CHAPTER

8

MICROBES IN HUMAN WELFARE

CLASS 12TH

NCERT EXERCISE AND SOLUTIONS - BIOLOGY

Q. 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 is an ideal sample for demonstrating the presence of microbes under a microscope, as it contains abundant *Lactobacillus*, or lactic acid bacteria. These bacteria produce acids that help coagulate and digest the proteins in milk. A tiny drop of curd contains millions of these bacteria, which can be easily observed under a microscope.

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

ANSWER:-

Microbes release gases as part of their metabolic processes, with some examples being:

(i) *Methanobacterium* found in anaerobic sludge produces significant amounts of methane, along with hydrogen gas and carbon dioxide.

(ii) During the fermentation of cheese, dough, and the production of beverages, carbon dioxide is released. The microbes involved in these processes include *Propionibacterium sharmanii*, lactic acid bacteria, and *Saccharomyces cerevisiae*.

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

ANSWER:-

Lactic acid bacteria are present in curd, and they have several beneficial applications:

(i) They enhance the Vitamin B12 content of curd, boosting its nutritional value.

(ii) These bacteria can be used for fermenting or culturing food.

(iii) They contribute to improving gut health.

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

ANSWER:-

Some Indian foods made from wheat, rice, and Bengal gram include:

(i) **Wheat:** Bread, Bhatura, and Cake are made from wheat.

(ii) **Rice:** Idli, Dosa, and Uttapam are made from rice.

(iii) **Bengal gram:** Dhokla and Khandvi are made from Bengal gram.

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

ANSWER:-

Microbes play a vital role in combating diseases caused by harmful bacteria, as outlined below:

(i) Microbes produce antibiotics, which are used to treat diseases such as leprosy and diphtheria.

(ii) Microbes generate antitoxins or antisera that target specific pathogens. Antisera are commonly used to treat conditions like lockjaw (tetanus) and diphtheria.

(iii) Microbes produce antibodies containing antitoxins and opsonins, which help prevent diseases such as cholera, typhoid, and smallpox.

(iv) Antibiotics are designed to destroy bacteria by weakening their cell walls, which allows immune cells (like white blood cells) to enter the bacterial cells and cause cell lysis, the destruction of cells such as blood cells by bacteria.

(v) *Penicillium notatum*, a fungus, produces penicillin, a chemical that inhibits the growth of the bacteria *Staphylococci*.

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

ANSWER:-

Many microbes produce antibiotics that are effective in killing disease-causing microbes. These antibiotics are generally derived from fungi and bacteria. Two fungal species commonly used in antibiotic production are:

(i) **Penicillin:** sourced from the fungus *Penicillium notatum*

(ii) **Cephalosporin:** derived from the fungus *Cephalosporium acremonium*

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

ANSWER:-

Sewage refers to the waste material from municipalities that is transported through drains and sewers. It consists of both solid and liquid waste, which contain a high concentration of microbes and organic matter.

Many of these microbes are pathogenic, meaning they can cause diseases, particularly waterborne illnesses. Sewage water is a major contributor to the contamination of drinking water. Thus, it is crucial to properly treat sewage by collecting and disposing of it safely.

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

ANSWER:-

Primary sewage treatment	Secondary sewage treatment
This involves the physical removal of both large and small particles from sewage.	This process focuses on removing organic matter using microbes.
The treatment is carried out through sedimentation and filtration.	The treatment relies on the biological digestion of waste.
It is a simpler and more cost-effective method.	It is a more complex and costly process.

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

ANSWER:-

Yes, microbes can indeed serve as a source of energy. Certain bacteria, such as Methane producing bacteria, can be utilized to produce biogas, also known as Gobar gas.

In a biogas plant, biogas is generated under anaerobic conditions. The plant consists of a concrete tank, typically 10-15 feet deep, with appropriate inlets and outlets. Dung is mixed with water to form slurry, which is then introduced into the tank. Inside the tank, there is a digester filled with anaerobic methane-producing bacteria, which break down the slurry and produce biogas. The biogas is extracted through a pipe and can be used as an energy source. The remaining slurry is removed from the outlet and can be used as fertilizer.

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

ANSWER:-

Organic farming is conducted without the use of pesticides or chemical fertilizers, with microbes playing a crucial role. Bio-fertilizers, which consist of beneficial microbes, help enhance plant growth by supplying essential nutrients. These living organisms increase soil fertility by being introduced into the roots, seeds, and soil, making nutrients more available and enriching the soil with organic matter. Several species of bacteria and cyanobacteria, such as *Rhizobium, Azotobacter, Azospirillium, Nostoc, Oscillatoria, and Anabaena*, have the ability to fix nitrogen from the atmosphere.

