear, nose and throat)
5. Shalya Tantra (surgery)
6. Agada Tantra (toxicology)
7. Rasayana Tantra (geriatrics)
8. Vajikaran Tantra (gynecology)

Siddha System

Siddha system of medicine is one of the oldest medical systems known to mankind even before ayurvedic system which was flourished in Vedic culture, Dravidian culture and Indus Valley Civilization. This system of medicine originated from Tamil traditional medicine. The most of literature of this system is given in Tamil Language. 18 "Siddhas" (Spiritual persons) developed this system so it is called as Siddha. Sage Agathiyar is considered the guru of all Sidhas. According to Palm Leaf manuscript, it is believed that it was first described by Lord Shiva to his wife Parvathy and then to their son Lord Muruga. Then he taught all these knowledge to his disciple sage Agasthya. Agasthya taught 18 Siddhars and they spread this knowledge to human beings. Siddhars have to get Siddhi means attainment of supernatural powers

***Theory and principles*:** Generally the basic principles of the Siddha medicine are almost similar to ayurveda. The only difference appears is that the siddha system explains in detail about various basic treatments of diseases while Ayurveda where surgeries like modern treatments are practiced and written in detail. Siddha system is based on 96 principles and out of these Triguna theory, i.e., vata, pitta and kapha is more prominent. Under normal conditions, the ratio between Vata, Pitta, and Kapha is 4:2:1, respectively. Siddha deals with thousands of herbs, animal, mineral and metals. Like in Ayurveda, in Siddha medicine also, the physiological components of the human beings are classified as vata (air), pitta (fire) and kapha (earth and water).

Siddha system believes that health is perfect state of physical, mental, social, moral and spiritual component. It is based on Andapinda Thathuvam means relationship between universe and human body. Siddhas are called as Vaithiyars.

***Diagnosis*:** A Siddha physician studies eight important things of body i.e. nadi (pulse), kan (eyes), swara (voice), sparisam (touch), varna (colour), na (tongue), mala (faeces) and neer (urine).

Guna	Personalities	Complications
Vata	Stout, black, cold and inactive healthy	Increased *Vata* shows arrogant behaviour, paralysis, heart attack.
Pitta	Lean, whitish complexion and perfectionist	Increased *Pitta* shows graying of hair, anemia and instability.
Kapha	Well built, good complexion and well behaved	graying of hair, causes jaundice, heart attack.

***Treatment*:** Internal as well as external medicines are divided into 32 categories each separately. Pressure or massage techniques

are also part of treatment and called as Thokkanam. There are 108 varma points for pressure techniques. Treatment is classified into three categories: devamaruthuvum (Divine method); manuda maruthuvum (rational method); and asura maruthuvum (surgical method). In Divine method medicines like parpam, chendooram, guru, kuligai made of mercury, sulphur and pashanams are used. In the rational method, medicines made of herbs like churanam, kudineer, vadagam are used. In surgical method, incision, excisions, use of heat or leech are used. Treatment in this system emphasizes preparation of fresh medicine. It is then prepared and administered with some Pathya (some restriction). E.g., Day time sleeping is not allowed or some food material is restricted like chicken, mango, coconut, mustard, groundnut, almond, tobacco etc. Medicine can be kashayam (extract), churnam (powder), tailams (medicated oil), gulligai (pills), chenduram (metal), bhasmam (calcination product) and or ghritam (medicated ghee).

Unani System

This system is also called as unani-tibb or yunani medicine which was developed by arab and persian physicians such as Rhazes (al-Razil), Avicenna (ibn sena), Al-zahrawi, and Ibn nafis.

Book

Ibn Sina's The Canon of Medicine

Theory and principles: Unani medicine involves concept of the four humours (akhlat) i.e. Phlegm (Balgham), Blood (Dam), Yellow bile (bafrâ') and Black bile (Saudâ'). These "humors" are believed to have its roots in the appearance of a blood sedimentation test made in open air, which exhibits a dark clot at the bottom (black bile), a layer of unclotted erythrocytes (blood), a layer of white blood cells (phlegm) and a layer of clear yellow serum (yellow bile). Abnormality in humor leads to disease condition in body.

***Diagnosis*:** The human body is considered to be made up of seven components, which have direct bearing on the health status of a person. They are 1. Elements (Arkan) 2. Temperament (Mijaz). 3. Humors (Aklat) 4. Organs (Aaza) 5. Faculties (Quwa) 6. Spirits (Arwah) 7. Functions (Afaal). These components are taken in to consideration by the physician for diagnosis and also for deciding the line of treatment.

