Microbes in Human Welfare

CHAPTER 10

NCERT FOCUS

ANSWERS

Topic 1

1. Microbes or microorganisms like bacteria, fungi and protozoans are omnipresent (*i.e.*, found everywhere) but are not visible to naked eyes because they have a size of 0.1 mm or less. The common household products that show the presence of bacteria is yoghurt. Milk is converted to yoghurt by *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.

2. There are lots of examples which prove that microbes release gases during their metabolism. Some examples are as follows :

(i) Batter, which is used for making *dosa* and *idli* is fermented by bacteria. The puffy appearance of batter is due to production of CO_2 by fermentation process.

(ii) Swiss cheese is characterised by having the characteristic flavour and large holes. The large holes are formed due to the amount of CO_2 released by a bacterium *Propionibacterium shermanii*.

3. Microorganisms such as *Lactobacillus* and others commonly called lactic acid bacteria (LAB) grow in milk. They convert lactose sugar of milk into lactic acid. Lactic acid causes coagulation of milk protein casein. Milk is changed into curd, yoghurt and cheese, etc.

(i) Curd – Indian curd is prepared by inoculating cream and skimmed milk with *Lactobacillus acidophilus* at a temperature of about 40°C or less.

(ii) Yoghurt – It is produced by curdling milk with the help of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. It has a flavour of lactic acid and acetaldehyde. It is often sweetened and flavoured with fruit.

(iii) Cheese – It consists of milk curd separated from liquid part. In preparation of raw cheese milk is curdled with the help of lactic acid bacteria.

In our stomach too, the LAB play very beneficial role in checking disease causing microbes.

4. A number of dishes can be prepared through fermentation process by using microbes. Some important traditional dishes made up of wheat, rice and Bengal gram or black gram (vernacular *urad*) are as follows :

(i) Bread – It is a fermented preparation of wheat by *Saccharomyces cerevisiae*.

(ii) *Dosa*, *upma* and *idli* – They are fermented preparation of rice and black gram (*urad*). The two are allowed to ferment for 3-12 hrs with *Leuconostoc* and *Streptococcus species* of bacteria.

5. Microbes are very useful to combat disease causing harmful bacteria. A number of antibiotics have been isolated from microorganisms. An antibiotic is a substance which in low concentration inhibits the growth and metabolic activity of pathogenic organisms without harming the host. Penicillin was the first antibiotic to be discovered by Alexander Fleming from fungus *Penicillium notatum*. Antibiotics are obtained from lichens, fungi, eubacteria and actinomycetes. Some common antibiotics and their sources are as follows :

(i) Polymyxin – *Bacillus polymyxa*
(ii) Chloramphenicol – *Streptomyces venezuelae*
(iii) Neomycin – *Streptomyces fradiae*
(iv) Tetracycline (Terramycin) – *Streptomyces rimosus*
(v) Cephalosporin – *Cephalosporium acremonium*

6. *Penicillium notatum* provides antibiotic penicillin and antibiotic fumagillin is obtained from *Aspergillus fumigatus*.

7. Cyclosporin A (an immunosuppressive drug) is obtained from fungus *Trichoderma polysporum* while statins (blood cholesterol lowering agent) are obtained from yeast *Monascus purpureus*.

Topic 2

1. Sewage is a collective term used to represent municipal waste water (both liquid and solid wastes) generated in cities and towns which is carried off in sewers. Chemically, the sewage consists of approximately 99% water and 1% solid waste including inorganic and organic matter. The microorganisms present in sewage include bacteria (coliforms, streptococci, clostridia, lactobacilli), micro-fungi, protozoa and microalgae. Proper sewage disposal is of prime importance, because disposal of untreated sewage in river and other water bodies may be harmful in the following ways :

– It results in dissemination of water borne diseases caused by microorganisms.

– It may cause depletion of dissolved oxygen (DO) in water. Reduction in oxygen availability may kill aerobic aquatic microorganisms.

– Untreated sewage produces offensive odour.

2. There are three stages of sewage treatment : primary, secondary and tertiary. Primary treatment is a physical

process involving removal of large, floating or suspended solid materials through filtration and sedimentation while secondary is a biological process involving the action of microbes. The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically. Aerobic microbes grow into flocs and BOD of effluent decreases.

3. Microbes can be used as source of energy. Biogas is a mixture of gases produced from degradable organic matter by the activity of various anaerobic microorganisms and it may be used as fuel.

