

CLASSIFICATION OF MICROORGANISMS

INTRODUCTION

Microorganisms are very diverse and represent all the great kingdoms of life. In terms of numbers, most of the diversity of life on Earth is represented by microorganisms. Microorganisms were the first living organisms on the planet. Prokaryotes (bacteria) were first appeared approximately 3.5 billion years ago. Microbes are found in soil, oceans, on and in higher organisms, on rocks, inside roots, buried under miles of Earth, extreme environments, in compost piles and toxic wastes, and all over the Earth's surface. Microbes are found in boiling hot springs and on frozen snowfields.

The purpose of microbial taxonomy is to provide useful ways for identifying and comparing microorganisms and to assess the extent of diversity of different types of microorganisms.

Microbial Taxonomy is the science, which deals with classification of microorganisms. **Classification** is the placement of organisms into various taxonomic groups. **Nomenclature** is the assignment of names to the taxonomic groups according to international rules.

THE TAXONOMIC HIERARCHY

Microorganisms are placed into various taxonomic groups also known as taxa. The seven most commonly used hierarchical ranks are – Domain, Phylum, Class, Order, Family, Genus and Species.

A **bacterial species** is a population of cells with similar phenotypic and genotypic characteristics. It is different from the definition of the eukaryotic species.

A **eukaryotic species** is a group of organisms that interbreeds but does not breed with individuals of another species.

Similar species are grouped into a genus; similar genera are grouped into a family; families, into an order; orders, into a class; classes, into a division or phylum; phyla, into a domain. This seven-layered hierarchy is the version still used today. An example based on this system is shown in table 2.1.

Additional levels of classification can be added by adding super-, sub- or infra- (e.g. subclass, suborder, subspecies).

Table 2.1 : Taxonomic ranks and names

| Taxonomic Ranks | Example |
|-----------------|----------------------------|
| Domain | Bacteria |
| Phylum | Firmicutes |
| Class | Bacilli |
| Order | Lactobacillales |
| Family | Lactobacillaceae |
| Genus | <i>Lactobacillus</i> |
| Species | <i>Lactobacillus casei</i> |

Infrasubspecific ranks

Terms that are used for infrasubspecific subdivisions are listed below–

Strain : A strain is a population of organisms that descends from a single organism or pure culture isolate.

Isolate : An isolate is a pure culture of a microorganism derived from its heterogeneous wild population.

Type strain : A type strain is the one that is usually first studied and used for the original description among strain population.

Morphovar (Morphotype) : A morphovar is a strain which is differentiated on the basis of morphological features.

Biovar (Biotype) : A biovar is a strain which is differentiated by biochemical or physiological properties.

Serovar (Serotype) : A serovar is a strain that is differentiated by serological means.

Phagovar (Phagotype) : A phagovar is a strain that can be characterized by reactions to bacteriophage.

Chemovar (Chemotype) : A chemovar is a strain which can be distinguished by production or the amount of production of a particular chemical.

Pathovar (Pathotype) : A pathovar is a strain that can be differentiated by pathogenic reactions in one or more hosts.

Cultivar : A cultivar is a cultivated strain with special properties.

Forma specialis : It is a parasitic, symbiotic or commensal microorganism that is distinguished primarily by adaptation to a particular host or habitat.

Phase : It restricts to well defined stages of naturally occurring alternating variations.

State : These are colonial variants, e.g., rough, smooth, mucoid.

