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Chapter 2

Classification of microbes based on biochemical requirements

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Abstract: Microorganisms are classified based on their ability to synthesize their own food materials and also based on biochemical requirements like Oxygen availability and their effect on microbial growth. Cyanobacteria can able to fix atmospheric Co2 in to carbon compounds and categorized as Autotroph and whereas heterotrophs like animals cannot fix atmospheric CO2 and obtain energy from chemical compounds. Similarly, the microorganisms are grouped as Lithotrophs, Organotrophs etc., based on their nutritional requirements.

Keywords: Autotroph, Chemotroph, Heterotroph, Lithotroph, Organotroph

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1. Classification of microorganisms based on nutritional requirements

On the basis of energy source organisms are classified as:
Phototrophs:
The organisms that survive by utilizing light as the energy source are designated as Phototrophs. These bacteria carry out Photosynthesis.
Chemotrophs:
These organisms depend on chemical compounds for energy purpose and they are not able to carry out photosynthesis.
On the basis of electron source organisms are designated as:
Lithotrophs: .
These organisms can use Inorganic chemical sources or reduced organic sources as electron donors and termed as Lithotrophs. Some organisms can be Chemolithotrophs and Photolithotrophs

Organotrophs:
Some organisms can use organic compounds as electron donors and are termed as organotrophs. Some can be Chemoorganotrophs and Photoorganotrophs.

Thus, bacteria may be either:
Photo-lithotrops: These bacteria can utilize sunlight as source of energy and reduced organic compounds such as H2S as the source of electron donor. eg: *Chromatium okeinii*.
Photo-organotrophs: These bacteria utilize sunlight as source of energy and organic compounds such as succinate as source of electron donor.eg; *Rhodospirillum.*
Chemo-lithotrophs: These bacteria utilize energy from the inorganic source NH3 and electrons from the inorganic source itself. eg; *Nitrosomonas*.
Chemo-organotrophs: These bacteria utilize energy from the organic compounds like glucose and amino acids as a source of electrons.eg; *Pseudomonas pseudoflora*.

2. Classification of microorganisms based on Oxygen requirement:

The presence of oxygen can be a critical factor in survival of many microorganisms. When bacteria utilize oxygen for their metabolism produce free radicals like peroxides and super oxides as byproducts of the metabolism. Aerobes neutralize the free radicals by scavenging through utilizing antioxidant enzymes like catalase, peroxidase and super oxide dismutase. Anaerobes generate ATP through anaerobic respiration and they cannot tolerate oxygen due to absence of antioxidant enzymes catalase, Peroxidase and Dismutase and hence they are unable to neutralize free radicals produced by oxygen and die when exposed to oxygen.

Bacterial species are classified based on their oxygen requirements as follows:

- **Obligate aerobes:** Generate ATP through Aerobic respiration and require around 20% of atmospheric oxygen.
- **Microaerophiles:** Generate ATP through aerobic respiration and Fermentation. Requires around 5- 15% of atmospheric oxygen for growth.
- **Aerotolerant anaerobes:** Generate ATP through Aerobic respiration and can perform fermentation. They can survive in the presence of oxygen but not required for ATP production or fermentation.
- **Facultative anaerobes:** Generate ATP through Aerobic respiration, Fermentation and Anaerobic respiration. They can survive equally well in both presence and absence of oxygen.

- **Obligate anaerobes:** Generate ATP through Anaerobic respiration or fermentation. They cannot survive in the presence of oxygen as these microorganisms does not possess enzymes required to break down the toxic oxygen products or their intermediates.

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