**Microbe interactions**

With the development of microbial communities, the demand for nutrients and space also increases. As a result, there has been a development of different strategies to enable single-cell organisms to persist in an environment. cell–cell interactions or association may produce cooperative effects where one or more individuals benefit, or competition between the cells may occur with an adverse effect on one or more species in the environment. Several cell types are known for their microbe–microbe interaction, and studies are underway on cells interacting with other microorganisms to produce a highly competitive living system. Microorganisms not only respond to the chemical environment but also interact with other microorganisms in their immediate environment.

We shall describe the following types of microbial association:

Positive Association – Mutualism, Commensalism

Negative Association- Competition, Predation, Parasitism, Amensalism

**Positive association**

1. **Mutualism- Mutualism,** is anexample of a symbiotic relationship in which each organism benefits from the association. This is an obligatory relationship in which the **mutualist** and the host are metabolically dependent on each other. One type of mutualism association is that involve the exchange of nutrients between two species, a phenomenon called syntrophism.

Example- Lichens are excellent example of mutualism. **Lichens** are the association between specific ascomycetes(the fungus) and certain genera of either green algae orcyanobacteria. In a lichen, the fungal partner is termed the **mycobiont** and the algal or cyanobacterial partner, the **phycobiont.** Because the phycobiont is a photoautotroph dependent only on light, carbon dioxide, and certain mineral nutrients—the fungus can get its organic carbon directly from the alga or cyanobacterium. The fungus often obtains nutrients from its partner by haustoria (projections of fungal hyphae) that penetrate the phycobiont cell wall. It also uses the O2 produced during phycobiont photophosphorylation in carrying out respiration. In turn the fungus protects the phycobiont from excess light intensities, provides water and minerals to it, and creates a firm substratum within which the phycobiont can grow protected from environmental stress.

1. **Commensalism- Commensalism,** is a relationship in which one symbiont, the **commensal,** benefits while the (sometimes called the host) is neither harmed nor helped.

Commensalism is a unidirectional process. The proximity of two partners permit the commensal to feed on substarte captured or ingested by the host, and the commensal often shelter by living either on or in the host.

The commensal is not directly dependent in the host metabolically and causes no particular harm. When the commensal is separated from its host experimentally, it can survive without being provided some factor or factors of host origin.

Commensalistic relationships between microorganisms include situations in which the waste product of one microorganisms is the substrate for another species.

For example- Nitrification, the oxidation of ammonium ion to nitrite by microorganisms such as *Nitrosomonas*, and the subsequent oxidation of nitrite to nitrate by *Nitrobacter* . *Niteobacter* benefits from its association with *Nitrosomonas* because its uses nitrate to obtain energy for growth.

Commensalistic association also occur when one microbial group modifies the environment to make it more suited for another organisms. For example, in the intestine the common, nonpathogenic strain of *Escherichia coli* lives in the human colon, but also grows quite well outside the host, and thus is a typical commensal. When oxygen is used up by the facultatively anaerobic *Escherichia coli,* obligate anaerobes such as *Bacteroides* are able to grow in colon. The anaerobic environment benefit from their association with the host and *E.coli* derives no obvious benefit from the anaerobes.

**Negative association**

1. **Competition –** When two or more species use the same nutrients or niches for growth, some of the populations will be compromised. Competition between microbial species may be attributed to availability of nitrogen source, carbon source, electron donors, electron acceptors, vitamins, light, and water. The *laws of Liebeg and Shaford* refer to the limiting of growth resources in macroecology, and these may have applications in microbial populations.

Competition is seen in aquatic environments where extensive phototrophic activity results in blooms of single species of diatoms or cyanobacteria. In thermophilic springs where chemolithotrophic organisms are selected, the filaments that are present are predominantly of a single bacterial species. When succession of populations occurs, the final species could be considered to result from competition exclusion.

1. **Ammensalism (antagonism)- Amensalism** describes the negative effect that one organisms has on another organism. This is unidirectional process based on the release of a specific compound by one organism which has a negative effect on another organism.

A classical example of Amensalism is the production of antibiotic that can inhibit or kill a susceptible microorganisms.

Other important Amensalistic relationship involve microbial production of specific organic compounds that disrupt cell wall or plasma membrane integrity. These include bacteriocins.

1. **Parasitism- Parasitism** is defined as a relationship between organisms in which one organisms lives in or on another organisms. These parasite feeds on the cells, tissues or fluids of another organisms, the host, which is commonly harmed in the process.

An interesting example of a parasite relationship between microbe is the bacterial parasite of Gram negative bacteria named *Bdellovibrio bacteriovorous,* which is widespread in soil and sewage. This unusual motile bacteria attaches to a host cell at a special region and causes lysis of that cell.

Viruses which attack bacteria, fungi and algae are strict intracellular parasites since they cannot be cultivated as free-living forms. The phenomenon of lysogeny is quite important because of the possibility of genetic recombination in natural population and subsequent expression of new characteristics.

1. **Predation- Predation** is the widespread phenomenon where the predator engulfs or attack the prey. The prey can be smaller or larger than the predator, and this normally results in the death of the prey.

Examples of the predation are - *Bdellovibrio, Vampirococcus* and *Daptobacter.* Each of these has unique attack against against susceptible bacterium.

a). *Bdellovibrio* – *Bdellovibrio* penetrate the cell wall and multiply between the wall and the plasma membrane, a periplasmic mode of attack followed by lysis of prey and release of progeny.

b). *Vampirococcus* – *Vampirococcus* attaches to the surface of the prey (an epibiotic relationship) and then secreates enzyme to release the cell contents.

c). *Daptobacter* – *Daptobacter* penetrate the susceptible host and uses the cytoplasmic contents as a nutrient source.

References

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