

12th Standard Biology

Microbes in Human Welfare

Microbes in Household Products, Industrial Products and in Sewage Treatment:

1. Microbes are the major components of biological systems on the earth. They are present everywhere, i.e. in soil, water, air, inside our bodies and those of other animals and plants. They can also be found deep inside the geysers (thermal vents), deep in soil, under the layer of snow and in highly acidic environments.

- (i) Microbes are so minute that they cannot be seen by naked eyes.
- (ii) Various types of microbes are Protozoa, bacteria, fungi, virus, viroids and prions.

2. Microbes in household products The common products obtained by the use of microbes are curd, dough, toddy, cheese, etc.

(i) Curd is formed by adding bacteria such as Lactobacillus and others, commonly called as Lactic Acid Bacteria (LAB) in milk.

(a) A small amount of curd is added to the fresh milk as starter, which contain millions of LAB.

(b) LAB at suitable temperature multiply and convert milk into curd, which also improves nutritional quality by increasing vitamin-B₁₂.

(c) During growth, LAB produce acids that coagulate and partially digest the milk proteins.

(d) LAB also checks disease causing microbes in the stomach.

(ii) Dough is formed by fermentation caused by bacteria.

(a) Dough used to make bread, is fermented using baker's yeast (*Saccharomyces cerevisiae*).

(b) Carbon dioxide released during the process of fermentation gives the fluffy appearance to dough.

(c) Dough is also used to make foods like idli, dosa, in addition to different types of breads.

(iii) Toddy is a traditional drink of Southern India. It is made by fermentation of sap from palm trees by bacteria. A number of other drinks and food are also made by fermentation.

(iv) Cheese is made by partial degradation of milk using different microbes. (a) Swiss cheese is made by a bacterium *Propionibacterium shermanii*. The large holes in this cheese are due to production of a large amount of CO_2 by the bacterium.

(b) Roquefort cheese is made by ripening with the fungi, *Penicillium roqueforti* to obtain a specific flavour.

(v) Microbes are also used to ferment fish, soybean and bamboo shoots to make food.

3. Microbes in industrial products have immense importance. The main industrial products obtained from microbes are fermented beverages, antibiotics, organic acids, alcohol, enzymes and bioactive molecules, etc. Production of these products on industrial scale needs growing microbes in very large vessels called fermentors.

(i) Fermented beverages are wine, beer, whisky, brandy and rum.

(a) These are obtained by fermenting malted cereals and fruit juices with *Saccharomyces cerevisiae* or brewer's yeast to produce ethanol.

(b) Variety of alcoholic drink depend on the type of raw material used and the type of processing.

(c) Wine and beer are produced without distillation.

(d) Whisky, brandy and rum are produced by the distillation of the fermented broth.

(ii) Antibiotics (anti – against and bio – life) are chemical substances, which are

produced by some microbes and can kill or retard the growth of other (disease causing) microbes.

(a) Penicillin was the first antibiotic discovered by Alexander Fleming.

(b) Fleming discovered penicillin, while working on *Staphylococcus* bacteria. He observed a mould growing in one of his unwashed culture plates around which *Staphylococci* could not grow. He found out that it was due to a

chemical produced by the mould. He named it penicillin after the mould *Penicillium notatum*.

(c) Ernst Chain and Howard Florey discovered full potential of this antibiotic.

(d) Penicillin was extensively used during World War II. Fleming, Chain and Florey were awarded Nobel Prize in 1945 for this discovery.

(e) Antibiotics are used to cure deadly diseases such as plague, whooping cough, diphtheria and leprosy.

(iii) Organic acids are produced by the microbial metabolic action. Important ones are:

(a) Citric acid – *Aspergillus niger* (fungi)

(b) Acetic acid – *Acetobacter aceti* (bacteria)

(c) Butyric acid – *Clostridium butylicum* (bacteria)

(d) Lactic acid – *Lactobacillus* (bacteria)

(iv) Ethanol is produced by yeast (*Saccharomyces cerevisiae*) on commercial scale.

(v) Enzymes used in various fields are also produced by microbes as given below:

(a) Lipase used in detergent formulations and helps in removing oily stains from the laundry.

(b) Pectinase and protease used for clarifying bottled juices.

(c) Streptokinase produced by *Streptococcus* and modified by genetic engineering is used as a 'Clot buster' for removing clots from blood vessels of patients, who have undergone myocardial infarction leading to heart attack.

(vi) Bioactive molecules produced by microbes are:

(a) Cyclosporin-A produced by *Trichodermapolysporum* (fungus). It is used as immunosuppressive agent in organ-transplant patients.

(b) Statins produced by *Monascus purpureus* (yeast), is used as blood cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for the synthesis of cholesterol.

4. Microbes in sewage treatment play major role:

(i) Sewage is the municipal wastewater containing mainly human excreta. It contains

large quantity of organic matter and pathogenic microbes. Therefore, before discharging into natural bodies, sewage needs to be made less polluting.

(ii) Sewage treatment is carried out in Sewage Treatment Plants (STPs) in following steps:

A. Primary treatment of sewage is:

(a) This step involves physical removal of large and small particles from sewage through filtration and sedimentation.

(b) Floating debris is removed by sequential filtration by passing through wire mesh screens.

(c) After this, the grit (soil and small pebbles) is removed by sedimentation in settling tanks. The sediment is called primary sludge and the supernatant forms the primary effluent.

(d) The effluent is taken for secondary treatment.

B. Secondary treatment (biological treatment) of sewage is done on primary effluent.

(a) Primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply.

(b) This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh-like structures).

(c) These microbes consume major part of organic matter in the effluent, while growing. This reduces the Biochemical Oxygen Demand (BOD) of the effluent.

(d) When BOD of sewage gets reduced, it is passed into settling tank.

(e) The bacterial flocs settle in tank and the sediment is called activated sludge.

(f) A small amount of activated sludge is pumped back into the aeration tank to serve as inoculum.

(g) The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters.

(h) In sludge digesters, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge. During this process, bacteria produce a mixture of gases, such as methane, hydrogen sulphide and the carbon dioxide, which form biogas (can be used as source of energy).

(i) The effluent from secondary treatment is generally released into natural water bodies.

(iii) Biochemical Oxygen Demand (BOD) refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water is oxidised by bacteria.

(a) BOD measures the rate of uptake of oxygen by the microbes in a sample of water. Indirectly, it measures the organic matter present in the water.

(b) More BOD of waste water indicates more polluting potential.

(iv) Due to the increasing urbanisation, sewage is being produced in larger.