

Topic: Role of Bacteria in Agriculture & Industries

B.Sc. Botany (Hons.)

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For more than a century man has feared the microbes as dreadful disease causing organisms. Although many microbial processes have been used by man since prehistoric times, without knowing the actual basis of it.

The role of bacteria in the agriculture and industries are -

Role of Bacteria in Agriculture:

Many species of saprophytic and symbiotic bacteria add to the fertility of the soil and provide nitrogen to the plants.

Ammonifying bacteria

These are (*Bacillus subtilis*, *B. mycoides*, *B. ramosus* etc.,) act upon the dead animal and plant tissues and decompose their complex organic compounds like proteins into ammonium compounds. They are also known as putrefying bacteria.

Nitrifying bacteria

Nitrosomonas oxidise the ammonium compounds into nitrites in presence of free oxygen and Nitrobacter oxidise nitrites into nitrates in the presence of free oxygen. Thus ammonifying and nitrifying bacteria increase the amount of nitrogenous compounds in the soil. Dead plants, animals and dung, etc., are converted into humus by the action of

putrefying bacteria. This humus itself acts as fertilizer for plants.

Nitrogen fixing bacteria

They are *Azotobacter*, *Clostridium* and *Rhizobium spp.* They fix free nitrogen of the soil and make it available to the plants. The first two bacteria live freely in soil and fix the atmospheric nitrogen in the form of nitrogenous compounds in the soil. The third one is a symbiotic type.

They live in the root nodules of leguminous plants, take the free atmospheric nitrogen and fix it within its tissues. These bacteria enable plants to grow in soil where no nitrogenous fertilizers are available. The leguminous plants make the soil rich in nitrogen, and therefore used as green manures.

Nitrogen fixation:

The phenomenon of nitrogen fixation takes place by special type of bacteria which fix free atmospheric nitrogen gas into ammonia by means of symbiosis with leguminous plants. The bacteria taking part in this process are *Rhizobium leguminosarum* (Rhizobiaceae) which live in soil. These bacteria produce IAA (Indol-Acetic Acid) due to which the root hairs curl. These rod-like bacteria penetrate through the tip of the root

hair forming a continuous 'infection thread' that enters the cortical region within twenty-four hours.

During its passage through the root hair, the infection thread gets surrounded by a cellulose wall. This wall is secreted by the host as a reaction to the infection. The infection thread ramifies in the cortical region and the bacterial rods are released in the cytoplasm of the cells which are stimulated.

These cells enlarge and multiply to form the characteristic nodules all over the root system. On the outside, the root nodule possesses a cortical layer which is followed by an actively proliferating meristemical region, then the vascular system enclosing in the centre the bacterial zone possessing abundantly the branched rods of *Rhizobium leguminosarum*.

These bacteria absorb atmospheric nitrogen and make it available to the host plant in the form of ammonia which is being converted into nitrates. In turn, the bacteria get shelter and carbohydrate-nutrition from the leguminous plant. On the death and decay of root nodules the rhizobia are again set free in the soil; the decomposition of roots adds nitrates into the soil thus increasing fertility of the soil.

Azotobacter is also found in the soil; this fixes the nitrogen gas of the atmosphere in the presence of carbohydrates. This fixation of free nitrogen from the atmosphere through ammonia into free nitrates and again their conversion into ammonia and free nitrogen takes place by means of nitrifying and denitrifying bacteria, along with other organisms. This process is termed nitrogen cycle.

Role of Bacteria in Industries:

A large number of saprophytic bacteria are employed in the manufacture of various industrial products.

Butter making industry

Saprophytic bacteria such as Lacto bacilli popularly known as starters make the milk sour and produce various flavors. These bacteria are largely employed in butter industry for ripening milk and producing flavors in butter.

Cheese making industry

Bacteria are employed in this industry. First the casein of milk is coagulated and then it is ripened by certain bacteria. Bacteria make the case in spongy, soft and give it characteristic taste and flavor.

Pasteurization

Heating milk at 62°C for 30 minutes or at 71°C for 15 seconds.

Vinegar making industry

Bacillus aceti convert the sugar solution into vinegar.

Alcohol and acetone manufacture

Butyl alcohol and acetone are manufactured by the action of bacteria on molasses.

Tobacco curing

Crude dry tobacco leaves pass through curing and ripening processes before they are ready for use. Bacteria are employed in both these processes and the peculiar taste and smell in the tobacco is due to the bacterial activity. For this purpose molasses and alcohol are added to tobacco.

Tea curing

Crude tea leaves are acted upon by certain bacteria. The process is known as curing, which is employed to impart a peculiar taste and flavor to the leaves. For this purpose alcohol is added to tea leaves.

Leather tanning

The hides and skins after drying, salting and clearing are steeped in fluids containing specific bacteria. The process of fermentation goes on for some time and then they are transferred to tan-pits and are further allowed to be fermented. This whole process is known as tanning and the bacteria employed in the process are obtained from cowdung and the excreta of dogs and poultry.

Fibre retting

Retting is the process of separating fibres from the plant tissues. Bacteria are employed in this industry, which cause decay of the softer tissues and render fibres easily separable mechanically. Fibres of flax, hemp, jute, coconut and other fibrous plants are obtained by immersing the specific plant organs in stagnant pond water.

Medicines

Antitoxins are chemical substances produced in the host tissues in response to the attack of parasitic bacteria. Different vaccines and serums now prepared from these antitoxins are used in the treatment of specific ailments. The antibiotics such as streptomycin, aureomycin, Chloromycetin, etc., are obtained from certain actinomycetous bacteria