

TAXONOMIC EVIDENCES

PHYTOCHEMISTRY and MOLECULAR DATA

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.

- There are various chemical compounds used in the taxonomy.
- Alkaloids, amino acids, betalins fatty acids, carotenoides, flavonoids, polysaccharide, tannins, terpenoids and aromatic compounds are the important examples.
- The chemical constituent is termed as chemical character.

Chemical characters of plants are used mainly in classification or in solving taxonomic problems are called Chemotaxonomy, Plant Chemo-systematics and Chemical Plant Taxonomy.

In this phase classification of plants are based on their chemical ingredient i.e., on their molecular characteristics.

- Mentzer (1966) categorized three types of chemical constituents for taxonomy:
- **(1) Primary constituents:** like proteins, nucleic acid derivative, chlorophylls and polysaccharides.
- **(2) Secondary constituents:** who lack nitrogen and are not involved in the basic metabolism of cells.
- **(3) Miscellaneous substances.**

- Turner (1969) categorized these compounds according to their molecular size into
- following type:
- **(1) Micro molecules:** Compounds having low molecular weight eg alkaloids, amino acids, cyanogenic glucosides, glucosinolates (mustard oil glucosides), pigments (anthocyanins, betalains, and so on), phenolics (flavonoids), and terpenoids.
- **(2) Macromolecules:** Compounds having high molecular weight (over 1,000) eg Proteins, DNA, RNA, cytochrome-c, ferredoxin complex polysaccharides etc.

- Naik (1984) classified these compounds as follow and chemical characters can be used in taxonomy as
- (1) Directly visible like starch grains, raphides etc.
- (2) Secondary plant products like alkaloids, flavonoids and terpenoids
- (3) Proteins.
- Following some example are given here on the basis of various Chemical character there data have practical solved same taxonomic problems at the order level to generic level.

- These data have been treated as characters used in classification.
- Tannin is present in Sapindaceae, alkaloids in Solanaceae (e.g. *Nicotiana*, *Datura*), aromatic compounds in Lamiaceae (Cronquist, 1981).
- Protopine is present in Papaveraceae. This alkaloid protopine is not found in any plant of other families (Manske 1954).

- According to Hutchinson Fumarioideae is quite distinctly separated as a group from Papaveraceae proper and closely allied to certain genera of the family Berberidaceae e.g., Epimedium, Aceranthus and Bongardia.

Tannins

Tannins bearing or tanniniferous families are
Anacardiaceae, Polygonaceae, Punicaceae,
Rhizophoraceae, Tiliaceae, Ulmaceae, Urticaceae,
Vitaceae, Winteraceae, Casuarinaceae, Lauraceae,
Lythraceae, Sapindaceae, Sapotaceae, Sterculiaceae,
Magnoliaceae, Meliaceae, Moraceae, Myrtaceae,
Oxalidaceae, etc.

- Some example of families which are without tannins :
Acanthaceae, Amaranthaceae, Convolvulaceae,
Portulacaceae, Solanaceae, Cucurbitaceae, Basellaceae,
Campanulaceae, Capparidaceae, Caryophyllaceae,
Chenopodiaceae, Lamiaceae, Papaveraceae, Brassicaceae,
Verbenaceae, Violaceae, Zygophyllaceae etc.

Terpenoids

- Terpenoid compounds are found in Citrus plants, Mints and Umbellifers etc.
- Many tribes of the Asteraceae (Compositae) are characterized by the sesquiterpene lactones they produce. Sesquiterpene lactones have been used to show that in the tribe Vernoniaeae.
- Ambrosia, Iva, Franseria and Xanthium are removed from the tribe Heliantheae and placed in a separate tribe.

Sulphur Compounds

- The Sulphur compounds having significance in taxonomy.
- Disulphides are largely responsible for the odour of plants e.g.
- Onions and Garlics etc. Glucosinolates (mustard oil glucosides) occur in Brassicaceae, Capparidiaceae Tovariaceae, and Moringaceae etc. clear odour of sulphur can observe in these plants.

Alkaloids

- Alkaloid protopine is present in family Papaveraceae.
- Protopine is also present in family Fumariaceae, showing their close relationship with Papaveraceae.
- The lupin alkaloid is found in Fabaceae and tropane derivatives occur in the Solanaceae.
- Morphine is restricted to the *Papaver somniferum*, Coniine to a few members of Apiaceae similarly Strichnine to the some members of Strychnos.

Taxonomic Evidences from Molecular Data

- The genomic DNA G+C content within the overall number of nucleotides in the genome, is one of the most frequently used features in taxonomic descriptions of micro-organisms (Rosselló-Mora & Amann, 2001; Johnson & Whitman, 2007; Tindall et al., 2010; Mesbah et al., 2011).

