PHYTOCHEMISTRY AND MOLECULAR DATA IN RELATION TO TAXONOMY

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Phytochemistry in Relation to Taxonomy:

- The science of chemical taxonomy is based on classification of Plants on the basis of their chemical constituents related with the molecular characteristics.

- Development of plant natural product chemistry revealed possibility of characterizing classifying, and establishing phyletic relationships of genera, in (1699) it was first indicated correlation between chemical properties and morphologically character i.e., morphologically similar plants possess similar chemicals.

- **Chemotaxonomy includes:**

(i) Investigation of pattern of the compounds existing in plants,

(ii)Investigation pattern of the compounds in plant parts likes bark, wood, eaves, roots etc.

- **Basic characters as evidence come from:**

(i) Flavonoids,

(ii) Terpenoids,

(iii) Carotenoids,

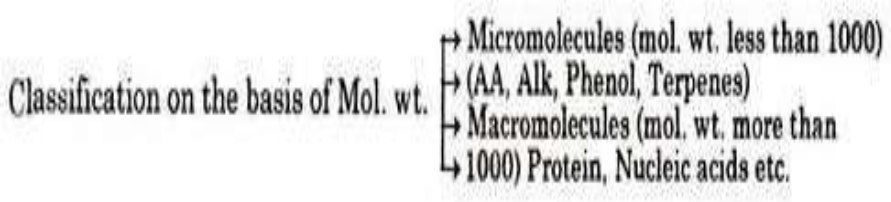
(iv) Polysaccharides,

(v) Alkaloids,

(vi) Aminoacids,

(vii) Fattyacids,

(viii) Aromatic compounds



- **Popularity of Phytochemistry is due to:**

(a) Development of rapid analytical techniques.

(b) Belief that data from many sources should be employed for classification.

Mentzar (1966) provided biogenetic classification on the basis of natural relationships between various constituents.

- Among the Amino acids the distribution of single amino acids restricted e.g., Lathyrus martinus has protein which is absent in other species of Lathyrus.

- Members of Asteraceae lack unsaturated lipids. Linolenic rich seeds e.g., Rhamnaceae.Linoleic rich seeds e.g., Juglans, Liliac etc. Oleic and Palmitic rich e.g., Acanthaceae, Annonaceae, Malvaceae etc.

- Phytochemistry can supply data of use to the taxonomists. In Pinus every species has different type of terpentine. In Lichen chemical methods are largely used for the identification of genera an species.

- Chemistry of Betacyanins led to recognition of 10 families containing them (Centrospermae); they do not occur in plants containing anthocyanins. On this basis Caryophyllaceae and Illeceberaceae is separated from centrospermae as these two families lack betalin pigment. Takhtajan and Cronquist placed anthocyanins producing families in Caryophyllales.

- Glucosinolates are widely distributed in the families kept under Capparaceae (Capparidaceae) have specialized myrosin cells. Myrosin is enzyme involved in the formation of mustard oil.

- Asteraceae is divided in two tribes Tubiflorae and Liguliflorae on the presence of latex (chemical substances). Mc Nair (1935) concluded that the evolution of chemical substances in plants have followed the evolution of plants themselves.

- Fatty acids are primary metabolites and are not of much importance but nut oil fatty acid in Juglandaceae and Juice sac fatty acid of Citrus are used as taxonomic significance.
- β carotene is present in all green cells. Terpenoid, glycosides (cardiac glycosides) are present in Apocynaceae, Liliac, Moraceae etc. Monoterpenes are also known as essential oils. It depends on odors and essence etc. e.g., Lamiaceae, Apiaceae, Rutaceae etc.

Molecular data in relation to taxonomy

- Genome size and C-value denote the quantity of DNA in the chromosome of an organism. C-value is the quantity of DNA in haploid set. The amount is denoted in pico grams, nucleotide pairs or Dalton (1 pg = 0.965 x 10 nucleotides; 1 nucleotide = 660 daltons). C—value is measured by feulgen cytophotometry or fluorometry with DNA ligands.

- In Arabidopsis thaliana the C-values is 1C = 0.2 pg while in Fritillaria assyriaca the C-value is 1C = 127 4 pg. C-values vary even in closely related species with same chromosome number. There is no co-relation of C-value and estimated gene number and is known as C-value Paradox.

❖ **Genomic relationship among diploid species is determined as:**

(a) Crossing affinity:

Inter-specific crosses involving parental species with similar genus usually set normal pods and seeds while crosses between dissimilar species, seeds are commonly abortive. Some hybrids do not set seeds. Sometimes the crossing is successful in one direction and is genotype dependent.

(b) Chromosome pairing:

In inter specific hybrids the degree of chromosome pairing facilitates the analysis, of phylogenetic relationships among species; providing information about ancestral types.

❖ Chromosome. A taxonomic marker:

- Delaunay (1926) for the first time reported phylogenetic reduction in chromosome size in Muscari (Liliaceae). Reduction in chromosome size is reported in Crepis and Dianthus also.

- Phylogenetic increase in chromosome size is reported in Poaceae by Rohweder (1934). Trillium and Paris (Largest chromosome) are considered to have descended from Uvularieae by Hutchinsion. Darlington suggested that Chiasma frequency is more in large chromosomes.

- **The DNA based molecular markers are applied in various aspects of taxonomy to analyse:**

(i) Genetic identity.

(ii) Genetic relatedness among populations, geographic populations and species.

(iii) Pedigree.

(iv) Differentiation among isolated species.

(v) Phylogenetic structure at various micro and macro levels.

- Use of automated tissue processors for isolation of DNA, robotic sample handling and transfer systems for further treatment of the DNA and for automation of PCR, use of different fluorochromes labeled primers in conjunctionn with advanced gel electrophoresis systems for carrying out multiplex PCRs in a single tube, advanced imaging technology which permits efficient data analysis etc., are the integral part of laboratory engaged in molecular taxonomy.

- Plant herbaria world over started incorporating the DNA profile of the specimens with increasing use of computers and micro-processors analysis of PCR products, documentation and archival of data sophistication in instrumentation is started for future analysis of genetic system.

- Mitochondrial DNA is studied in many plants. Each mitochondrian contains several copies of mt DNA and each cell contains many mitochondria. Generally mt DNA is circular but is linear in Chlamydomonas reinhardtii mt DNA is larger circular with many non-coding sequences in vascular plants.

- Chloroplast DNA can be easily isolated and analysed. The DNA of chloroplast is highly conserved type. In all cp DNA same set of genome are found but arranged differently in different species. The genes present in cp DNA include genes for r-RNA, t-RNA, ribosomal proteins and about 100 different polypeptides and subunits of enzyme coupling CO_2. The important gene on cp DNA is rbcL encoding large subunit of photosynthetic enzyme i.e. RUBISCO. This gene is not found in parasites. It is a long gene consisting of 142 bp.

THANK YOU