Rhizobium, a symbiotic bacterium, resides in the root nodules of leguminous plants, while free-living nitrogen-fixing bacteria, like *Azotobacter* and *Azospirillium*, and nitrogen-fixing cyanobacteria, like *Nostoc* and *Anabaena*, contribute to soil enrichment. These bio-fertilizers are environmentally friendly and cost-effective.

Microbes also serve as bio-pesticides to control insect pests in plants. *Bacillus thuringiensis*, a well-known bio-pesticide, produces toxins that kill insect pests. When bacterial spores are mixed with water and sprayed on crops, they are ingested by insect larvae, releasing toxins in their gut. Similarly, the free-living fungus *Trichoderma*, found in the roots of higher plants, protects them from pathogens. Baculovirus, another bio-pesticide, is used as a biological control agent against various arthropods and insects.

Q. 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 (biochemical oxygen demand) refers to the amount of oxygen required to oxidize all the organic matter in one liter of water by bacteria. The BOD test measures the rate at which microbes consume oxygen in a water sample, making it an indicator of the organic matter present in the water. Therefore, a higher BOD indicates a higher potential for pollution.

Sample A, with a BOD of 20 mg/L, represents secondary effluent discharged from a sewage treatment plant.

Sample B, with a BOD of 8 mg/L, is representative of river water.

Sample C, with a BOD of 400 mg/L, indicates untreated sewage water.

This classification is based on the principle that the sample with the highest BOD value contains the most polluted water.

Q. 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, an immunosuppressive medication, is derived from the fungus *Trichoderma polysporum*. Statins, a drug used to lower blood cholesterol levels, are obtained from the yeast *Monascus purpureus*.

Q. 13. **Find out the role of microbes in the following and discuss it with your teacher.**

(a) Single cell protein (SCP)

(b) Soil

ANSWER:-

The roles of microbes in the following areas are as outlined:

(a) Single Cell Protein (SCP)

(i) SCP refers to safe microbial cells that can replace traditional protein sources.

(ii) Certain microbial cells can be consumed as a nutritious food source rich in minerals, proteins, fats, vitamins, and carbohydrates, similar to how mushrooms are eaten, or yeast is consumed by athletes for protein.

(iii) *Methylophilus methylotrophus* and *Spirulina* are cultivated on a large-scale using materials such as starch-rich wastewater from potato processing, molasses, straw, animal manure, and sewage.

(b) Soil

(i) Microbes play a vital role in maintaining soil fertility.

(ii) They contribute to the formation of nutrient-dense humus through decomposition.

(iii) Various bacteria and cyanobacteria species are capable of fixing atmospheric nitrogen into a usable form for plants.

(iv) *Rhizobium*, a symbiotic bacterium, is found in the root nodules of leguminous plants.

(v) Free-living nitrogen-fixing bacteria, such as *Azotobacter* and *Azospirillum*, as well as nitrogen-fixing cyanobacteria like *Nostoc*, *Oscillatoria*, and *Anabaena*, are present in the soil.

Q. 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 following are ranked in decreasing order of importance, with the most significant listed first for human welfare:

Penicillin > Biogas > Curd > Citric Acid

Reason:

(i) Penicillin is an antibiotic that combats harmful pathogens, preventing dangerous diseases and infections, thus saving lives. It holds the highest importance.

(ii) Biogas ranks second as it serves as a clean, non-polluting fuel produced during sewage treatment. It is used for cooking and as a source of lighting, especially in remote areas.

(iii) Curd comes next due to its high nutritional value, providing vitamin B12. It promotes gut health and helps replace harmful bacteria with beneficial ones in the stomach.

(iv) Citric acid is last, primarily used as a food preservative.

Q. 15. How do biofertilizers enrich the fertility of the soil?

ANSWER:-

Bio-fertilizers are composed of beneficial microbes that enhance plant growth by providing essential nutrients. These living organisms are known to improve soil fertility by enriching it with organic matter.

Bio-fertilizers are applied to roots, seeds and soil to make nutrients more accessible to plants. Several species of bacteria and cyanobacteria can fix atmospheric nitrogen.

For example, the symbiotic bacterium *Rhizobium* is found in the root nodules of leguminous plants, while free-living nitrogen-fixing bacteria such as *Azotobacter* and *Azospirillum*, along with nitrogen-fixing cyanobacteria like *Nostoc*, *Oscillatoria* and *Anabaena* also play a role. These bio-fertilizers are environmentally friendly and cost-effective.