In diagnosis Unani Physican (Hakim) ask a patient a lot questions to know history and decides treatment.

Treatment: After diagnosing the disease, treatment involves either to eliminate cause (Izalae sabab), normalize humors (tadeele akhlat) or to normalise tissues or organs (tadeele aza). Method of treatment involves modification of essential pre-requisites of health (Ilaj-bil-tadbeer) or panchkarma like in Ayurveda (Ilaj-bil-tadbeer) or pharmacotherapy (Ilaj-bil-advia) or surgery (Ilaj-bil-yad). As far as possible unani medicine therapy attempts to use simple physical means to cure a disease. Some of the techniques used in Ilaj-bil-tadbeer (regimental therapy) include hijamah (cupping), fasd (venesection), tareeq (sweating), idrar-e-baul (diuresis), hamam (turkish bath), dalak (massage), kai (cauterization), ishal (purging), qai (vomiting), riyazat (exercise) and taleeq (leeching).

The bases are generally purified by adding aab leemun (lemon juice), sat leemun (lemon extract) or shibb-e-yamani (alum) etc., before making the qiwam. Afterwards, the ingredient drugs are mixed in qiwam to prepare majun, itrifal, laboob, tiryaqat or mufarreh. For making majun or any of its preparations, the consistency of qiwam for majun is three Tars. The consistency of qiwam for laooq is two tars.

Word Majun is derived from Ajn, which means to mix. In this preparation powder of drugs is mixed well in qiwam (basic solution of particular consistency) of sugar or asl (honey). Their names are given on the name of inventor, chief ingredients or action. Like majun sheikhurrais is named on inventor. majun mullein is named due to its laxative action. Majun azaraqi, as azaraqi is chief ingredient. So itrifal (triphala), jawarish (digestive tonic), yaqooti (ruby containing), bershasha are all majun but according to composition use ingredient preparation method, and other properties, their names are different.

Homeopathy System

Homeo means 'similar' and Pathos means 'suffering' so homeopathy is the "system of similar suffering". German physician Samuel Hahnemann first stated the basic principle of homeopathy in 1796, known as the "law of similars" (let like be cured by like").

***Theory and principle*:** Homeopathy emphasises the root cause of the disease and the nature's law of its cure that is 'like cures like'. Thus, homeopathy deals with the following seven principles which are outlined below:

- ***Individualisation*:** No two individuals in the world are alike, i.e., the disease affecting two individuals cannot be similar though they may share common symptoms. Therefore, the medicines used to cure the same disease in different individuals are different.
- ***Principle of similar:*** Use of the medicine will produce similar symptoms of disease in a healthy individual. For example, an onion is a substance, which makes your eyes water and your nose burn. If you are having an attack of hay fever with watering eyes and a burning nose, a homeopathic remedy made from onion can relieve it.
- ***Principle of simplex:*** Only one single simple medicine at one time and no combination is allowed.
- ***Minimum dose*:** Minimum medicine at a time.
- ***Law of proving:*** Medicine should have the capacity to produce disease state in a healthy individual.
- ***Law of dynamisation:*** Medicine should preserve the normal state of healthy body.
- ***Vital force:*** Medicine should have the capacity to arouse sufficient energy to maintain a healthy body.

Diagnosis: It involves knowing of complete hereditary history as well as observation of moods, habits, skin, eyes, tongue, blood, urine etc., of patients.

***Treatment*:** When the symptoms picture matches with the drug picture, the physician always attempts to identify a single medicine. In producing remedies for diseases, homeopaths use a process called "dynamisation" or "potentiation", whereby a substance is diluted with alcohol or distilled water and then vigorously shaken in a process called "succussion". Three logarithmic potency scales are in regular use in homeopathy for dilution. Hahnemann created the "centesimal" or "C scale", diluting a substance by a factor of 100 at each stage. Homeopathic pills are made from an inert substance (often sugars, typically lactose), upon which a drop of liquid homeopathic preparation is placed. Hahnemann began to test what effects substances produced in humans, a procedure that would later become known as "homeopathic proving".

