Microbes in Human Welfare

CHAPTER 10

EXAM DRILL

ANSWERS

1. **(b) :** The most common fungal partner of mycorrhiza is *Glomus.*

2. **(b) :** Rifampicin is a bactericidal broad spectrum antibiotic. Griseofulvin is obtained from *Penicillium griseofulvium* and has antifungal activity.

3. **(d) :** *Lactobacillus* are rod shaped non-spore forming bacteria. They are lactic acid bacteria that convert sugars to lactic acid. They are used in the production of dairy products.

OR

(a)

4. **(d)**

5. **(b) :** Cyclosporin A is a drug which is widely used in post allogenic organ transplant to reduce the activity of patient's immune system, and therefore the risk of organ rejection. It is obtained from a fungus, *Trichoderma polysporum*.

6. Bt-cotton is a genetically modified crop developed using soil bacterium *Bacillus thuringiensis* that has been modified to resist attack by insect pests.

7. Nucleopolyhedroviruses are baculoviruses. They are biocontrol agents that attack insects and other arthropods. They are species-specific, narrow spectrum insecticides and do not harm plants, mammals, bird, fish and other non-target insects.

8. Two microbes that are used in biotechnology are:
(i) *Escherichia coli*
(ii) *Bacillus thuringiensis.*

9. Chemical pesticides are synthetic broad spectrum pesticides which affect several non target organisms and also pollute air, water and soil.

10. Methanogens or methanobacterium are found in the rumen of cattle and anaerobic sludge of sewage treatment.

11. **(b)**

12. **(a) :** Activated sludge of the previous operation is inoculated to hasten decomposition. A large number of aerobic heterotrophic microbes grow in the aeration tank.

13. **(b) :** The resistance of pathogen to existing antibiotics is generally produced due to extra chromosomal genes present in plasmid. They can pass from one bacterium to another due to transformation and transduction.

14. **(a)**

15. **(i) (a)**
(ii) (a)
(iii) (b) : Rotenone and thurioside are bioinsecticides just like pyrethrin.
(iv) (b) : Bioinsecticides are used to control harmful insects while bioherbicides are used for inhibiting growth of plants in unwanted places.
(v) (d)

16. **(i) (c)** : B is fermentative microbes
D is methane gas
E is carbon dioxide gas (CO_2).
(ii) (c) : In the given flow chart, A is soluble compounds (monomers) formed by anaerobic digestion of complex organic compounds.
(iii) D is showing methane and its percentage in biogas is 50-70%, whereas percentage of E, *i.e.*, CO_2 is 30–40%.
(iv) C is representing methanogenic bacteria that work on organic acids to produce biogas, *e.g.*, *Methanobacterium*.
(v) (c) : F shown in the flow chart is representing decomposer microbes (*e.g.*, *Clostridium*) that performs solubilisation (in the first stage) during the formation of biogas. In this process, anaerobic decomposer microbes bring about enzymatic breakdown of complex organic compounds into simpler compounds.

17. Batch culture is one of the methods of fermentation. In the batch culture, conditions are set up and not changed from outside once the fermentation starts. It is a closed system.

18. Toddy is a traditional drink of some parts of South India, which is made by fermentation of sap of palms. Toddy left for few hours undergoes fermentation with the help of naturally occurring yeast to form alcoholic beverage.

19. **(a) :** Whisky, rum, brandy, vodka
(b) Beer and wine
(c) *Saccharomyeces cereviae* and *S.pyriformis*

20. The two functions of LAB that are useful to humans are :
(i) It increases nutritional quality of curd by increasing vitamin B_{12} content.
(ii) It checks the growth of disease causing organisms in the gut.

21. Baculoviruses are pathogens that attack insects and other arthropods. They belong to the genus *Nucleopolyhedrovirus* and family Baculoviridae. They are usually extremely small and composed primarily of ds DNA.