MICROBIAL NOMENCLATURE

The rules governing the naming of prokaryotes are established by the International Committee on Systematics of Prokaryotes (ICSP). Binary names consisting of genus and a specific epithet are used for most microorganisms. The binomial naming system was developed by Carolus Linneaus (Fig. 2.1). According to the binomial system—

1. A species is a binary combination consisting of a genus followed by a specific epithet.
2. The specific epithet is meaningless without the genus name.
3. The genus name is capitalized and the species is lower case.
4. Specific names are always latinized and either italicized or underlined.
5. Once the complete name of a microorganism has been written out once, the genus name can be abbreviated to just the capital letter provided there is no confusion with other genera. Example: *Staphylococcus aureus* can be written as *S. aureus* however, the ICSP recommends that the entire name be spelled out again in the summary of any publication.
6. If the species belonging to two or more genera, which have the same initial letter (e.g., *Enterococcus* and *Escherichia*), are listed, the generic name should be used in full.
7. The species name is never abbreviated.
8. The designation "sp." after a genus refers to a single unnamed species, while the designation "spp." after a genus refers to more than one unnamed species. Example: *Lactobacillus* spp. refers to more than one species of *Lactobacillus*.
9. In lists that contain a series of species all belonging to the same genus, it is acceptable to name the genus only once, even if the other species have not been mentioned previously. Example: *Clostridium tetani*, *C. botulinum*, *C. perfringens*.
10. Often bacteria are divided into subspecies, which are indicated by "infrasubspecific subdivisions" such as: biovar (bv.), chemovar, cultivar (cv.), *forma specialis* (f. sp.), morphovar, pathovar (pv.), phagovar, phase, serovar, and state. This is placed before an additional italicized name e.g. *Rhizobium leguminosarum* biovar *viciae*.

11. The ICSP does not have rules for covering subspecies ranks. The strain designation should follow after the genus and species and it may be a combination of letters and numbers. Example: *Escherichia coli* O157:H7, where O157:H7 designates the particular antigenic strain of *E. coli*.

The rules governing the naming of viruses are established by the International Committee on Taxonomy of Viruses (ICTV). Rules for the assignment of names to bacteria are established by the International Committee on Systematic Bacteriology. Rules for naming fungi and algae are published in the International Code of Botanical Nomenclature. Rules for naming protozoa are found in the International Code of Zoological Nomenclature.

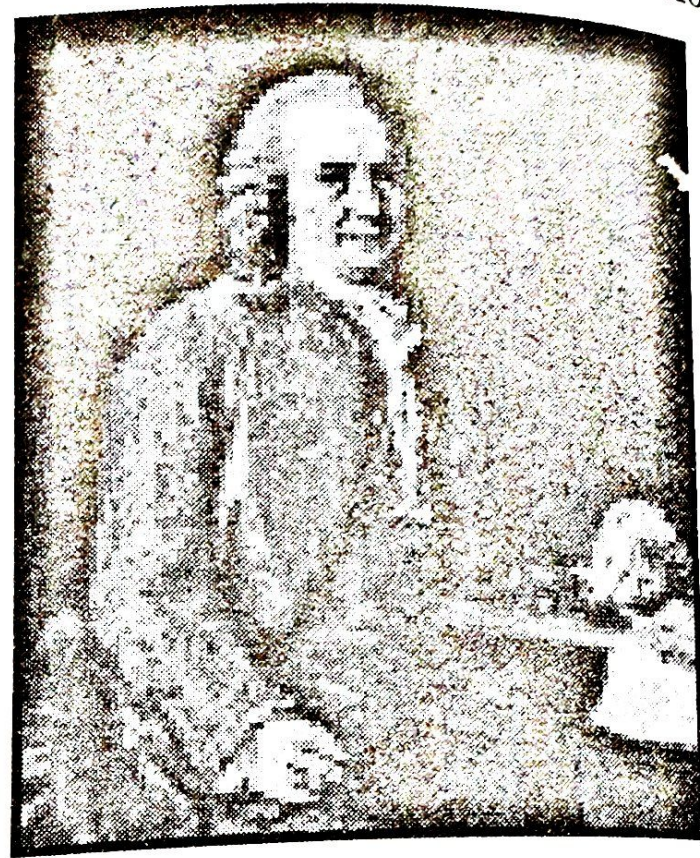


Fig. 2.1 : Carolus Linnaeus