Chinese System

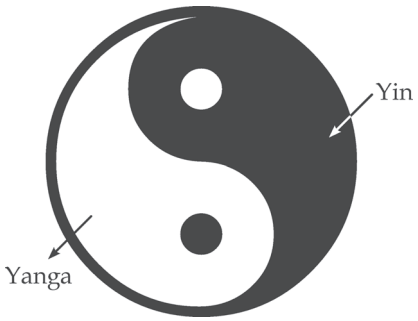
Traditional Chinese Medicine (TCM) is older than 2,000 years have been developed in China. Historical physicians in TCM include Zhang Zhongjing, Hua Tuo, Sun Simiao, Tao Hongjing, Zhang Jiegu, and Li Shizhen.

Book

Yellow Emperor's inner Canon, Treatise on Cold Damage

***Theory and principles*:** Chinese medicine involves concept of Yin and Yang. Yin means negative, dark, water, moon, female, inside, cold or moist. Yang means positive, bright, sun, fire, male, outside, hot or dry. Yin dominating body shows inactivity, cold or lethargy while yang dominating body shows fever, hyper-activity. Five element theory of TCM (wood-germination, water-decay, fire-growth, earth-ripening and metal-nourishment) relates to five body organs (wood-liver, fire-heart, water-kidney, earth-spleen and metal-lung) and symolises man and nature relationship. TCM believes that *qi* means energy, blood and water are three essential substances for body's normal health.

***Diagnosis*:** Diagnosis is based on "pattern of discrimination" i..e valuation of the present signs and symptoms on the basis of the "Eight Principles" or causes like internal, external, heat, cold, vacuity (deficiency), Repletion (excess), yin and yang. TCM diagnosis consists in tracing symptoms to an underlying disharmony pattern, mainly by palpating the pulse and inspecting the tongue.



Symbol of Chinese System

***Treatment*:** Treatment includes:

1. Acupuncture: The acupuncture points located in skin are opened and closed by a stainless steel needle for 20-40 minutes to adjust proper blood circulation.
2. Herbal Medicine: Specific herbs and their combinations are used to cure diseases.
3. Diet: Herbal supplements are given as a part of diet to fortify the body constituents.
4. Exercise: For healthy individuals as well as for patients, exercise is properly planned in the Chinese system.
5. Massage: It is an important part of the Chinese system to harmonize body climate.

Kampo System

Kampo medicine is an ancient traditional system that developed in Japan between the 7^{th} and 9^{th} centuries after adapting traditional Chinese system. Shanki Tashiro, Dosan Manase, Nagoya and Todo Yoshimasu are few people who played important role in development of Kampo system. Regulations, and likewise safety precautions, are much stronger and tighter for Japanese kampo than chinese traditional medicine due to strict enforcement of laws and standardization. It was not as famous but merits of natural medicines have been recognized today and hence it is estimated that 80% of Japanese physicians integrate kampo prescriptions into their practice. In Japan, kampo is integrated into the national health care system and it follows strict regulations of the standardization, purity, and stability of kampo ingredients. In treatment kampo medicine is patient-centered.

***Theory and principles*:** Generally the basic principles of the kampo medicine are almost similar to TCM except abdominal diagnosis which very important in kampo than TCM.

***Diagnosis*:** In kampo system, the focus is not on the disease, but rather on treating patients and promoting well-being, assessing the proper fit between a pattern of symptoms and a kampo prescription.

***Treatment*:** Now a days, it is very popular system in treating chronic diseases. Till date about 400 herbs has been explored and standardized in kampo system.

Aromatherapy System

Aromatherapy is a form of alternative medicine that uses essential oils in the treatment or prevention of certain diseases especially related to pain, anxiety, hair or skin. Evidence for the efficacy of aromatherapy in treating medical conditions remains poor, with a particular lack of studies employing rigorous methodology, but some evidence exists that essential oils may have therapeutic potential. Many such oils are described by dioscorides, along with beliefs of the time regarding their healing properties, in his *De Materia Medica*, written in the first century.

Modes of application in aromatherapy:

- *Aerial diffusion*: mood elevation, treatment of migraine and headache
- *Direct inhalation*: respiratory or central nervous system associated diseases
- *Topical applications*: skin rejuvenation, skin disease treatments, ,

Materials employed in Aromatherapy:

- *Essential oil:* Pure essential oils obtained by solvent extraction or distillation or expression
- *Absolutes:* Alcoholic dilutions of Pomades (fragrant oils obtained by cold fat extraction)
- *Carrier oil:* Essential oils diluted in fatty oils
- *Herbal distillates (hydrosols):* Aqueous by product of essential oil extraction
- *Infusions:* Aqueous extracts of aromatic plants
- *Vaporiser:* inhalation of aroma/fragrance/ medicated oils from crushed/heated plant materials

Aromatherapy is alone does not cure conditions but in combination with other techniques show positive effects and helps the body to find a natural way to cure itself and improve immune response.

