

Microbes in Human Welfare

Topic 1: Microbes in Household Products, Industrial Products and in Sewage Treatment

Previous Years'

Examination Questions

1 Mark Questions

- Write the scientific name of the microbe used for fermenting malted cereals and fruit juices. [Delhi 2011]
- Mention the information that the health workers derive by measuring BOD of a water body. [All India 2010]
- Why is sewage water treated until the BOD is reduced? Give a reason. [Delhi 2010C]
- Name the group of organisms and the substrate that act on to produce biogas. [Delhi 2009]
- Milk starts to coagulate when Lactic Acid Bacteria (LAB) is added to warm milk as a starter. Mention any other two benefits LAB provides. [All India 2009]
- BOD of two samples of water A and B were 120 mg/L and 400 ms/L respectively. Which sample is more polluted? [Foreign 2009]
- Given below are a few impurities in urban wastewater. Select two colloidal impurities. [All India 2009C]

2 Marks Questions

- Name the source of streptokinase. How does this bioreactor molecule function in our body. [Delhi 2012]
- Mention the importance of lactic acid bacteria to humans other than setting milk into curd. [Delhi 2012]
- Name the source of cyclosporin-A. How does this bioactive molecule function in our body? [All India 2012]

- Name the enzyme produced by *Streptococcus* bacterium. Explain its importance in medical sciences. [All India 2011]
- Why are some molecules called 'bioactive molecules'? Give two examples of such molecules. [All India 2011]
- Give the scientific name of the microbes from which cyclosporin-A and statin are obtained. Write one medical use of each one of these drugs. [Foreign 2011]
- How does addition of a small amount of curd to fresh milk help formation of curd? Mention a nutritional quality that gets added to the curd. [Delhi 2010]
- During the secondary treatment of the primary effluent. How does the significant decrease in BOD occur? [Delhi 2009]
- Explain the change fresh milk undergoes when a small amount of curd as starter is added to it and kept at suitable temperature. [Delhi 2009C]
- Name the blank spaces a, b, c and d in the table given below.

Type of Microbe	Name	Commercial Product
Fungus	'd'	Penicillin
Bacterium	<i>Acetobacter acetic</i>	'b'
'c'	<i>Aspergillus niger</i>	Citric acid
Yeast	'd'	Ethanol

[Delhi 2008]

18. Name the blank spaces *a*, *b*, *c* and *d* given in following table.

Type of Microbe	Name	Commercial Product
Bacterium	'd'	Lactic acid
Fungus	'b'	Cyclosporin-A
'c'	<i>Monascus purpureus</i>	Statin
Fungus	<i>Penicillium notatum</i>	'd'

[All India 2008]

19. Name the blank spaces *a*, *b*, *c* and *d* given in the following table.

Type of Microbe	Scientific Name	Commercial Product
Bacterium	'd'	Clot buster enzyme
'b'	<i>Aspergillus niger</i>	Citric acid
Fungus	<i>Trichoderma polysporum</i>	'c'
Bacterium	'd'	Butyric acid

[All India 2008]

20. Name the blank spaces *a*, *b*, *c* and *d* from the table given below.

Type of Microbe	Scientific Name	Product	Medical Application
Fungus	'd'	Cyclosporin	'b'
'c'	<i>Monascus purpureus</i>	Statin	'd'

[All India 2008]

21. State the use of following enzymes/acids produced by the microbes
- Lipase
 - Lactic acid
 - Streptokinase
 - Pectinase

[Foreign 2008]

22. Name the organism that causes large holes in 'Swiss cheese'. How are these holes caused?

[Delhi 2008C]

3 Marks Questions

23. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water. [Delhi 20112]
24. Explain the different steps involved in average treatment before it can be released into natural water bodies. [Foreign 2011]
25. Identify *a*, *b*, *c*, *d*, *e* and *f* in the table given below :

Organism	Bioactive Molecule	Use
<i>Monascus purpureus</i> (yeast)	'a'	'b'
'c'	'd'	antibiotic
'e'	cyclosporin-A	'f'

[Delhi 2010]

26. Mention the product and its use produced by each of the microbes listed below :
- Streptococcus*
 - Lactobacillus*
 - Saccharomyces cerevisiae*

[All India 2010]