These are preferred as biocontrol agents as they are species specific and have no negative effect on crop plants, animals, birds and other non-target insects.

OR

Once the BOD of sewage water is reduced significantly, the effluent is passed into a settling tank where aerobic bacterial flocs undergo sedimentation. The sediment of settling tank is called activated sludge.

22. Cyclosporin A is an eleven membered cyclic oligopeptide obtained from the fungus *Trichoderma polysporum*. It has antifugal, anti-inflammatory and immunosuppressive properties. It inhibits activation of T cells, therefore, prevent rejection reaction in organ transplant.

23. Packaged fruit juices are more clearer than those made at home as they are treated with amylase and pectinase enzymes.

24. Differences between ectomycorrhiza and endomycorrhiza are as follows :

Ectomycorrhiza	Endomycorrhiza
In ectomycorrhiza the fungal mycelium completely encloses the feeder rootlets forming sheath or mantle. The mantle of fungal hyphae increases the absorptive surface of roots and hence serve better intake of nutrients such as nitrogen, phosphorus, calcium and potassium from the surrounding soil. *E.g. Pinus, Quercus, Betula, Alnus, Salix, Populus*, etc.	In endomycorrhiza fungus does not form an external sheath of mantle. The fungus mostly lives in the intercellular spaces as well as intracellularly in the cortical cells of roots. Only a small portion of fungus lives outside the root. Such type of mycorrhizal association occurs in the roots of grasses, cereals, legumes, rubber, tea, tobacco, soybean, citrus and in many orchids (*Neottia, Vanilla, Galeola, Epipogon*, etc.). One of the important type of endomycorrhizae is vesicular-arbuscular mycorrhizae (VAM)

25. Oxidation tanks/ ponds, also called lagoons or stabilization ponds are large shallow ponds designed to treat waste-water through the interaction of sunlight, bacteria and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria. Mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

26. **(a)** Antibiotics - Antibiotics are medicines produced by certain microorganisms to kill other disease causing microorganisms. These medicines are commonly obtained from bacteria and fungi, *e.g.*, penicillin, streptomycin.

(b) Biogas - Biogas is a mixture of gases mainly methane (CH_4) and carbon dioxide produced by the microbial activity. Biogas is used for cooking and lighting. It is a methane rich fuel gas produced by anaerobic breakdown of biomass with the help of methanogenic bacteria.

(c) Sewage - The wastewater that flows down drains and though pipes from toilets and sinks is called sewage.

27. Advantages of biofertilisers:

(i) They increase the yield of plants by 15-35%.
(ii) Biofertilisers are effective even under semi-arid condition.
(iii) Farmers can prepare the inoculum themselves.
(iv) They improve soil texture and are non-polluting.
(v) Biofertilisers do not allow pathogens to flourish.
(vi) They produce vitamins and growth promoting biochemicals.

OR

The natural methods of pest and pathogen control involving use of viruses, bacteria and other insects which are their natural predators and pests are called biocontrol agents. For example, Lady bird beetles feed on aphids while dragonflies prey upon mosquitoes. Free living fungus, *Trichoderma* exerts biocontrol over several plant pathogens. An example of microbial biocontrol agents that can be introduced in order to control butterfly caterpillars is the bacterium *Bacillus thuringiensis*.

Biofertilisers are the microorganisms such as bacteria, cyanobacteria, fungi, etc, which bring about soil nutrients enrichment, maximise the ecological benefits and minimise the environmental hazards. Bacteria and cyanobacteria have the property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from organic matter for the plant with which they are associated. Insoluble forms of soil phosphorus are converted into soluble forms by certain micro-organisms. This makes the phosphorus available to the plants. Phosphate is also solubilised by some bacteria and by some fungi that form association with plant roots.