Naturopathy

The term Naturopathy was coined in 1895 by John Scheel**.** Naturopathy is a system of prevention rather treatment. Prevention through stress reduction and a healthy nutritious diet and lifestyle is emphasized, and drugs and surgery are generally minimized. It focuses on natural healing power of body thus art of living. This system uses soil and water in treatment of diseases in the form of mudpacks and steam baths respectively. Fasting is also part of naturopathy treatment.

Yoga

Yoga consists of exercises (physical postures) and meditation (mental concentration). It believes that exercise improves blood circulation in the body and meditation improves mental health. Thus Yoga improves physical, mental as well as social health along with personal behavior of the person.

Table 1.2 Eight limbs included in yoga

Yama	Five abstentions	Ahimsa (non-violence), satya (truth), asteya (non-covetousness), brahmacharya (celibacy) and aparigraha (non-possessiveness).
Niyama	Five observances	Shaucha (purity), santosha (contentment), tapas (austerity), svadhyaya (study of the vedic scriptures to know about god and the soul) and ishvara-pranidhana (surrender to god).
Asana	Seat	Seated position used for meditation
Pranayama	Suspending breath	To restrain or stop and thus control of the life force.
Pratyahara	Abstraction	Withdrawal of the sense organs from external objects
Dharana	Concentration	Fixing the attention on a single object
Dhyana	Meditation	Intense contemplation of the nature of the object of meditation
Samadhi	Liberation	Merging consciousness with the object of meditation

Crude Drugs

Crude drugs are the drugs, which are obtained from natural sources like plant, animals or minerals and used as such as they occur in nature without any processing except, collection, drying and size reduction. It also defined as the drugs that have not been advanced in value or improved in condition by shredding, grinding, chipping, crushing, distilling, evaporating, extracting, artificial mixing with other substances or any other process beyond that which is essential to its proper packing and to prevention of decay or deterioration during manufacturing. Crude drugs and their constituents are commonly used as therapeutic agents. Major sources of crude drugs are plant (senna, opium, digitalis and clove), animal (musk, honey, shark liver oil) and mineral (shilajit, talc, bentonite).

Classification of Crude Drug

In Pharma-cognosy crude drugs are classified in the following category.

Alphabetical Classification: In this classification drugs are classified in alphabetical order using either their Greek name or Latin name. Though pharmacopoeias, formulary, encyclopedias of various countries follow this classification, but due to lack of scientific value now-a-days this classification is not preferred. Example: Acacia, Bael, Cinchona, Dill, Ergot, Fennel, Ginger, Henbane, Ipecac, Jalap, Kurchi, Licorice, Myrrh, Nux-Vomica, Opium, Podophyllum, Quassia, Rauwolfia, Senna, Tea, Urgenia, Vasaka, Wool Fat, Yam, Zedoary etc. Major Advantage of this method is that it provides quick reference.

Morphological Classification: This is most simple classification method where crude drugs are grouped into two major classes: organized (having specific parts of plant like root, rhizome, flower, leaf, fruit, bark, seed, wood etc.,) and unorganized drugs (dried lattice, juice, gum, wax, oil etc.). But many crude drugs are very similar morphologically and hence difficult to distinguish. Many times crude drug available in powder form that time morphological classification is not so suitable and acceptable.

Organised crude drugs		**Un-organised crude drugs**	
Parts of plants or animals		Obtained from parts of plants	
Well defined structure		Not well defined structures	
Solid in nature		Semisolid, solid, liquid in nature	
Microscopic studies are useful in quality control		Chemical tests are more useful in quality control	
Examples		***Examples***	
Parts	**Example**	**Class**	**Example**
Leaves	Senna, digitalis, vasaka, eucalyptus	Resins	Balsam of tolu, myrrh, asafoetida, benzoin
Barks	Cinchona, kurchi, cinnamom, quaillia	Gums and mucilages	Acacia, tragacanth, guar gum
Woods	Quassia, sandalwood	Dried latices	Opium
Roots	Rauwolfia, ipecacuanha, aconite	Dried juices	Aloes, kino
Rhizomes	Turmeric, ginger, valerian, podophyllum	Volatile oils	Cinnamon oil