27. Describe how biogas is obtained from the activated sludge. [Foreign 2010]
28. (a) How does activated sludge get produced during sewage treatment?
(b) Explain how this sludge is used in biogas production. [All India 2009]
29. How are flocs produced in the secondary treatment plant of the average? Explain their role? [All India 2009C]
30. (a) Expand BOD.
(b) At a particular segment of a river near a sugar factory, the BOD is much higher than the normal level. What is it indicative of? What will happen to the living organism in this part of the river?
(c) Under what conditions will the BOD be lowered in the river? How will it affect the aquatic life? [Foreign 2008]

31. Describe the functions of anaerobic sludge in a sewage treatment plant.

[All India 2006C]

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Explanations

1. *Saccharomyces cerevisiae* or brewer's yeast.
2. Higher the BOD of water body, more is its polluting potential and vice versa.
3. BOD indicates the presence of organic matter in the water. The greater the BOD of sewage water, more is its polluting potential. So, the sewage water is treated, till its BOD is reduced.
4. Methanogens, substrate cellulose materials/cow dung.
5. Two benefits of LAB :
 - (i) They improve the nutrient quality of curd by increasing the vitamin-B₁₂ content.
 - (ii) LAB also check the disease causing microbes in the stomach.
6. Sample B (BOD 400 mg/L) is more polluted
7. Fecal matter and silt.
8. Streptokinase enzyme is produced by the bacterium *Streptococcus*. It is modified by genetic engineering and is used as a clot buster for removing clots from the blood vessels of patients who have suffered from myocardial infraction.
9. Lactic Acid Bacteria (LAB) are used to produce acid called lactic acid is an important industrial product. It is also used in bakery products, beverages, meat products, confectionery, dairy products, etc.
10. Refer to Ans. 8.
11. It produces streptokinase enzyme. It is used as a clot buster for removing the blood clots in blood vessels of patients who have suffered from myocardial infraction.
12. Bioactive molecules are produced from living organisms and are useful active in other living organisms. Examples are streptokinase, cyclosporin-A, statins.
13. Cyclosporin-A is obtained from the fungus *Trichoderma polysporum*. It is used as an immuno suppressive agent in organ transplant patients.

Statin is obtained from the yeast *Monascus purpureus*. It is used as blood cholesterol lowering agent.
14. When a small amount of curd as starter is added to fresh milk, millions of Lactic Acid Bacteria (LAB) present in the starter grow in milk and convert it to curd. During this process, acids are produced by LAB that coagulate and partially digest the milk proteins. LAB increases vitamin-B₁₂ content along with other vitamins in the curd.
15. During the secondary treatment, the aeration allows vigorous growth of useful aerobic microbes into flocs (masses of bacterial cells in association with fungal filaments forming mesh-like structures). As they grow, the microbes consume a major part of the organic matter in the effluent, So BOD is significantly reduced.
16. Curd is formed by adding a small amount of curd to milk, which acts as a starter. LAB present in starter multiply at suitable temperature and convert milk into curd. Acids released by LAB during growth, coagulate and partially digest milk protein, casein.
17. a- *Penicillium notatum*
b- Acetic acid
c- Fungus
d- *Saccharomyces cerevisiae*
18. a- *Lactobacillus*
b- *Trichoderma polysporum*
c- Fungus
d- Penicillin
19. a- *Streptococcus*
b- Fungus
c- Cyclosporin-A
d- *Clostridium butylicum*
20. a- *Trichoderma polysporum*
b- Immuno-suppressive agent
c- Fungus
d- Blood cholesterol lowering agent

21. (a) **Lipase** It is used in detergent preparation and in removal of oil stains from clothes.
 (b) Lactic acid produced by *Lactobacillus* converts milk into curd.
 (c) Streptokinase is used as a 'clot buster' for removing blood clots from blood vessels of patients of myocardial infraction.
 (d) Pectinase is used to clear (bottled) fruit juices.

22. A bacterium *Propionibacterium sharmanii* causes large holes in Swiss cheese. The formation of large holes occur due to the production of large amount of CO_2 .

23. Bacteria and fungi are two categories of naturally occurring microbes present in sewage. The bacteria along with the fungal mycelia form flocs. These flocs are utilized during the secondary treatment of sewage. The primary effluent after separation of the grit and debris is taken to the secondary treatment. Here, the effluent is passed to an aeration tank, where it is constantly agitated and air is pumped into it. This leads to vigorous growth of bacteria and floc formation. The bacteria in these flocs consume organic matter, thus decreasing the BOD of the sewage.

