Microbial Communities and their Factors

The M.O.communities divided according to the environment that lived it in to two groups :

1- **Terrirestal communities**
2- **Aquatic communities**

Terrestrial communities The M.O. communities present on land masses such as continents and islands are characterized by a lower availability of water compared to aquatic environments, making water a limiting factor.

Soil

Soil is formed as a result of physical , chemical weathering, as well as biological processes that occur to rocks over millions of years. The surface of the soil is rich in M.O. communities such as bacteria, the most important are actinomycetes, fungi, microalgae, and protozoa. Human activities add other M.O.to the soil, such as **activated sludge**, through which bacteria can be added as a decomposing agent to enhance its fertility. Activated sludge is a mixture of organic matters and aerobic M.O.in wastewater treatment tanks. It is rich in essential nutrients such as C, N, Ca, P. Birds serve as a microbial source for the soil by it wastes.

Factors affecting microorganisms in the soil:

1-Organic matters
2-pH
3-Temperature
4-Humidity

1-Organic matters: Bacteria, including actinomycetes (filamentous bacteria), and fungi are decompose organic matter to carbon and energy for building their cellular structures. Soil rich in plant or animal organic waste increases the numbers of bacteria and fungi.

- The number of bacteria increases in the surface layers of the soil, especially in the **Rhizosphere** (the region surrounding the root) due to the abundance of organic matter and the exudates of growing roots which include organic acids, vitamins, and plant growth regulators.
- fungi are concentrated at the soil surface because they are obligate aerobes and due to the high amount of organic matter.
- Fertile soil rich in organic materials directly or indirectly increases the number of protozoa, because some feeds on organic matter and another feeds on bacteria.

2-pH : Soil with high acidity or high alkalinity affects the presence of bacterial and fungal species.

- In general, bacteria are high number and more active than fungi at a pH = 7 or slightly above,
- while fungi high number and more active than bacteria at pH = 5.5.
- studies indicate that protozoa have a wide range of pH and are not sensitive to increases or decreases in pH.

3-Temperature: it effects on the activity of cellular enzymes. Most soil bacteria and fungi are prefer moderate temperatures, they are known as mesophiles.. the optimal temperature for protozoa is between 18-32 °C.

4-Humidity : moisture is necessary to reproduction and growth of M.O. increase in humidity due to rain or continuous irrigation indirectly effects on numbers of M.O. because it decrease aeration and creates anaerobic conditions in rain and continues irrigation :1-fungi growth decrease because fungi are obligate aerobes.

2-obligate aerobes bacteria may die or forming spores, 3-anaerobes bacteria increase in growth.

Air

Air is an unsuitable environment for survival of M.O. due to dryness, which makes it difficult to remain M.O.in active and viable state for long period. Some M.O. have the ability to resist environmental stress in the air by specific mechanisms that lead to loss of biological activity. For example, some types of bacteria form **spores**, as well as molds, and thus most M.O. possess means to protect themselves from dryness.

Factors affecting microorganisms in the Air:

1- Temperature
2- Humidity
3- Radiation
4- Air association factors (AOFs).

1. **Temperature:** high temperatures cause protein denaturation for M.O., while very low temperatures lead to the inhibition of M.O. activity due to the formation of ice crystals inside it.

2. **Relative Humidity:** essential for the survival of microbes during airborne transition.
   - Most Gram-negative bacteria remain for a long period at low humidity levels when suspended in air particles,
   - while Gram-positive bacteria are more resistant to dehydration than Gram-negative bacteria due to thick cell wall
   - Viruses have an enveloped-viruses, such as the influenza virus, remain in low humidity air (below 50%) for a longer period, while non-enveloped viruses, such as enteric viruses remain for a long period in high humidity (above 50%).

3- Radiation: the short wavelength rays such as ultraviolet (U.V.) rays and X-rays have a lethal affect on M.O. by damaging DNA. for example, (U.V.) rays damage DNA by creating thymine dimers within a single strand which prevent DNA replication. at the same time, there are natural mechanisms that protect microbes from the effects of harmful radiation, such as :

- connection of viruses with airborne particles like dust, pollen, and pollutants like ash and soot
- high relative humidity.
- The cover formed by clouds can protect microbes from radiation.

4- Air association factors (AOFs): The components of outdoor air that are lethal to M.O. by connection with M.O. and killing it by damage DNA and mutagenesis, such as

- free oxygen radicals, superoxide radicals O^{-}_{2} and hydroxyl radicals $.OH^{-}$, which formed due to effects of U.V.
- Positive ions cause changing the fluidity of the plasma membrane and protein channels in bacteria.
- Negative ions cause similar physical damage as bellow, as well as oxidizing DNA and inhibition protein synthesis and cell death.