Table *Contd...*

Parts	Example	Class	Example
Seeds	Nux-vomica, strophanthus	Fixed Oil	Castor oil and lard
Flowers	Clove, saffron	Waxes	Beeswax
Fruits	Coriander, colocynth, fennel, bael	Extracts	Catechu
Entire plant	Vinca, belladonna	Saccharine substances	Honey

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Leaves	Senna, digitalis, vasaka, eucalyptus
Barks	Cinchona, kurchi, cinnamom
Woods	Quassia, sandalwood
Roots	Rauwolfia, ipecacuanha, aconite
Rhizomes	Turmeric, ginger, valerian, podophyllum
Seeds	Nux-vomica, strophanthus
Flowers	Clove, saffron
Fruits	Coriander, colocynth, fennel
Entire plant	Vinca, belladonna
Resins	Balsam of tolu, myrrh, asafoetida, benzoin
Gums and Mucilages	Acacia, tragacanth, guar gum
Dried lattices	Opium
Dried juices	Aloes, kino

Taxonomic Classification: In this classification crude drugs are arranged according to taxonomic order i.e., phylum, division, class, sub-class, orders, families, genus and species (See chapter 2 for more details). Precise and orderly arrangement of drugs has no ambiguity in this classification. But again this type of classification lacks scientific value and unorganized crude drugs are difficult to classify.

Phylum - Spermatophyta
Division - Angiospermae
Class - Dicotyledons
Sub-class - Sympetalae
Order - Tubiflorae
Family - Solanaceae
Genus - *Atropa*
Species – *belladonna*

Biological or Pharmacological Classification: In this classification, crude drugs having similar therapeutic effects or pharmacological activity are grouped together but drugs having more than one therapeutic effect are difficult to classify. It also doesn't give any idea about chemistry or taxonomy.

Pharmacological Action	Drug
Carminatives	Fennel, coriander, clove.
Purgatives	Cascara, aloe, senna, rhubarb.
Cardio tonics	Digitalis, squill, strophanthus
Anti- cancer	Taxol, vinca, podophyllum
CNS stimulant	Nux-vomica
Expectorant	Vasaka, liquorice
Bitter tonic	Gentian, chirata

Chemical Classification: This classification is purely based on chemistry of constituents. Different crude drugs are classified according to the presence of major active constituents. This is most preferred method of classification.

Chemical class	Drugs
Alkaloid	Cinchona, rauwolfia, datura
Volatile oil	Clove, fennel oil, coriander
Glycoside	Senna, digitalis, licorice
Resin	Jalap, ginger, tolu balsam
Carbohydrate	Acacia, honey, starch, isapgol
Tannin	Arjuna, ashoka
Lipid	Castor oil, peanut oil, mustard
Protein	Casein, gelatin
Enzyme	Papain, trypsin

Chemotaxonomic Classification: Chemotaxonomy is a technique which establishes relation between chemistry and taxonomy. It is also called as chemosystematics.

Morphological characters and chemical constituents are interrelated and have a lot significant for the plant taxonomy. E.g., In case of eucalyptus, feather-veined leaves have high pinene content in their essential oil, while intermediate veined leaves contain both pinene and cineole. Chemotaxonomic study starts with exact choice of group, then sound sampling, analysis of chemical content, interpretation, comparison and finally classification. More details on this topic can be read in chapter 7.

Serotaxonomical Classification: Serology deals with studies of antigen-antibody reaction to provide knowledge of origin and properties of antisera. Serotaxonomic classification involves phytoserology which carries in-vitro immunochemical reaction of plant proteins (antigens or agglutinogens) to detect taxonomic homology based on antibodies (agglutinins) produced in animals. Desipite significant contribution made in the serotaxonomy, it has so far not gained much importance in the plant classification. The most common approach in serotaxonomic classification of plants is "precipitin reaction". Precipitin is antibody which causes precipitation.