24. Sewage treatment includes following steps :

- (i) Primary treatment (ii) Secondary treatment
 (i) **Primary Treatment**

- A physical process of removal of small and large particles through filtration and sedimentation.
- The first step is to remove floating objects (like polythene bags) by letting the sewage to pass through wire mesh screen of sequential smaller pore sizes.
- Sewage is then passed into the grit chamber where grit is sedimented.
- Sewage is then allowed to pass into settling tank, where the suspended materials settle down to form primary sludge.
- Effluent is then taken for the secondary treatment.

(ii) **Secondary Treatment**

- It is a biological process in which heterotrophic bacteria naturally occur in sewage.
- Effluent obtained from the primary treatment is passed into large the aeration tank. Here, it is constantly agitated and air is pumped into it.
- Due to this, rapid growth of bacteria occur into flocs. These consume organic matter of the sewage and reduced the BOD.
- Effluent is passed into settling tank, where the flocs are allowed to sediment forming the activated sludge.
- A small amount of activated sludge is pumped back into aeration tank as inoculum.
- The remaining major part of the activated sludge is pumped into anaerobic sludge digesters, where the anaerobic bacteria digest the organic matter and produced methane, hydrogen sulphide and carbon dioxide.
- Effluent is then allowed to pass into the water body.

25. a – Statins, b – They are used as blood cholesterol lowering agent. c – *Penicillium notatum*. d – Penicillin, e – *Trichoderma polysporum*, f – Used as an immuno suppressive agent in organ transplant patients.

26. (a) *Streptococcus* – Product is streptokinase. It is used as clot-buster for removing the clots from the blood vessels of patients suffered from myocardial infraction.
 (b) *Lactobacillus* – Product is lactic acid. It is used to convert milk into curd and improves nutrient quality of curd by enriching it with vitamin- B_{12} .
 (c) *Saccharomyces cerevisiae* – Product is ethanol and also used for bread making.

27. Biogas formation from activated sludge :

- (i) A small part of activated sludge is pumped into the aeration tank to serve as inoculum.

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- (ii) In aeration tank, anaerobic bacteria digest the bacteria and fungi of the sludge.
 - (iii) During this digestion, the bacteria produce a mixture of gases like carbon dioxide, methane and hydrogen sulphide which form the biogas.
- 28.** (a) Once the BOD of sewage water gets reduced significantly, the effluent is passed into a settling tank, where the bacterial flocs undergo sedimentation and the sediment is called activated sludge.
- (b) Refer to Ans. 27.
- 29.** The effluent obtained from primary treatment is passed into large aeration tanks, where it is constantly agitated and air is pumped into it. This allows rapid growth of aerobic microbes into 'flocs'.
- Flocs consume organic matter of the sewage and reduce the Biochemical Oxygen Demand (BOD). When BOD of sewage is reduced, the effluent is passed into a settling tank, where the flocs are allowed to form the activated sludge.
- 30.** (a) Biochemical oxygen demand.
- (b) The higher BOD indicates lot of organic matter. Microbes involved in the biodegradation of organic matter in the water body consume a lot of oxygen. Due to this, a sharp decline occurs in the dissolved oxygen. This leads to killing of fish and other microorganisms.
- (c) BOD of water body decreases when the amount of organic matter decreases and microbes do not need oxygen for its decomposition.
- Due to decreased BOD, aquatic life will start flourishing.
- 31.** Function of activated sludge in sewage treatment plant :
- (i) A small part of activated sludge is pumped back into aeration tank to serve as aeration tank.
 - (ii) The remaining part of activated sludge is pumped back into large tanks called anaerobic sludge digesters. All kinds of bacteria grow anaerobically in it, which digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases, such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as a source of energy.

Topic 2: Microbes in Production of Biogas, as Biocontrol Agents and Biofertilizers

Previous Years' Examination Questions

1 Mark Questions

1. Mention the rôle of cyanobacteria as a biofertilizer. [All India 2012]
2. Which of the following is a free-living bacteria that can fix nitrogen in the soil? *Spirulina*, *Azospirillum* and *Sonalika* [Delhi 2009]
3. Which of the following is a cyanobacterium that can fix atmospheric nitrogen? *Azospirillum*, *Oscillatoria* and *Spirulina* [All India 2009]
4. How is the presence of cyanobacteria in the paddy fields beneficial in rice crop? [Delhi 2009C]

