10. Microbes in Human Welfare

Question 1. Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes with the help of a microscope, which sample would you carry and why?

Answer: Curd can be used as a sample for the study of microbes. Curd contains numerous lactic acid bacteria (LAB) or Lactobacillus. These bacteria produce acids that coagulate and digest milk proteins. A small drop of curd contains millions of bacteria, which can be easily observed under a microscope.

Question 2. Give examples to prove that microbes release gases during metabolism.

Answer: Microbes carry out lactic acid fermentation (the anaerobic respiration) and produce carbon dioxide and lactic acid. The puffy appearance of Idli and Dosa dough is due to carbon dixoide released by microbes during fermentation. Likewise, baking industries uses Baker's yeast that causes rise of batter of cakes and pastries during the process. It is also due to released carbon dioxide during lactic acid fermentation.

Question 3. In which food would you find lactic acid bacteria? Mention some of their useful applications.

Answer: Lactic acid bacteria (LAB) is found in curd. The useful applications of LAB are as follows:
1. These bacteria can convert milk into curd.
2. LAB are also found in our stomach to check the growth of harmful bacteria in our stomach.
3. LAB increases the amount of vitamin B12 in curd. Thus, it makes curd nutritious.

Question 4. Name some traditional Indian foods made of wheat, rice and Bengal gram (or their products) which involve use of microbes.

Answer: Nan, bhature (made from wheat flour), idli, dosa (made from rice flour) and pakoda (made from Bengal gram flour).

Question 5. In which way have microbes played a major role in controlling diseases caused by harmful bacteria?

Answer: Several micro-organisms are used for preparing medicines. Antibiotics are medicines produced by certain micro-organisms to kill other disease-causing micro-organisms. These medicines are commonly obtained from bacteria and fungi. They either kill or stop the growth of disease-causing micro-organisms. Streptomycin, tetracycline, and penicillin are common antibiotics. *Penicillium notatum* produces chemical penicillin, which checks the growth of staphylococci bacteria in the body. Antibiotics are designed to destroy bacteria by weakening their cell walls. As a result of this weakening, certain immune cells such as the white blood cells enter the bacterial cell and cause cell lysis. Cell lysis is the process of destroying cells such as blood cells and bacteria.

Question 6. Name any two species of fungus, which are used in the production of the antibiotics.

Answer: Antibiotics are medicines that are produced by certain micro-organisms to kill other disease-causing micro-organisms. These medicines are commonly obtained from bacteria and fungi. The species of fungus used in the production of antibiotics are:
Antibiotic - Penicillin Penicillium notatum
Fungus source - *Penicillium notatum*
Antibiotic – Cephalosporin
Fungus source - *Cephalosporium acremonium*

Question 7. What is sewage? In which way can sewage be harmful to us?

Answer: Sewage is the municipal waste matter that is carried away in sewers and drains. It includes both liquid and solid wastes, rich in organic matter and microbes. Many of these microbes are pathogenic and can cause several water- borne diseases. Sewage water is a major cause of polluting drinking water. Hence, it is essential that sewage water is properly collected, treated, and disposed.

Question 8. What is the key difference between primary and secondary sewage treatment?

Answer:

Primary sewage treatment	**Secondary sewage treatment**
It is a mechanical process involving the removal of coarse solid materials.	It is a biological process involving the action of microbes.

It is inexpensive and relatively less complicated.	It is a very expensive and complicated process.

Question 9. Do you think microbes can also be used as source of energy? If yes, how?

Answer: Yes, the microbes present in activated sludge are digested anaerobically to generate a biogas i.e. by release of inflammable biogas in biogas plant, which is a source of energy.
Use of microbial culture for SCP (single cell protein).

Question 10. Microbes can be used to decrease the use of chemical fertilisers and pesticides. Explain how this can be accomplished.

Answer: Various bacteria, fungi and cyanobacteria are used in organic farming instead of chemical fertilizers and pesticides. Biofertilizers are organisms that help in enriching the soil with nutrients.

• Rhizobium, Azospirillum and Azotobacter help in nitrogen fixation and hence, enrich the soil with nitrogen.

• Fungi such as mycorrhiza form symbiont relationship with plants and absorbs phosphorus from soil and passes it to the plant.

• Cyanobacteria help in nitrogen fixation and is an important biofertilizer.

• Blue green algae adds organic matter to the soil.

• Bio-pesticides such as Bacillus thuringiensis produces a toxin that kills the insect pests

• Baculoviruses are bio-pesticide that is used as a biological control agent against insects and other arthropods.