Precipitin reaction: After injecting a crude plant protein extract into the blood stream of an experimental animal like rabbit or a rat results in the production of specific antibodies. When animal serum containing antibodies also called antiserum reacts in-vitro with the antigenic proteins as well as proteins from other related taxa, of which the affinities are in question, leads to formation of a precipitate. This is called precipitin reaction. The degree of protein homology is determined by the amount of precipitation and hence it is taken as a phylogenetic marker and taxonomic character. If no precipitation is observed then there is no relation and if high precipitate then close relationship among examined taxas.

Crude protein extracts contain a large number of proteins, which stimulates the production of a vast range of antibodies, which differ in their specificity and reactivity. Some are produced in abundance while others are hardly detectable. But advanced serologic techniques allows to deals with single antigen and antibody. The "antisystematic" reactions have recently been shown to result from variation in the systematic ranges of determinants; and the absorption (pre-saturation) technique for removing common determinants increases the accuracy of serological placements. Immunodiffusion in Agarose Gels, Rocket Immuno-electrophoresis and Enzyme-Linked Immuno-sorbent Assay (ELISA) are commonly used techniques in serotaxonomy.

Table 1.3 Parameters involved in pharmacognostic study of crude drug

Parameters	Description
Common names	Names in various languages
Biological source	Genus, species and family
Geographical source	Location
History	Discovery of crude drug
Cultivation , collection and preparation for market	Time and method of cultivation, irrigation, climate, fertilizers, collection time, processing etc.
Morphological description	Color, odor, taste, size, shape, extra features
Microscopical description	Cell, tissue type and arrangement, cell inclusions, special characters etc

Table 1.3 *Contd...*

Parameters	Description
Chemical constituents	major and minor chemical constituents present
Chemical tests	To Identify crude drug and its chemistry
Uses and pharmacological actions	Various therapeutic applications
Adulterants and Commercial varieties	Useful for quality control
Formulations available in Market	To understand market potential
Quality control and standardization	To establish qualitative and quantitative standards with the help of sophisticated instruments.

Sources of Crude Drug

Plant	Plant source is the oldest source of drugs. About 25% of the drugs prescribed worldwide come from plants, 121 such active compounds being in current use. Of the 252 drugs considered as basic and essential by the World Health Organisation (WHO), 11% are exclusively of plant origin and a significant number are synthetic drugs obtained from natural precursors. Plants provide a large bank of rich, complex and highly varied structures which are unlikely to be synthesized in laboratories. e.g. digoxin from Digitalis spp., quinine and quinidine from Cinchona spp., vincristrine and vinblastine from *Catharanthus roseus*, atropine from *Atropa belladonna* and morphine and codeine from *Papaver somniferum*.
Animal	Animals can sometimes be a source of new drugs. e.g. Honey from honeybee, beeswax from bees, cod liver oil from shark, Bufalin from toad, animal pancreas is a source of Insulin, musk oil from musk, spermaceti wax from sperm whale, woolfat from sheep, carminic acid from colchineal, venoms from snake
Mineral	A mineral is a naturally occurring substance that is solid and stable at room temperature, representable by a chemical formula, usually abiogenic, and has an ordered atomic structure. Most naturally occurring mineral substances are used in medicine in a highly purified form. e.g. sulfur is a key ingredient in certain bacteriostatic drugs, shilajit is used as tonic, calamine is used as anti-itching agent
Marine	Bioactive compounds from marine flora and fauna have extensive past and present use in the treatment of many diseases and serve as compounds of interest both in their natural form and as templates for synthetic modification. Several molecules isolated from various marine organisms (microorganisms, algae, fungi, invertebrates, and vertebrates) are currently under study. For instance, about 300 patents on bioactive marine natural product have been issued between 1969 and 1999. So far, more than 10,000 compounds have been isolated from marine organisms. Only 10% of over 25,000 plants have been investigated for biological activity. e.g. Agar -agar is a gelatinous substance derived by boiling a polysaccharide in red algae, Carrageenans or carrageenins are a family of linear sulfated polysaccharides that are extracted from red seaweeds,
Plant tissue culture	Plant tissue culture refers to growing and multiplication of cells, tissues and organs on defined solid or liquid media under aseptic and controlled environment. Plant cell and tissue cultures hold great promise for controlled production of myriad of useful secondary metabolites on demand. e.g. antihypertensive ajmalicine from callus culture of *Catharanthus roseus*, anti-inflammatory berberine from suspension culture of *Thalictrum minus,* anti-parkinson L-DOPA from callus culture of *Stizolobium hassjo,* immunomodulatory ginsenoside from callus culture of ginseng etc.