EXERCISE PAGE NO.189-190

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?

Solution:

To demonstrate the presence of microbes with the help of a microscope, Curd is apt. It can be used as a sample as it contains plenty of Lactobacillus or lactic acid bacteria. These are the bacteria that produce acids which coagulate and digest the milk proteins. A small drop of curd consists of millions of bacteria. These can be observed easily under a microscope.

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

Solution:

Microbes release gases during metabolism, some examples are as follows:

(i) Methano bacterium observed in anaerobic sludge releases large amount of methane along with hydrogen gas and carbon dioxide

(ii) The process of fermentation of cheese, dough and production of beverages releases carbon dioxide. The microbes involved in the process are Propionibacterium sharmanii, lactic acid bacteria and Saccharomyces cerevisiae.

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

Solution:

We can find lactic acid bacteria in curd. Some of the useful applications of these bacteria are:

(i) It causes an increase in the Vitamin B_{12} level of curd, thus increasing the nutritional value of curd

(ii) It can be used to ferment or culture food

(iii) They check the health of the gut

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

Solution:

Some Indian food made of wheat, rice and Bengal gram are:

(i) Wheat: Bread, Bhatura and Cake are made of Wheat

(ii) Rice: Idli, Dosa and Uttapam are made of Rice

(iii) Bengal gram: Dhokla and Khandvi are made of Bengal gram

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

Solution:

Microbes play an important role in controlling diseases caused by harmful bacteria, some are:

(i) Microbes are known to produce antibiotics which can be used to treat harmful diseases such as leprosy, diphtheria etc

(ii) Microbes produce antitoxins or antisera which acts against a specific pathogen. Antisera is known to be widely used against lock jaw tetanus, diphtheria etc

(iii) They produce antibodies which contain antitoxins and opsonins that check the occurrence of diseases namely, cholera, typhoid, small pox etc

(iv) The design of antibiotics is such that they destroy bacteria by weakening their cell walls. This in turn weakens several immune cells (white blood cells) that enter the bacterial cell causing cell lysis. The process of destructing cells such as blood cells by bacteria is known as cell lysis.

(v) Penicillium notatum, a fungus, produces chemical penicillin. It inhibits the growth of bacteria named Staphylococci in the body

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

Solution:

Several microbes produce antibiotics,that kills other microbes which cause diseases. These medicines, antibiotics are typically acquired from fungi and bacteria. Two species of fungus that are used in the production of antibiotics are:

(i) Penicillin, fungal source is *Penicillium notatum*

(ii) Cephalosporin, fungal source is *Cephalosporium acremonium*

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

Solution:

The term sewage refers to the municipal waste material which is carried away in drains and sewers. Sewage includes both solid and liquid wastes that is rich in microbes and organic matter.

Most of these microbes are pathogenic, i.e., they are capable of causing diseases such as water-borne diseases. This sewage water is one of the major causes to contaminate drinking water. Therefore, it is vital to treat sewage water, by collecting and disposing it.

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

Solution:

The key differences are as follows:

Primary sewage treatment	**Secondary sewage treatment**
It is the mechanical or physical removal of small and large substances from sewage	It includes the removal of organic matter by microbes
The process deployed is through sedimentation and filtration	The process used is Biological digestion of wastes
Less complicated and relatively low-priced method of treatment	It is a complicated process and is expensive.

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

Solution:

Yes, microbes can certainly be a source of energy. Some bacteria such as the Methane bacterium can be used to generate biogas or gobar gas. In a biogas plant, under anaerobic conditions, biogas can be generated. The biogas plant consists of a concrete tank, with a depth of nearly 10-15 feet, comprising of adequate outlets and inlets. The gathered dung is mixed with water for the formation of slurry and flung into the tank. The tank consists of a digester, which is filled with plenty of anaerobic methane-producing bacteria.

This produces biogas from the slurry. Biogas can be extracted through a pipe which can be used as a source of energy. The slurry that is used, is removed from the outlet and used as a fertilizer.

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

Solution:

Organic farming is carried out without the use of any pesticides and chemical fertilizers. Microbes play a major role in organic farming. Bio-fertilizers involves picking advantageous microbes to help improve plant growth, by supplying nutrients. Bio-fertilizers are living entities that are known to increase soil fertility. These are introduced into roots, seeds and soil in order to make nutrients available, thus enriching the soil with organic nutrients. Many species of cyanobacteria and bacteria have the potential to fix the free atmospheric nitrogen.