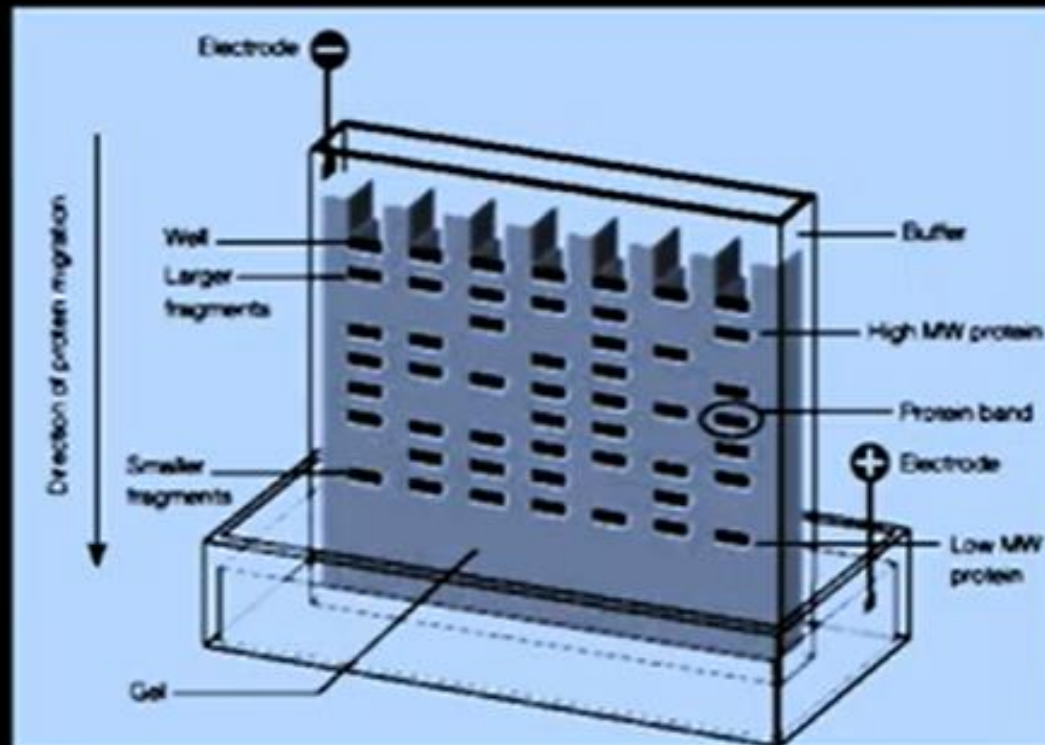
Taxonomic Evidences from Molecular Data

- Techniques with which G+C contents have been estimated in the past include thermal denaturation (Marmur & Doty, 1962), buoyant density in CsCl (Schildkraut et al., 1962) and melting profiles (Owen et al., 1969); modern techniques are HPLC (Ko et al., 1977; Mesbah et al., 1989) and real-time PCR (Moreira et al., 2011).

- As a DNA–DNA hybridization (DDH) similarity of $\geq 70\%$ is still the main criterion for assigning two strains to the same species (Brenner 1973; Wayne et al., 1987; Stackebrandt & Goebel, 1994; Rosselló-Mora & Amann, 2001; Johnson & Whitman, 2007; Tindall et al., 2010).
- These were computed using the recommended settings of the Genome-to-Genome Distance Calculator (GGDC) web server (Auch et al., 2010a, b) version 2.0 (Meier-Kolthoff et al., 2013a).

Electrophoresis

- The Electrophoresis is important molecular technique to study mainly the proteins and to separate and identify proteins.



- Johnson (1972) studied on hexaploid wheat (*Triticum aestivum*) and supported on the bases of electrophoresis that the origin of *Triticum aestivum* from *Aegilops tauschii* and *Triticum dicoccum*.

DNA and RNA Hybridization

- DNA is extracted from the organism to convert to a single strand polynucleotide chain and the amount of reassociation (annealing) with similarly treated DNA from another taxon which occur on mixing the two is taken as a measure of similarity of the nucleotide sequences.

- This utility and importance of DNA values in taxonomy may perhaps best be demonstrated in *Scikka bifolia* alliance (संधि) a group of plants which a constant basis number $x = 9$ and little evidence for major structure rearrangement.

DNA Polymorphism

- Utilization of DNA sequence data for phylogenetic relation analysis involves the identification of unique sequences which show certain variation in different organisms.
- These sequences which can be use as genetic markers and identification of the target taxa and ultimate construction of phylogenetic trees.
- This procedure is also known as DNA Fingerprinting or DNA polymorphism.
- This method is now widely used in forensic investigations.

THANK YOU