28. Antibiotics are chemical substances produced by some microbes which in small concentration can kill or retard the growth of harmful microbes without adversely affecting the host. Broad spectrum antibiotic can kill or destroy a number of pathogens that belong to different groups with different structures and wall compositions. Specific antibiotics are effective only against one type of pathogen. Good antibiotics should be harmless to host with no side effects. They should be harmless to beneficial microorganism of alimentary canal and should be effective against all strains of pathogen. They should also be quick in action.

29. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum, the remaining

major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria digest the bacteria and fungi in the sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas. The left out sludge is used as manure.

30. Differences between primary sludge and activated sludge are as follows:

S.No.	Primary sludge	Activated sludge
1.	It is sludge formed during primary sewage treatment.	It is sludge formed during secondary sewage treatment.
2.	It does not possess flocs of decomposer microbes.	It possesses flocs of decomposer microbes.
3.	It does not require aeration.	Formation of activated sludge requires aeration.
4.	Little decomposition occurs during the formation of primary sludge.	A lot of decomposition occurs during the formation of activated sludge.

OR

Acetic acid is prepared from fermented alcohols with the help of acetic acid bacteria. Alcoholic fermentation of sugar is anaerobic process but the conversion of alcohol to acetic acid is aerobic process.

$$C_6H_{12}O_6 \xrightarrow[\text{complex}]{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

Ethyl alcohol

$$C_2H_5OH + O_2 \xrightarrow[\textit{aceti}]{\textit{Acetobacter}} CH_3COOH + H_2O$$

Acetic acid

31. Microbes especially yeasts, have been used from time immemorial for the production of beverages like-wine, beer, whisky, brandy or rum. Yeast *Saccharomyces cerevisiae* commonly called brewer's yeast is used for fermenting malted cereals and fruit juices to produce ethanol. Depending on the type of the raw material used for fermentation and the type of processing (with or without distillation), different types of alcoholic drinks are obtained. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of the fermented broth. Yeast species used in alcoholic fermentation and *Saccharomyces cerevisiae* (Brewer's Yeast). *S. ellipsoidus* (Wine Yeast), *S. sake* (Sake Yeast) and *S.pyriformis* (Ginger Beer/Ale Yeast). The nutrient medium is barley malt for beer, fermented rye malt for gin, fermented rice for sake, cashew-apple for fenny, potato for vodka, fermented cereales for whisky, fermented molasses for rum and fermented juices for wines and brandy. Yeast does not possess sufficient diastase/amylase. Therefore, either 1% malt or *Rhizopus* is used when the nutrient medium consists of complex carbohydrates as present in cereals and potato. Hydrolysis of starch is carried out in separate tank at high temperature (55°C) for 30 minutes. The crushed food mixed with hot water for obtaining malt is called mash. The sweetened nutrient medium prior to alcoholic fermentation is called wort.

Bioreactor/fermentation tank is sterilised with the help of steam under pressure. The liquid nutrient medium or wort is added into the tank and sterilised similarly. It is then allowed to cool.

When the liquid nutrient medium is cooled down to appropriate temperature, it is inoculated with appropriate strain of yeast through support growth system (on the surface) or suspended growth system (inside the wort). Fermentation occurs in three ways (i) Batch process, (ii) Continuous process and (iii) Fed Batch Process.

OR

Sewage treatment prevents water pollution and water born diseases so it is essential in order to protect the natural water bodies from sewage pollution.

It involves physical removal or particles from the sewage through filtration and sedimentation. It is the process of removal of small and large, floating and suspended solids from sewage. It includes the physical processes of screening, comminution, grit removal and sedimentation.

The shredded material is removed later by sedimentation or floatation processes. Grit chambers are long narrow tanks that are designed to slow down the flow so that solids such as sand, coffee, eggshells, etc. will settle down. Grit causes excessive wear and tear on pumps and other equipments. Suspended solids that pass through screens and grit chambers are removed from the sewage in sedimentation tanks. These tanks, also called primary classifiers, provide about two hours of detention time for gravity setting to take place. The settled solids known as raw or primary sludge are moved along the tank bottom by mechanical scrapers. The supernatant is called effluent.