2 Marks Questions

5. How do mycorrhizae act as biofertilizers? Explain. Name a genus of fungi that forms a mycorrhizal association with plants. [Delhi 2012]
6. How do methanogens help in producing biogas? [Delhi 2012]
7. Why do the toxic insecticidal proteins secreted by *Bacillus thuringiensis* kill the insect and not the bacteria itself? [Foreign 2010]

8. How is *Bt* cotton made to attain resistance against bollworm? [Delhi 2010]

3 Marks Questions

9. Name the genes responsible for making *Bt* cotton plants resistant to bollworm attack. How do such plants attain resistance against bollworm attacks? Explain [Delhi 2012]
10. Name the genus to which baculoviruses belong. Describe their role in the integrated pest management programme. [Delhi 2011]
11. Name a genus to which baculoviruses belong. Describe their role in the integrated pest management [Foreign 2011]
12. An organic farmer relies on natural predation for controlling pests and diseases. Justify giving reasons why this is considered to be a holistic approach. [Foreign 2010]
13. (a) Baculoviruses are excellent candidates for integrated pest management in an ecologically sensitive area. Explain giving reasons.
(b) What is organic farming? Why is it suggested to switch over to organic farming? [Foreign 2008]

Explanations

1. Cyanobacteria fix atmospheric nitrogen and increase the organic matter of the soil through their photosynthetic activity.
2. *Azospirillum*.
3. *Oscillatoria*.
4. In paddy fields, cyanobacteria, such as blue-green algae fix nitrogen to enrich the nitrogen content of soil. Therefore, the entire need of nitrogen of rice crop can be supplied by blue-green algae.
5. Fungi form symbiotic associations with plants. This is called mycorrhiza. The fungal symbiont

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in these associations absorbs phosphorus from soil and passes it to the plant. The fungi belonging to the genus *Glomus* form mycorrhizal associations with plants.

6. Methanogens are a group of bacteria that produce biogas. These bacteria are found in cattle dung, anaerobic sludge during sewage treatment, etc., and grow anaerobically on cellulosic material and produce large amount of methane alongwith CO_2 and H_2 .

7. *Bt* toxin does not kill the *Bacillus thuringiensis* because it exists as an inactive protoxin. When *Bt* toxin is ingested by an insect, it is converted into its active form when exposed to the alkaline pH in the gut. The activated toxin binds to the surface of the epithelial cells of the midgut and creates pores. Water enters the cells and causes its lysis.

8. Dried spores of *Bt* are used to control butterfly caterpillars.

(i) Insect larvae, after eating these are killed by the toxin released in their gut.

(ii) *B. thuringiensis* toxin genes have been introduced into plants to provide resistance to pests.

9. The *Bt* toxin is encoded by the *cry* gene. The *cry IIAC* and *cry IIAb* control cotton bollworms, while the *cry IAb* controls corn borer. *Bt* gene produces *Bt* toxin. This toxin provides resistance to plants against lepidopteron, coleopteron and dipterans pests.

Specific *Bt* toxin genes are isolated from *B. thuringiensis* and incorporated into the crops. Since, these toxins are insect specific, they do not harm the crops or humans.

10. Baculoviruses belong to the genus *Nucleopolyhedrovirus*.

(i) They attack insects and other arthropods.

(ii) They are species-specific, narrow spectrum insecticides, which have no negative impact on plants, birds, mammals, fish and even non-target insects.

(iii) This is desirable because beneficial insects are conserved to aid in Integrated Pest Management (IPM) programmes.

11. Refer to Ans. 10.

12. Organic farming is a holistic approach that seeks to develop an understanding of the webs of interaction among the myriads of organisms that form the flora and fauna of the field.

(i) An organic farmer works to create a system, where the insects are not eradicated, but kept at manageable levels by a complex system of checks and balance within a living and vibrant ecosystem.

(ii) Organic farmer states that the eradication of pests, is not only possible but also undesirable, because many beneficial predatory and parasitic insects cannot survive without them.

(iii) This use of biocontrol methods reduces the use of chemical pesticides and thereby pollution.

13. (a) Reasons.

(i) Baculoviruses are biological control agents which are excellent candidates for species-specific, narrow-spectrum insecticidal applications.

(ii) They have no negative impacts on plants, mammals or even on non-target insects.

(b) The use of biofertilizers and biopesticides to improve the crop yields as there are problems associated with over use of chemical fertilizers is called organic farming. It is advised to switch over organic farming due to following :

(i) Use of excess chemical fertilizers make the soil unsuitable for cultivation.

(ii) Natural resources get depleted due to manufacturing of chemical fertilizers.