CHAPTER – 10 : MICROBES IN HUMAN WELFARE

Microbes in Household products:

- *A common example is the production of curd from milk. Micro-organisms such as Lactobacillus and others commonly called Lactic Acid Bacteria (LAB) grow in milk and convert it to curd. During growth, the LAB produces acids that coagulate and partially digest the milk proteins. It also improves its nutritional quality by increasing vitamin B12. In our stomach too, the LAB play very beneficial role in checking disease causing microbes.*
- *The dough, which is used for making bread, is fermented by using baker's yeast (Saccharomyces cerevisiae).*
- *"Toddy", a traditional drink of some parts of southern India is made by fermenting sap from palms.*
- *Microbes are also used to ferment fish, soya bean and bamboo-shoots to make foods. Cheese, is one of the oldest food items in which microbes were used. The large holes in 'Swiss cheese' are due to production of a large amount of CO2 by a bacterium named Propionibacterium sharmanii. The 'Roquefort cheese' is ripened by growing a specific fungus on them for a particular flavour.*

Microbes in Industrial products:

Production on an industrial scale requires growing microbes in very large vessels called Fermentors.

a) Fermented Beverages:

The yeast Saccharomyces cerevisiae used for bread making and commonly called brewer's yeast, is used for fermenting malted cereals and fruit juices to produce ethanol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of the fermented broth.

b) Antibiotics:

Antibiotics are chemical substances, which are produced by some microbes and can kill or retard the growth of other disease causing microbes.

Pencillin was the first antibiotic to be discovered and it was a chance discovery. Alexander Fleming while working on Staphylococci bacteria, once 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 and he named it Pencillin after the mould Pencillium notatum. Later, Ernest Chain and Howard Florey made its full potential effective antibiotic.

c) Chemicals, Enzymes and other Bioactive Molecules:

- *Aspergillus niger (fungus) – Citric acid*
- *Acetobacter aceti (bacterium) – Acetic acid*
- *Clostridium butylicum (bacterium) – Butyric acid*
- *Lactobacillus (bacterium) – Lactic acid*
- *Saccharomyces cerevisiae – Ethanol*

Enzymes:

- *Lipase – used in laundry detergents*
- *Pectinase and protease – used in bottled juices*
- *Streptokinase (Streptococcus bacterium) – used as clot buster (to remove clots)*

Bioactive molecules:

- *Cyclosporin A (Trichoderma polysporum fungi) – used as immunosuppressive agent (for organ transplant patients).*
- *Statins (Monascus purpureus yeast) – used as blood cholesterol lowering agents.*

Microbes in Sewage Treatment:

Treatment of waste waster is done by heterotrophic microbes naturally present in the sewage. This treatment is carried out in two stages;

Primary treatment / Physical treatment: It involves physical removal of particles from the sewage through filtration and sedimentation.

- *Sequential filtration – to remove floating debris*
- *Sedimentation – to remove grit (soil and small pebbles)*

All solids that settle form the primary sludge, and the supernatant forms the effluent. The effluent from the primary settling tank is taken for secondary treatment.

Secondary treatment / Biological treatment:

- *The primary effluent is passed into large aeration tanks, this allows vigorous growth of aerobic microbes into flocs. While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the BOD (biochemical oxygen demand) of the effluent. BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, more is its polluting potential.*
- *Once the BOD of sewage water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called Activated sludge.*
- *A small part of this sludge is pumped back into the aeration tank to serve as the inoculum.*

- *The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters.*
- *During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas.*
- *The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.*

Microbes in Production of Biogas:

Biogas is mixture of gases produced by the microbial activity and which may be used as fuel. Certain bacteria, which grow anaerobically on cellulosic material, produce large amount of methane along with CO2 and H2. These bacteria are collectively called Methanogens (Methanobacterium).

These bacteria are also present in the rumen of cattle. A lot of cellulosic material present in the food of cattle is also present in the rumen. In rumen, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle. Thus, the excreta (dung) of cattle, commonly called Gobar, is rich in these bacteria. Dung can be used for generation of biogas commonly called gobar gas.

Biogas Plant:

- *The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).*
- *The biogas plant consists of a concrete tank in which bio-wastes are collected and slurry of dung is fed.*
- *A floating cover is placed over the slurry, which keeps on rising as the gas is produced in the tank due to the microbial activity.*
- *The biogas plant has an outlet, which is connected to a pipe to supply biogas to nearby houses.*
- *The spent slurry is removed through another outlet and may be used as fertilizer.*
- *The biogas thus produced is used for cooking and lighting.*

Microbes as Biocontrol Agents:

Biological control of pests and diseases:

- *Lady bird – to control aphids*
- *Dragon fly – to control mosquitoes*
- *Bacillus thuringiensis (Bt Cotton) – to control wide range insects*
- *Trichoderma (fungi) – protects root system and control plant pathogens.*
- *Baculoviruses (Nucleopolyhedrovirus) – to attack insects and other arthropods.*

Microbes as Biofertilisers: Biofertilizers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria.

Bacteria:

- *Symbiosis – Rhizobium with root nodules of leguminous plants*
- *Free living (in the soil) – Azotobacter and Azospirillum.*

Fungi:

- *Symbiosis – Mycorrhiza with root system of genus Glomus and absorb phosphorus and water from the soil for the plant growth.*

Cyanobacteria:

- *Symbiosis – Anabaena in Azolla*
- *Free living – Nostoc, Oscillatoria and Blue green algae.*