32. Important biofertilisers used in agriculture are :

N_2 fixing bacteria (free living and symbiotic), N_2 fixing cyanobacteria (free living and symbiotic) and mycorrhiza.

Symbiotic nitrogen fixing cyanobacteria : N_2 fixing cyanobacteria form symbiotic association with several plants *e.g.*, cycad roots, lichens, liverworts, *Azolla* fern. Out of these, *Azolla-Anabaena* association is of great importance to agriculture. *Azolla pinnata* is a small free floating fresh water fern which multiplies rapidly doubling every 5-7 days. The fern can coexist with rice plants because it does not interfere with their growth. *Anabaena azollae* resides in the leaf cavities of this fern and fixes nitrogen. A part of the fixed nitrogen is excreted in the cavities and becomes available to the fern. The decaying fern plants release the same for utilisation of the rice plants.

OR

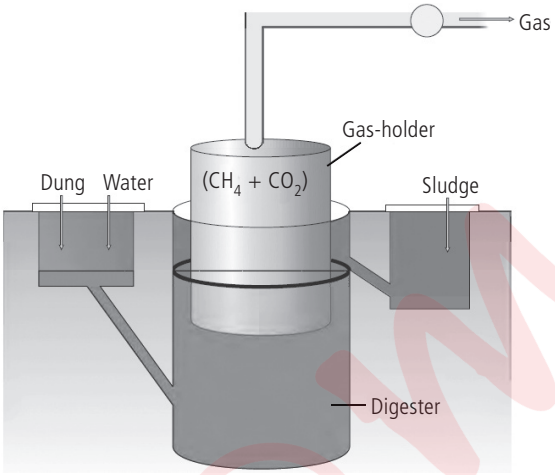
(i) Symbiotic N_2 fixing bacteria – In this system, fixation of molecular nitrogen occurs from a mutualistic association between leguminous or non-leguminous plants and bacterium. One of the most interesting symbiotic relationship

is seen between leguminous plants and genus *Rhizobium.* Infection of bacteria into roots of legumes form root nodules. The *Rhizobium* sp. is always specific to the species of legume. *Frankia*, a mycelial bacteria is associated symbiotically with the root nodules of several non legume plants like *Casuarina, Alnus.*

(ii) Symbiotic nitrogen fixing cyanobacteria : Nitrogen fixing cyanobacteria, the blue-green algae form symbiotic association with several plants, *e.g.*, cycad roots, lichens, liverworts, *Azolla* (fern). *Azolla* - *Anabaena* association is of great importance to agriculture. *Azolla pinnata* is a small free floating fresh water fish which multiplies rapidly, doubling every 5-7 days. The fern can coexist with rice plants because it does not interfere with their growth.

Anabaena azollae resides in the leaf cavities and becomes available to fern. The decaying fern plants release some for utilisation of the rice plants. When field is dried at the time of harvesting the fern functions as the green manure, decomposing and enriching the field for the next crop.

33. A typical biogas plant is as follows :



Advantages of biogas are as follows :

(i) Biogas is storable form of energy which can be used more efficiently and economically.

(ii) Biogas has wide applications than the direct burning of organic wastes.

(iii) It provides both energy and manure.

(iv) It minimises the chances of spread of pathogen. Sanitation and health are therefore improved.

(v) The fertiliser value of the manure produced in biogas plants is similar to that of manure formed directly from organic wastes.

(vi) Spread of plant pathogens with the help of residue is checked.

(vii) Biogas does not add to pollution.

OR

(a) Cheese - Cheese is one of the oldest milk products prepared with the help of microbes. Curd is separated from liquid part or whey to form cheese. Depending upon water content cheese is of three types : soft, semihard and hard. There are two groups of cheese, unripened and ripened cheese. Unripened cheese is prepared by single step fermentation which involves inoculation of skimmed milk with cheese culture, *e.g.*, *Lactobacillus, Saccharomyces* etc.