Question 11. Three water samples namely river water, untreated sewage water and secondary effluent discharged from a sewage treatment plant were subjected to BOD test. The samples were labelled A, B and C; but the laboratory attendant did not note which was which. The BOD values of the three samples A, B and C were recorded as 20mg/L, 8mg/L and 400mg/L, respectively. Which sample of the water is most polluted? Can you assign the correct label to each assuming the river water is relatively clean?

Answer: BOD values indicate the amounts of organic wastes present in the matter. The greater the BOD of waste water, more is its polluting potential. On the basis of this criterion, we can conclude: (i) The sample labelled as C is of untreated sewage water because such sewage water has highest quantities of organic matter and so has highest BOD value (i.e., 400 mg/L). (ii) The sample labelled as A is of water of secondary effluent chamber of STP because it comes after the primary treatment and is with less organic matter than untreated sewage water so has less BOD (i.e., 20 mg/L). (iii) The sample labelled as B has minimum BOD (i.e., 8 mg/L) and it has been assumed that river water is relatively clean so B sample is of river water.

Question 12. Find out the name of the microbes from which Cyclosporin A (an immunosuppressive drug) and Statins (blood cholesterol lowering agents) are obtained.

Answer: Cyclosporin A, a fungal product (*Trichoderma polysporum*), is an immunosuppressant that blocks the activation of T helper cells and interferes with the release of interleukin-2 and thereby prevents organ rejection in transplantation processes. Statins are the competitive inhibitor of enzyme HMG CoA reductase, an enzyme of cholesterol biosynthesis and are produced by *Monascus purpureus*.

Question 13. Find out the role of microbes in the following and discuss it with your teacher.
(a) Single cell protein (SCP)
(b) Soil

Answer: (a) Single cell protein (SCP):- A single cell protein is a protein obtained from certain microbes, which forms an alternate source of proteins in animal feeds. The microbes involved in the preparation of single cell proteins are algae, yeast, or bacteria. These microbes are grown on an industrial scale to obtain the desired protein. For example, *Spirulina* can be grown on waste materials obtained from molasses, sewage, and animal manures. It serves as a rich supplement of dietary nutrients such as proteins, carbohydrate, fats, minerals, and vitamins. Similarly, micro-organisms such as *Methylophilus* and *methylotrophus* have a large rate of biomass production. Their growth can produce a large amount of proteins.

(b) Soil:- Microbes play an important role in maintaining soil fertility. They help in the formation of nutrient-rich humus by the process of decomposition. Many species of bacteria and cyanobacteria have the ability to fix atmospheric nitrogen into usable form. Rhizobium is a symbiotic bacteria found in the root nodules of leguminous plants. *Azospirillium* and *Azotobacte*r are free living nitrogen-fixing bacteria, whereas *Anabaena, Nostoc*, and *Oscillatoria* are examples of nitrogen-fixing cyanobacteria.

Question 14. Arrange the following in the decreasing order (most important first) of their importance, for the welfare of human society. Give reasons for your answer. Biogas, Citric acid, Penicillin and Curd.

Answer: The order of arrangement of products according to their decreasing importance is:
Penicillin- Biogas − Citric acid − Curd
Penicillin is the most important product for the welfare of human society. It is an antibiotic, which is used for controlling various bacterial diseases. The second most important product is biogas. It is an eco-friendly source of energy. The next important product is citric acid, which is used as a food preservative. The least important product is curd, a food item obtained by the action of lactobacillus bacteria on milk
Hence, the products in the decreasing order of their importance are as follows: Penicillin- Biogas − Citric acid − Curd

Question 15. How do biofertilisers enrich the fertility of the soil?

Answer: Biofertilizers are the organisms that enrich the nutrient quality of soil. Bacteria, cyanobacteria and fungi are the three groups of organisms used as biofertilizers.

i) Bacteria
a) symbiotic bacteria Rhizobium.
b) Free living bacteria *Azospirillum & Azotobacter*.
c) They fix the atmospheric nitrogen and enrich soil nutrients.

ii) Cyanobacteria : Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environment. Many of them can fix atmospheric nitrogen and increase the organic matter of the soil through their photosynthetic activity. In paddy field cyanobacteria serves as important biofertilizers. Commercially farmers use these cyanobacteria in their fields to replenish soil nutrients and to reduce dependency on chemical fertilizers. Important examples are Anabaena, Nostoc and Oscillatoria.

iii) Fungi/ Mycorrhiza Fungi are also known to develop symbiotic relationship with plant roots. Such a relationship is called mycorrhiza. Many members of the genus Glomus form mycorrhizae. The fungus absorbs phosphorus from the soil and passes it to the plant. Plants having such association show other benefits also
a) Resistance to root borne pathogens
b) Tolerance to salinity.
c) Tolerance to drought
d) Overall increase in the plant growth and development.