

2.1.1.4. Chemical Classification

In chemical classification system, the crude drugs are classified as per the chemical nature of their significant constituent. This classification system is preferred because pharmacological and therapeutic activity of crude drugs depends on the nature of chemical constituents present.

The alkaloidal crude drugs are grouped as one, irrespective of their morphology and taxonomy. Some **examples** of drugs classified by chemical classification system are enlisted in **table 2.3**:

Table 2.3: Chemical Classification

Categories	Drugs
Glycosides	Digitalis, senna, cascara, and liquorice.
Alkaloids	Nux-vomica, ergot, cinchona, and datura.

Tannins	Myrobalan, pale catechu, and ashoka.
Volatile oils	Peppermint, clove, eucalyptus, and garlic.
Lipids	Castor oil, bees wax, lanolin, cod liver oil, and kokum butter.
Carbohydrates and derived products	Acacia, agar, guar-gum, pectin, honey, and ispaghula.
Resins and resin combinations	Colophony, jalap, and balsam of Tolu.
Vitamins and hormones	Yeast, shark liver oil, oxytocin, and insulin.
Proteins and enzymes	Casein, gelatin, papain, and trypsin.

Different morphologically or taxonomically categorised crude drugs are brought together if the chemical nature of their active constituents is somewhat similar.

Merit: Phytochemical studies are well performed through this system.

Demerit: Confusion occurs when a drug contains many compounds belonging to different groups.

2.1.1.5. Pharmacological/Therapeutical Classification

In pharmacological or therapeutical classification system, the crude drugs are classified based on the pharmacological action of their active constituent or their therapeutic uses. If the drugs exhibit similar pharmacological action they are put together irrespective of their morphology, taxonomy, or chemical relationship. Some **examples** of drugs classified as per this system are enlisted in **table 2.4**:

Table 2.4: Pharmacological Classification

Categories	Drugs
1) Drugs acting on gastrointestinal system	
i) Bitters	Gentian, quassia, and cinchona
ii) Carminatives	Dill, mentha, and cardamom
iii) Emetics	Ipecacuanha
iv) Anti-amoebs	Kurchi and ipecacuanha
v) Bulk laxatives	Agar, ispaghula, and banana
vi) Purgatives	Senna and castor oil
vii) Peptic ulcer treatment	Derivatives of glycyrrhetic acid (liquorice), and raw banana
2) Drugs acting on respiratory system	
i) Expectorants	Liquorice, ipecacuanha, and vasaka
ii) Anti-expectorants	Stramonium leaves (atropine)
iii) Antitussives	Opium (codeine and noscapine)
iv) Bronchodilators	Ephedra and tea (theophylline)
3) Drugs acting on cardiovascular system	
i) Cardiotonics	Digitalis, squill, and strophanthus
ii) Cardiac depressants	Cinchona (quinidine) and veratrum
iii) Vasoconstrictors	Ergot (ergotamine) and ephedra
iv) Anti-hypertensives	Rauwolfia
4) Drugs acting on autonomic nervous system	
i) Adrenergics	Ephedra
ii) Cholinergics	Physostigma and pilocarpus
iii) Anticholinergics	Belladonna and datura

5) Drugs acting on central nervous system	
i) Central analgesics	Opium (morphine)
ii) CNS stimulants	Coffee (caffeine)
iii) Analeptics	Nux-vomica, lobelia, and camphor
iv) CNS depressants	Hyoscyamus, belladonna, and opium (morphine, codeine)
v) Hallucinogenics	Cannabis and poppy latex
6) Antispasmodics	
i) Smooth muscle relaxants	Opium (papaverine), datura, and hyoscyamus
ii) Skeletal muscle relaxants	Curare
7) Anticancer	
Vinca, podophyllum, camptotheca, and taxus	
8) Anti-rheumatics	
Aconite, colchicum, and guggul	
9) Anthelmintics	
Quassia, male fern, and vidang	
10) Immuno-modulatory agents	
Ashwagandha, tulsi, ginseng, asparagus, and <i>Picrorrhiza kurroa</i>	
11) Drugs acting on skin and mucous membrane	
Olive oil, wool fat, bees wax, arachis oil, sesame oil, balsam of Tolu, and balsam of Peru	
12) Astringents	
Myrobalan and black catechu	
13) Anti-malarials	
Cinchona and artemisia	
14) Immunizing agents	
Vaccines, sera, toxoids, and antitoxins	
15) Drugs chemotherapeutically acting	
Antibiotics	
16) Local anaesthetics	
Coca	

Merit: This classification system aids in recommending substitutes of an unavailable drug.