(b) Yoghurt - Yoghurt is produced by curdling milk with the help of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* at about 45°C for 4 hours.

(c) Dosa and idli – Dosa and idli are fermented products of rice and black gram. The 'batter' which is used for making dosa and idli is allowed to ferment overnight for 10-12 hours. *Leuconostoc mesenteroides*, *Streptococcus faecalis* cause fermentation so that batter increases in volume and gets sour. CO_2 produced during fermentation causes puffing up of the batter.

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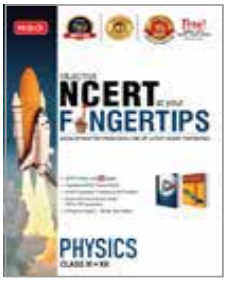

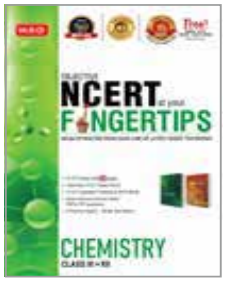

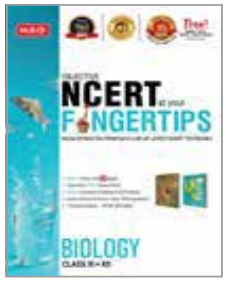

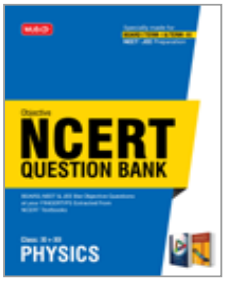

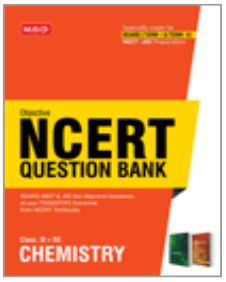

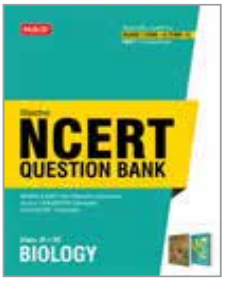

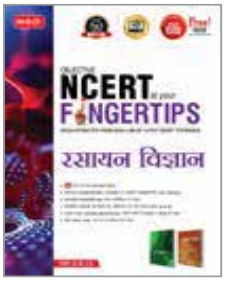

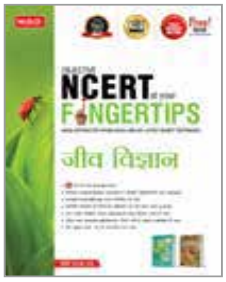

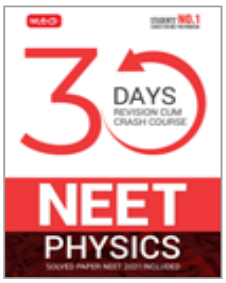

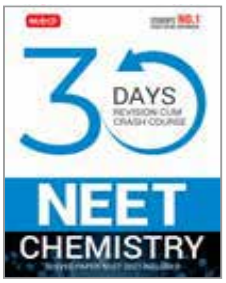

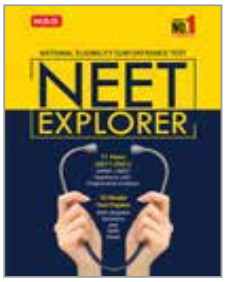

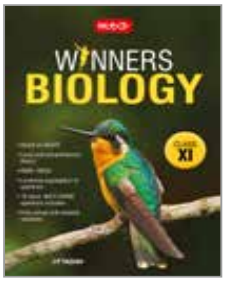

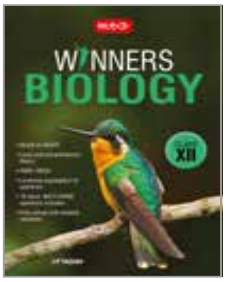

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