A symbiotic bacteria, Rhizobium, is found in the root nodules of leguminous plants. Some free living nitrogen-fixing bacteria are Azotobacter and Azospirillium, while Nostoc, Oscillitoria, Anabena are examples of nitrogen-fixing cyanobacteria. These bio fertilizers are eco-friendly and cost effective.

On the other hand, microbes can also serve as bio-pesticides to check insect pests in plants. The Bacillus thuringiensis, a bio-pesticide, produces a toxin which kills the insect pests.

Withered bacterial spores are mixed with water and sprinkled in fields. These spores enter the gut of the larvae to release toxins, when larvae of various insects feed on the crops. Likewise, a free living fungi, Trichoderma, are found in the roots of higher plants, safeguarding them from pathogens. Another bio-pesticide, Baculovirus, is used as a biological control agent against other arthropods and insects.

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?

Solution:

BOD or the biochemical oxygen demand refers to the amount of oxygen which would be consumed if all the organic matter in one liter of water were to be oxidized by bacteria. This BOD test measures the rate of uptake of oxygen by microbes in a sample of water, hence BOD is said to be a measure of the organic matter found in water. Therefore, greater the BOD of waste water, the greater is the polluting potential.

Sample A with BOD 20mg/L can be assigned as the secondary effluent discharged from a sewage treatment plant.

Sample B with BOD 8mg/L can be assigned as river water

Sample C with BOD 400mg/L can be assigned as untreated sewage water.

This assignment is on the basis that the highest BOD value is the sample carrying the most polluted water.

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

Solution:

Cyclosporin A, an immunosuppressive drug is obtained from the fungus *Trichoderma polysporum*. Statins, a blood cholesterol lowering agent, is obtained from yeast *Monascus purpureus*.

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

(a) Single cell protein (SCP)

(b) Soil

Solution:

The role of microbes in the following are as follows:

(a) Single cell protein (SCP)

(i) It refers to the harmless microbial cells that can be substituted for good proteins.

(ii) Some forms of microbial cells can be consumed as food enriched in minerals, proteins, fats, vitamins and carbohydrates like how mushrooms are consumed and yeast is eaten by athletes as a source of protein.

(iii) Methylophilus methylotrophus, Spirulina are cultivated on large scale on materials comprising starch-like waste water from potato processing plants, molasses, straw, animal manure and sewage

(b) Soil

(i) The role of microbes is crucial in preserving the fertility of soil

(ii) It helps in forming nutrient-rich humus by the phenomena of decomposition

(iii) Several bacteria and cyanobacteria species have the potential to fix atmospheric nitrogen to a form that can be used by plants

(iv) A symbiotic bacteria, Rhizobium, is found in the root nodules of leguminous plants

(v) Some free living nitrogen-fixing bacteria, Azotobacter and Azospirillum, and some nitrogen-fixing cyanobacteria – Nostoc, Oscillitoria, and Anabaena are found here.

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.

Solution:

The following are arranged in decreasing order of importance, the first being most important for welfare of human society.

Penicillin > Biogas > Curd > Citric acid

Reason:

(i) Penicillin is an antibiotic that kills pathogens which causes harmful diseases and infections hence saving lives. Therefore, it is the most important

(ii) Biogas is the next in line as it serves as a non-polluting clean fuel which is generated as a byproduct of sewage treatment. It can be used to cook food, and as a source of lighting homes in remote areas

(iii) Next is curd. It has a high nutritional value supplying vitamin B_{12}. It helps maintain the health of the gut, and replaces harmful bacteria of the stomach with the beneficial ones.

(iv) The last in order is citric acid. It is used as a food preservative.

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

Solution:

Bio-fertilizers involve picking advantageous microbes that help in improving plant growth, by supplying nutrients. Bio-fertilizers are living entities that are known to increase soil fertility. These are introduced into roots, seeds and soil in order to make nutrients available, thus enriching the soil with organic nutrients. Many species of cyanobacteria and bacteria have the potential to fix the free atmospheric nitrogen. A symbiotic bacteria, Rhizobium, is found in the root nodules of leguminous plants. Some free living nitrogen-fixing bacteria are Azotobacter and Azospirillum, while Nostoc, Oscillitoria, Anabaena are examples of nitrogen-fixing cyanobacteria. These bio fertilizers are eco-friendly and cost effective.