The microorganisms involved in biogas production are mainly facultative and strictly anaerobic bacteria. The most important among them are methanogenic archaebacteria, represented by *Methanobacterium*. The major component of biogas is methane (about 50-68%) which is highly inflammable. The other gases are CO_2 (25-35%), hydrogen (1-5%), nitrogen (2-7%), oxygen (0-0.1%) and H_2S (traces).

Biogas is used as fuel for heating, cooking, lighting, power for irrigation and other purposes as an alternative of fire wood, kerosene, dung cakes or even electricity and LPG. It is considered as ecofriendly and pollution free source of energy.

4. BOD (Biological Oxygen Demand) refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria. BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, the more are the pollutants. BOD value of clean water is generally between 1 and 2 mg/L. As the amount of pollution increases, BOD is also increased and grossly polluted waters may have the BOD around 20 mg/L.

In the given problem BOD values of the three samples A, B and C are 20 mg/L, 8 mg/L and 400 mg/L, respectively. Here sample C has greatest BOD value hence it is most polluted. If we correctly label the three samples, then sample A should be secondary effluent discharged from a sewage treatment plant (20 mg/L), sample B should be river water (8 mg/L) and sample C should be untreated sewage water (400 mg/L).

Topic 3

1. Due to hazardous nature and anti- environment effect, the use of chemical fertilisers and chemical insecticides are very illegitimate. Development of biofertilisers and bioinsecticides have enabled us to reduce the use of chemical fertilisers and chemical insecticides. Microbes are very important biological agents as biofertilisers and biopesticides.

Microbes as biofertilisers :

(i) Free living nitrogen fixing bacteria – *Azotobacter*, *Clostridium*.

(ii) Free living nitrogen fixing cyanobacteria – *Anabaena*, *Nostoc*.

(iii) Symbiotic nitrogen fixing bacteria – *Rhizobium*

(iv) Symbiotic nitrogen fixing cyanobacteria – *Anabaena*

(v) Mycorrhiza – symbiotic association between fungi and roots of a higher plant.

Microbes as biopesticides :

Biopesticides are those biological agents that are used to control weeds, insects and pathogens. The microorganisms used as biopesticides are viruses, bacteria, protozoa, fungi and mites. Some of the biopesticides are being used at a commercial scale. Most important example is soil bacterium *Bacillus thuringiensis* (Bt). Spores of this bacterium produce the insecticidal Cry protein. This bacterium was the first biopesticide to be used on a commercial scale in the world. Through the use of genetic engineering the scientists have introduced *B. thuringiensis* toxin gene into plants. Such plants are resistant to attack by insect pests.

2. (a) Single cell protein (SCP) – Microorganisms (*e.g.*, bacteria, yeast, filamentous fungi, algae, etc.) can be cultured on a commercial scale in a fermenter, treated in various ways, dried or used as food source or as animal feed are called single cell protein. Some common microorganisms used in production of SCP are as follows:

- Bacteria (*e.g.*, *Methylophilus*, *Brevibacterium*, etc.)
- Cyanobacteria (*e.g.*, *Spirulina*)
- Yeasts (*e.g.*, *Saccharomyces cerevisiae*, *Candida utilis*, etc.)
- Filamentous fungi (*e.g.*, *Fusarium graminearum*)
- Algae (*e.g.*, *Chlorella*)

There are several advantages of SCP as food. Some of them are listed below :

- SCP is rich in high quality protein and poor in fat content.
- The SCP can be produced in laboratories all the year round. Its production is not dependent on climatic factors.
- The microorganisms, used in the production of SCP, are very fast growing and produce large amount of SCP from relatively very small area of land.

(b) Soil – Microbes are very useful to maintain and restore soil fertility. The fertility of soil depends not only on its chemical composition but also on the quantity and quality of useful microbes present in it. Moreover, if the composition of the soil is not upto the mark and poor in fertility, materials of biological origin are added into it to improve and maintain its fertility. These materials are grouped under two broad categories : manures and biofertilisers. Manures are of three types, farmyard manure, compost and green manure. Farmyard manure is the oldest manure known to mankind which is made up of dung of farm animals and plant remains, etc. which are allowed to partial decay with the help of soil microorganisms. These microorganisms decompose complex organic debris into a dark amorphous substance (humus) and degradation products are easily assimilated by plants. The

manure loosens the soil, increases its aeration and makes soil more fertile.

3. Biofertilisers are the microorganisms which bring about soil nutrient enrichment, maximise the ecological benefits and minimise the environmental hazards. The main sources of biofertilisers are bacteria, fungi and cyanobacteria. Some of the biofertilisers and their importance in maintaining soil fertility are as follows :

(i) Free living nitrogen fixing bacteria fix atmospheric nitrogen in the soil and make it available for the higher plants. The best example is *Azotobacter*. Apart from this *Clostridium*, *Bacillus polymyxa*, etc., are also known to fix atmospheric nitrogen.