Demerits: Given below are the demerits of pharmacological classification system of drugs:

- 1) Drugs with different actions on the body get classified into many groups, thus creating confusion.
- 2) Cinchona, though an anti-malarial drug due to its active constituent quinine, is also categorised under group of drug affecting heart due to the anti-arrhythmic action of its another constituent quinidine.

2.1.1.6. Chemotaxonomical Classification

The vastness of phytochemical screening proved that relationship between the plant constituents and their taxonomy do exists. Chemotaxonomy bought the plant chemists back to systematic botany. This is because some compounds are characterised in certain groupings. Chemotaxonomy relates the position of plants and uses chemical knowledge to comprehend biological evolution and relationships.

Plants can also be classified using their chemical characteristics. Applying chemistry to taxonomy is known as **chemotaxonomy**, a branch of modern taxonomy which is in use from last 25 years for solving many taxonomic problems.

At the present time, chemotaxonomy is also described as **chemical plant taxonomy**, **chemosystematics**, and **plant chemistry**. Chemotaxonomical studies involve analysis of different chemical substances present in various plant groups, collection of evidences from the results of analysis, and use of evidences for classification.

Chemotaxonomy focuses on secondary metabolites (alkaloids, glycosides, flavonoids, etc.) of pharmaceutical relevance. Chemotaxonomical knowledge supports better classification of crude drugs. The position of berberine alkaloid in *hydrastis*, *berberis*, and *argemone*; distribution of rutin, ranunculaceous alkaloids, and flavonoids in species of higher plants are chemotaxonomically important. DNA hybridisation, amino acid sequencing in proteins, and serotaxonomy also are significant in this system of classification.

Distribution of different chemical substances holds a great importance in taxonomic studies since a long time. **For example**, presence of essential oils helps in the identification of *Apiaceae* and *Lamiaceae* families; similarly presence of milky latex helps in distinguishing *Apocynaceae* and *Asclepiadaceae* families.

A few currently available analytical techniques, e.g., chromatography, electrophoresis, and X-ray crystallography facilitate this chemical basis of taxonomy. This classification can be done on the basis of the distribution of chemicals like carbohydrates, lipids, and primary and secondary metabolites, e.g., flavonoids, alkaloids, acetylenic compounds, anthocyanin, betacyanins, and glycosides.

Merit: This classification system is recent and provides better understanding of the relationship between chemical constituents, their biosynthesis, and action.

Demerit: It is complex to recognise the chemicals in plant. Hence, it is also a time consuming process.

2.1.1.7. Serotaxonomical Classification

Serotaxonomy uses serology in understanding and solving the taxonomical problems. **Serology** involves study of the antigen-antibody reactions; or in other words, branch of biology which deals with the nature and interactions of antigens and antibodies is termed as **serology**. Antigens are foreign substances stimulating antibody formation. Antibodies are protein molecules produced by plasma cells of the immune system. Antibodies are specific towards antigens.

Proteins in serotaxonomy can carry useful taxonomic information, can be easily handled, and are the most widely used antigens. Storage proteins obtained from seeds, stem tubers, algal cells, fern spores, pollens, fruits, and leaves can be used as antigens. These proteins are first introduced in the form of emulsion in mice. By studying the amount and nature of precipitate formed by antigen-antibody complex, inter-relationships among the various groups of taxa can be studied. A high dilution (precipitate density) of serum means close relationships, and formation of no precipitate means distinct or no relationship.

The similarities and dissimilarities among different taxa are understood by serological reactions. These data are taxonomically beneficial. The degree of similarity among species, genera, family, etc., is also established. This is achieved by evaluating the reaction of antigens (obtained by many plant taxa) with antibodies (against a given taxon).

Non-morphological characteristics are evaluated through serology to obtain taxonomical data. Contrasting single proteins from different plant taxa is also achievable by this technique.

In 1902, **Nuttal** identified the importance of serology in plant systematics. In 1926, **Mez** and **Ziengenspect** (Germany) published **Stommbaum** (a family tree of plant relationships) based on their serological studies. In 1954, **Boyden** proved that *Michelia* and *Magnolia* are the two genera closely related by serological analysis.

In 1968, **Tucker** recorded serological relationships among various genera of Solanaceae, like *datura*, *hyoseyamus*, *nicotiana*, *salpiglossis*, and *solanum*. In the same year, **Jensen** conducted phyto-serological systematic survey on 20 Ranunculacean genera and demonstrated their relationships.

In 1971, **Kloz** identified different protein characters and made some significant contributions to the serology of Fabaceae family. This work also helped in selecting desirable proteins in plant breeding research.

Even though such significant contributions have been made in serotaxonomy, this mode of plant classification has not gained considerable importance. The reason is constant variations arising in serological tests. Taxonomists are unconvinced about the value of serological evidences in systematics of plant groups. In some cases however, accurate serological relationship exists which may provide evidence for the phylogeny.

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