MICROBES IN HUMAN WELFARE

1. Microbes

These are the major components of biological systems on the Earth. These are microscopic, single-celled, tiny creatures that are very small and can only be seen under the microscope.

Microbes are diverse protozoans, viruses, bacteria, algae (small plant groups) and fungi. Study of microorganisms is called **Microbiology**. Although, microbes are causal agents of most infectious diseases, they also have been in use by humans for their own benefits.

2. Microbes in Household Products

Microbes are used in household products in day-to-day life, e.g. curd is made by Lactobacillus, commonly called **Lactic Acid Bacteria** (LAB). It grows in milk and converts it into curd. The dough which is used for making food items such as dosa, idli, cakes and bread are also fermented by bacteria or yeast (Saccharomyces cerevisiae).

- **Cheese** is made by partial digestion of milk using different microbes. Different varieties of cheese are known by texture, flavour and taste. These specifications come from Propionibacterium shermanii in Swiss cheese and Penicillium roquefortii in roquefort cheese.

- **Toddy** is a traditional drink of Southern India. It is made by fermenting sap from palm trees, coconut, etc.

Note • The amount of curd added as raw material to convert milk into curd is known as inoculum.

3. Microbes in Industrial Products

A variety of microbes is used to synthesise a number of products valuable to human beings, e.g. beverages and antibiotics. For industrial production, microbes are grown in large vessels called **fermentors** or **bioreactors**.

(i) **Fermented Beverages** Saccharomyces cerevisiae (commonly called as brewer's yeast) is used for producing food, drinks and bakery products, e.g. in the production of, alcohol drinks and bread.

(ii) **Antibiotics Production** Microorganisms are used in the production of antibiotics. Antibiotics (Anti–against, bio–life) suppress the growth of other disease

causing microbes, e.g. penicillin. It was the first discovered antibiotic by Alexander Fleming, when he was working on Staphylococci bacteria. It is obtained from a mould called Penicillium notatum. Some other antibiotics were also purified like streptomycin, terramycin, fumagillin (from Aspergillus fumigatus), etc.

Note • Judicious use of antibiotics is an approach to maximise the therapeutic efficiency and minimise the appearance of resistant microorganisms.

(iii) **Chemicals, Enzymes and other Bioactive Molecules** Microbes are being used for commercial and industrial production of certain chemicals like alcohols, organic acids, enzymes and other bioactive molecules. Some of them are given below

Organic Acids Produced by Microbes

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

Enzymes and their Functions

- **Lipase** is used in laundry detergents.
- **Pectinase** and **protease** are used to clarify the bottled juices.
- **Streptokinase** (Streptococcus bacterium) is used as clot buster to remove clots from the blood vessels of patients who have undergone myocardial infarction.

Bioactive Molecules and their Uses

Cyclosporin-A (Trichoderma polysporum fungi) is used as an immunosuppressive agent in organ transplant patients.

Statins (Monascus purpureus yeast) are used as blood cholesterol lowering agents.

4. Microbes in Sewage Treatment

In sewage treatment, several heterotrophic microbes like bacteria, fungi, protozoans, etc., which are naturally present in the sewage are utilised.

The treatment of waste water containing all discarded materials, domestic wastes, agriculture wastes, human excreta, etc., is done in **Sewage Treatment Plants** (STPs). This treatment is carried out in following two stages

(i) **Primary Treatment**It is the physical removal of large and small particles from the sewage. It is done through filtration and sedimentation. All grit (soil and small pebbles) is removed by sedimentation in settling tanks. All solids that are settled down at the bottom are known as primary sludge.It traps lots of microbes and debris. The supernatant forms the effluent which is taken for secondary treatment.

(ii) **Secondary Treatment** or **Biological Treatment** The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically. This allows the growth of the aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh-like structures) which consume the major part of the organic matter present in the effluent. It significantly reduces the BOD (Biochemical Oxygen Demand) of the effluent.

As the BOD of the waste matter is reduced to 10-15% of raw sewage, it is passed into settling tank. The sediment of settling tank is called activated sludge which is sent to anaerobic sludge digesters.

Here, anaerobic microbes like methanogens digest organic mass and aerobic microbes (bacteria and fungi) and produce gases like methane (CH_4), hydrogen sulphide (H_2S) , carbon dioxide (CO_2) , etc. These gases form biogas.

5. Microbes in Biogas Production

Microbes like methanogens and Methanobacterium are used for the production of 'biogas' which is used as an energy source. The major part of biogas, consists of methane (50-70%). Other constituents of biogas are CO_2 CO_2 (30-40%), small amount of hydrogen, nitrogen, ethylene, acetylene, ethane, propane and a very little amount of hydrogen sulphide (H_2S).

The excreta of cattle, i.e. **cattle dung** (commonly known as gobar) is rich in methanogenic bacteria which is used in the generation of biogas or g**obar gas**.

Biogas plant optimises the utilisation of manure, waste and other organic feed stock by converting these biomasses into energy and valuable bio fertilisers.

Biogas production technology was developed in India by Khadi and Village Industries Commission (KVIC) and Indian Agricultural Research Institute (IARI).

6. Microbes as Bio control Agents

It is the useful biological method for controlling plant diseases and pests. There are few examples of biological control agents given as

(i) **Bacillus thuringiensis** is a soil bacterium, which produces crystals of a protein (Bt toxin) in its endospore form. This protein kills insects like cotton bollworm and other termites, butterflies, ants, etc.

(ii) **Ladybird** and **dragonflies** are useful to get rid of aphids and mosquitoes, respectively.

(iii) **Trichoderma** are free-living fungi that are very common in the root ecosystems. They also act as biocontrol agents in control of plant pathogens.

(iv) **Baculoviruses** belonging to the genus Nucleopolyhedrovirus are also biological control agents aganist insect pests.

7. Microbes as Biofertilisers

Different types of microbes increase the nutrient content of soil via their biological processes. These are known as biofertilisers. These are responsible for increasing plant growth.

Some organisms such as bacteria, fungi and cyanobacteria enrich the nutrient quality of the soil. The main sources of biofertilisers are as follows

(i) **Symbiotic bacteria**, e.g. Rhizobium, **Free-living bacteria** in the soil, e.g. Azotobacter and Azospirillum.

(ii) **Symbiotic fungi**, e.g. Mycorrhiza.

(iii) **Symbiotic cyanobacteria**, e.g. Anabaena and Azolla, etc. **Free-living Cyanobacteria**, e.g. Nostoc, Oscillatoria and blue-green algae.