(ii) Symbiotic nitrogen fixing bacteria, *Rhizobium*, form an efficient symbiotic relationship with leguminous plants and can fix upto 500 kg nitrogen per hectare of land. *Rhizobium* forms nodules on the roots of legume plants.

(iii) Free living nitrogen fixing cyanobacteria includes *Anabaena*, *Nostoc*, *Aulosira*, *Stigonema*, etc. *Aulosira fertilissima* is considered to be most active nitrogen fixer of rice fields in India.

(iv) Nitrogen 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. *Anabaena azollae* resides in the leaf cavities of fern. It fixes nitrogen.

(v) Fungi are also known to form symbiotic associations with plants (mycorrhiza). The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.

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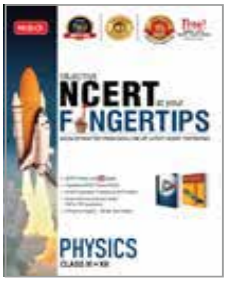

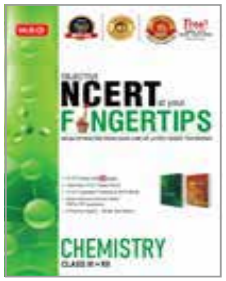

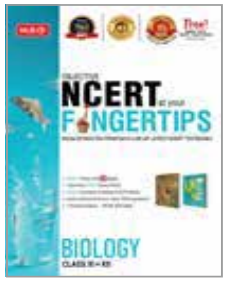

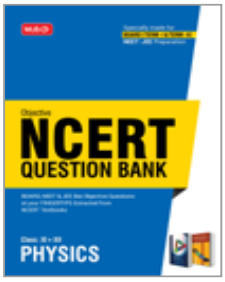

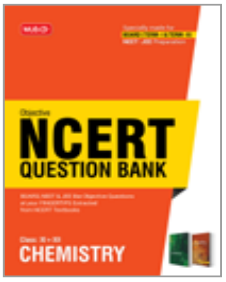

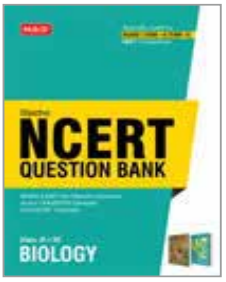

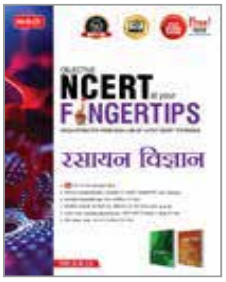

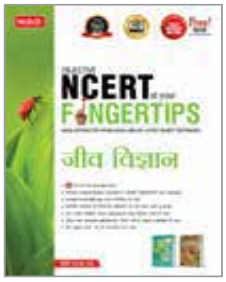

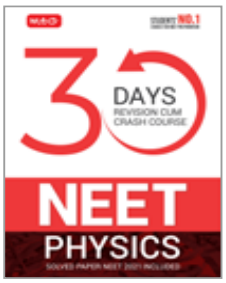

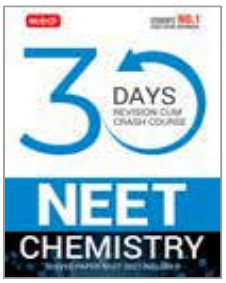

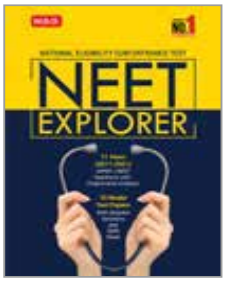

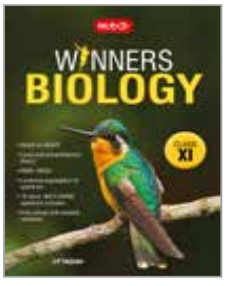

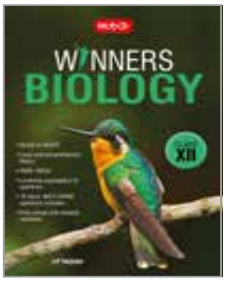

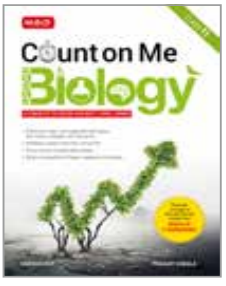

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