M.Sc. (Botany) Sem II

Chemotaxonomy

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Chemotaxonomy

It's a modern trend of taxonomy. Application of some chemicals in taxonomy which mainly depend on floral characteristics because floral characters are more conservative than other features. Phytochemistry also helps as Taxonomic evidence.

- Chemotaxonomy usefull in quick identification of plants.
- It is helpful in establishment of phylogenetic relationship of plants.
- It is helpful to solve the taxonomic species i.e. division of upper hierarchy to variety level i.e. in separation of genus and species.
- Aroma helps in identification.

Camerarius first of all establish the connection between plant and their chemical properties. Then medicinal importance of the plant can be recognized.

In 1890 Romburg worked on plants which contain HCL.

In 1945, Mc Nain report on Chemical distribution in plants.

In 1965, Swan published a book on chemical phylogeny.

A. External Chemicals:

Latex: Important in family identification. On the basis of it two tribes in Asteraceae can be identified.:

Tubiflorae: Having Latex
Liguliflorae: Latex not present

B. Internal Chemicals:

Those chemicals are important which are in discontinuous distribution in plants.
Plants contains some group of chemicals:

Ist group of chemicals:

Amino acids: 300 non protein Amino acids e.g. Lathyrene in *Lathyrus*.

Most of the Amino acids of legumes (Fabaceae) contain higher concentration of non protein Amino acids.

Lathyrus and *Vicia* are separated in to 7 or 4 species based on presence of non protein Amino acids.

Azetidine 2-carboxylic acid: It is found in members of family Liliaceae, Amaryllidaceae, Agavaceae. Therefore these three families are phylogenetically related.

Secondary metabolites of plants : These are most important in chemotaxonomy. e.g. Basil, Turmeric, Teak etc. In Tectona, tectol is present which is specific for it.

IInd group of chemicals:

- **Betalin:** If phenol contain Nitrogen in its ring, then it is known as Betalin.
  - β-Xanthin and β-Cyanin are betalin.
  - Anthocyanin pigment do not contain betalin like compound.
  - Only 10 families of angiosperms which contain betalin.
  - Cactaceae, whether separated from centrospermae or remain included in Centrospermae, it is determined by chemical betalin.
  - 10 families have betalin like compound. Chenopodiaceae, Portulacaceae,
  - Aizoidaceae, Cactaceae, Nyctaginaceae, Phytolaccaceae, Steynospermaceae, Amaranthaceae, Basallaceae and didiereaceae. Therefore Cactaceae should be kept in Centrospermae.
  - Caryophyllaceae, Illeubromaceae, Mollemgaceae families do not contain betalin like compound, therefore these families should be separated from Centrospermae.

In order Caryophyllales some chemicals in plants are found in conjugation with other chemicals.

IIIrd group of chemicals : It includes Phenols, flavones, isoflavones, flavanoides, biflavanoides, ellagic acid, Leucoanthocyanin etc.

Phenols: All phenols are easy to extract. The phenols are important to identify the hybrids. Different groups of phenolic compounds are present in plants of some families. Biflavonoides found only in single angiosperm i.e. in *Casuarina*.

Casuarina is regarded as primitive angiosperms in Engler and Prantl system of classification.

Biflavonoides is also found in *Ginkgo biloba* and in some gymnosperms, hence the problem became solved that *Casuarina* is one of the primitive angiosperms which was disputed earlier.

Ellagic Acid : It is a natural phenol antioxidant found in trees of angiosperms only in dicots.

Leucoanthocyanin: It is a colorless precursor of anthocyanin found in woody angiosperms. e.g. in Rosaceae, sub family Rosoidae. It is also present in seed coat of legumes.

Most of Plant chemicals are not water soluble. These phenolic content are species specific i.e. these are genetically regulated. Phenols are water soluble hence phenols are found in form of glucosides i.e. phenolic glucosides. These are not transported from one part to other part of the plant. Biological activity also related with their altering chemicals.

IVth group of Chemicals:

Alkaloides: Effect on Nervous system. These are nitrogen containing compound of heterocyclic ring. Some alkaloid rich families are:

Fumariaceae

Pappaveraceae

Capparidaceae

Leguminoceae

Solanaceae

Acanthaceae

Tropane alkaloid only in solanaceae Lupin found only in Leguminoceae.

Isoquinoline: In Papaveraceae, Fumariaceae hence papaveraceae and Fumariaceae are related and kept together in papaverales. Some times these alkaloids are generic characters. e.g. Strychnine – Strychnos

Conine – Apiaceae

Morphine – *Papaver somniferum*

V - Other Group of chemicals:

Glucosinulates: e.g. Mustard oil glucosides. These are found in Cruciferae and some members of Capparidaceae. Some workers kept both families in same order capparidales. Capparidaceae and Crucuferae have myrosin enzyme which is important component of mustard oil and also found only in capparidaceae and cruciferae hence both the families should be kept together in order capparidales.

Alkaloides: Alkaloides containing families are Euphorbiaceae, Caracaceae and Salvadoraceae. These families are independent in origin.

VI – Cyanogenic glycoside (HCN) containing plants:

- 80 Families (monocot and dicot) have HCN.
- Some of the HCN containing families are Cucurbitaceae, violaceae, Passifloraceae.
- Each and every member of Passifloraceae have cyanogenic glycoside.

VII – <u>Terpenoides:</u>

- Aroma and flavour chemicals but mostly aroma chemicals.
- Essential oils are not pure compound, they contain terpenoids.
- Isopentyl ring (Isoprene ring) formed by merolonic acid.
- Cestrol monoterpene found in Lemon grass *Cymbapogon citratus*.
- Sesquiterpene found in Pinaceae.
- Monoterpene found in Camphor.
- Triterpene not found in monocots.
- In dicots sometimes triterpene is substituted by glycosides. They can be called as **saponin.**
- In cucurbitaceae saponin is found.
- Lack of hemiterpenes in monocots.
- Hemiterpenes are substituted by diphenols.

<u>External Visible Chemicals:</u>

Raphides: Needle shaped crystals. Raphides found in

Balsaminaceae

Onagraceae

Colocaceae

Rubiaceae and on ovary wall of Asteraceae.

Trapa because of not containing raphides, included in Trapaceae and not in Onagraceae.

Silica: Silica found in Poaceae and Palmae. Both the families are Phylogenetically relative.

Ca^{+} crystal and Gypsum found in Tamareaceae – *Tamaricus* plant.

Cystolith : Found in Moraceae.