**NUMERICAL TAXONOMY**

**Introduction**

Numerical taxonomy is the method of classifying organisms with the help of numerical methods. This method clarifies and illustrates the degree of relationship among the organisms in an unbiased manner. The organisms are arranged in their respective taxa based on the similarities and differences. Now-a-days numerical taxonomy is a very important in modern systematics.

The main aim of numerical taxonomy is to classify organisms using numeric algorithms. The period from 1957 to 1961 saw the development of first methods and of theory of numerical taxonomy. Plants as we all know are classified based on their characters.

Michel Adanson, a French botanist, planned to assign numerical values to the similarities between organisms and he proposed that equal weightage should be given to all the characters while classifying plants. He used as many characters as possible for the classification, and these classifications came to be known as Adansonian classifications.

Later, Robert R. Sokal & Peter H. A. Sneath in 1963 divided the field into *phenetics*in which classifications are based on the patterns of overall similarities and *[cladistics](https://www.studyandscore.com/studymaterial-detail/cladistics-hypothesizing-evolutionary-relationships-among-organisms%22%20%5Co%20%22Cladistics%20is%20the%20method%20of%20studying%20relationships%20among%20animals%22%20%5Ct%20%22_blank)* in which classifications are based on the branching patterns of the estimated evolutionary history of the taxa. Numerical taxonomy was however largely developed and popularized by Sneath and Sokal.

The application of Adansonian principles and use of modern methods and electronic data processing techniques, have helped in the evolution of several new classifications of plants during the past few decades.

**Aspects of Numerical taxonomy**

Numerical taxonomy involves the following two aspects,

* **Construction of taxonomic groups:** Individuals are selected and their characters are spotted. Larger the number of characters better is the approach. Then resemblances among the individuals are then established on the basis of character analysis.
* **Discrimination of taxonomic groups:** When the taxonomic groups chosen for the study show overlapping of characters, discrimination should be used to select them.

**Principles of Numerical taxonomy**

1. The greater the content of information in the taxa, and more the characters taken into consideration, the better a classification system will be.
2. Every character should be given equal weightage in creating new taxa.
3. For comparison purpose, the similarity between any two entities is considered.
4. Correlation of characters differs in the groups of organisms under study. Thus distinct taxa can be recognized.
5. Phylogenetic conclusions can be drawn from the taxonomic structure of a group and from character correlations, assuming some evolutionary mechanisms and pathways.
6. Phenetic similarity is the basis of classifications.

**Advantages of Numerical taxonomy**

* The data of conventional taxonomy is improved by numerical taxonomy as it utilizes better and more number of described characters.
* As numerical methods are more sensitive in delimiting taxa, the data obtained can be efficiently used in the construction of better keys and classification systems.
* Many existing biological concepts have been reinterpreted in the light of numerical taxonomy.
* Numerical taxonomy allows more taxonomic work to be done by less highly skilled workers.

**Disadvantages of numerical taxonomy**

* The numerical methods are useful in phenetic classifications and not phylogenetic classifications.
* The proponents of “biological” species concept may not accept the specific limits bound by these methods.
* Character selection is the greatest disadvantage in this approach. If characters chosen for comparison are inadequate, the statistical methods may give less satisfactory solution.
* Different taxonometric procedures may yield different results. A major difficulty is to choose an apt procedure for the purpose and the number of characters needed in order to obtain satisfactory results by these mechanical aids.

**Applications of Numerical taxonomy**

* Can be successfully used in the study of various angiospermic genera like *Apocynum, Chenopodium, Crotalaria, Cucurbita, Oenothera, Salix, Zinnia, wheat cultivars, Maize cultivars*, etc.
* With the help of numerical taxonomy similarities and differences in bacteria, other microorganisms can be studied.

**CHEMOTAXONOMY**

**Introduction**

Chemotaxonomy is the method of biological classification based on similarities in the structure of certain compounds among the organisms being classified. As proteins are more closely controlled by genes and less subjected to natural selection than are anatomical features, they are more reliable indicators of genetic relationships. Hence, proteins are more reliable for biological classification.

Proteins, amino acids, nucleic acids, peptides etc. are the most studied chemicals in chemotaxonomy. In Chemotaxonomy, chemical features of plants are used in developing classifications or in solving taxonomic problems.

Chemotaxonomy has been used in all the groups of the plant kingdom starting from the simple organisms, such as fungi and bacteria, up to the most highly advanced and specialized groups of angiosperms and at all levels of the hierarchy of classification in plants, starting from the rank of Variety up to the rank of Division.

The use of chemical characters in plant classification has a long history. Since the early 1960s, phytochemical characters started to attract the attention of plant taxonomists. However recently, due to the development of new and powerful analytical techniques and the speed and simplicity of these techniques, it has been possible to screen a large number of individuals in a very limited time and utilize such information in plant taxonomy.

Some of the botanists who have included chemical evidences in plant classification are Nahemia Grew in 1673, William withering in 1785, A P de Condolle in 1804 and so on. But the modern phase of chemotaxonomy began with the publication of the work of Abbott in Botanical Gazzette. Also botanist McNair published a series of papers on the use of chemical evidences in solving taxonomical problems. The main research center of chemotaxonomy is the Institute of Pharmacology at University of Kiel, Germany

**Aspects of chemotaxonomy**

The chemical characters are considered more important, only when they show a high degree of correlation with other features. Chemotaxonomy should not be considered as more indicative of relationship than other characters such as external morphology, anatomy, cytology, etc. and as a replacement of other taxonomic characters, but at best a major source of new characters and information.

Moreover the evidences from the chemotaxonomic studies are used in plant classification with two main purposes.

1. To develop taxonomic characters which may improve existing systems of plant classification
2. To develop present day knowledge of phylogeny or evolutionary relationships of plants.

**Significance of chemotaxonomy**

Plants store various chemical substances and these substances have significant value in taxonomic studies. Though all the chemicals substances stored in the plants cannot be taxonomically significant and may not give out information valued by taxonomists. The phytochemical constuituents which are important in taxxonomic studies can be grouped into two categories,

* **Primary constituents:** These include the macromolecular compounds directly taking part in metabolism. These include proteins, nucleic acids, chlorophyll and polysaccharides. All chemical materials synthesized by an organism reflect the information in DNA, RNA and proteins.
* **Secondary constituents:** They include compounds lacking nitrogen and not involved directly in plant metabolism. For example, simple phenolic compounds like caffeine, benzoic acids, nicotinic acids and polyphenolic compounds like flavonoids, terpenes and coumarines.

**Chemical characters and their use in chemotaxonomy**

Till date there is no suitable classification of the chemical characters and their use in taxonomy. But according to Naik the chemical characters can be divided into three categories namely,

1. Directly visible characters (Eg: Starch grains, Silica, Gypsum)
2. Characters known by chemical tests (Eg: Phenolics, Oils, Fats, waxes)
3. Proteins

Some other Botanists also use other characters like molecular weight to differentiate chemical compounds. Jones and Luchsinger divided natural plant products useful in taxonomy on the basis of molecular weight.

Low molecular weight compounds (Amino acids, alkaloids, Fatty acids, Terpenoids)

High molecular weight compounds (Proteins, DNA, RNA. Polysaccharides)

Sometimes the term semantides is used for the information carrying protein like DNA and RNA