

**CHAPTER 10**

# MICROBES IN HUMAN WELFARE

## Topics Discussed

INTRODUCTION

MICROBES IN HOUSEHOLD PRODUCTS

FOODSTUFFS

USE OF MICROBES IN INDUSTRIAL PRODUCTS

MICROBES IN SEWAGE TREATMENT

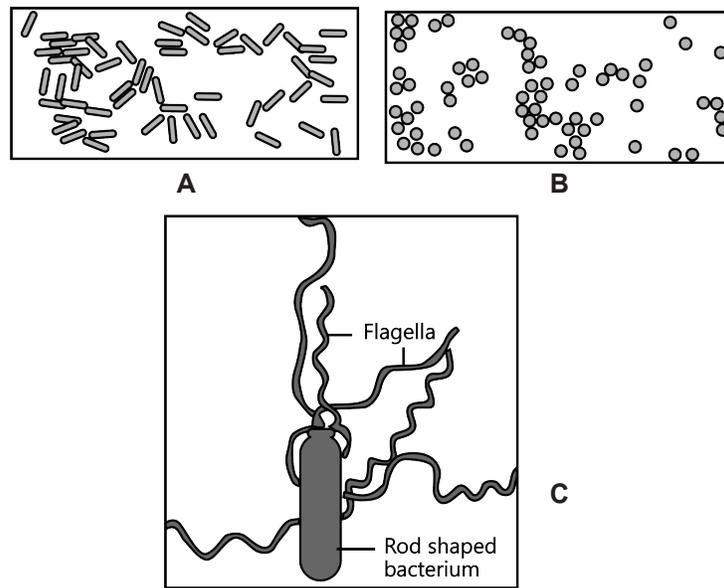
MICROBES IN ENERGY PRODUCTION

MICROBES AS BIOCONTROL AGENTS

MICROBES AS BIOFERTILISERS

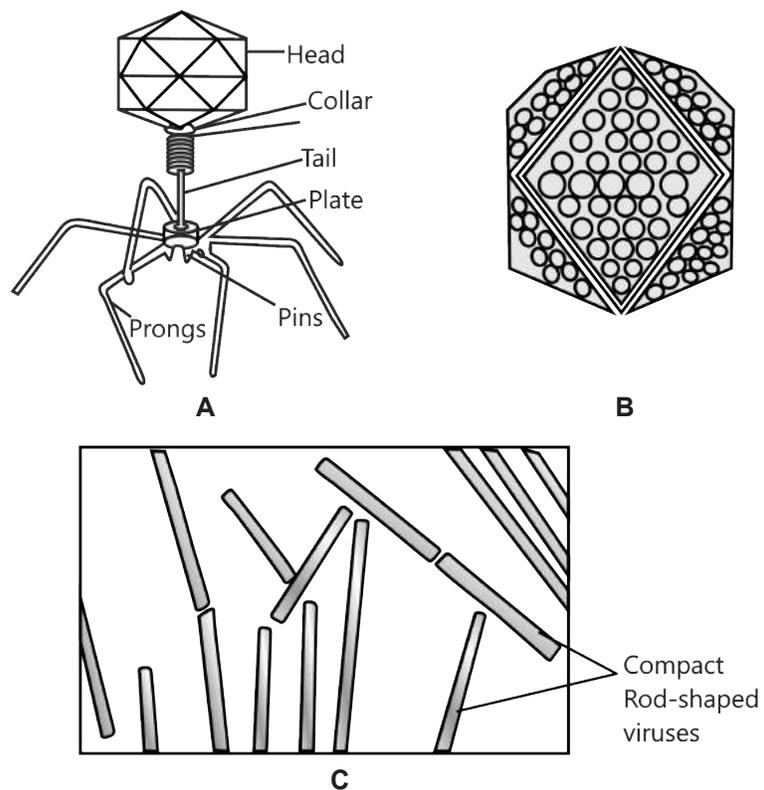
## 1. Introduction

- Microbes or micro-organisms are microscopic living being and viruses.
- They are the oldest life forms on earth.
- Some microbes are also capable of causing diseases.
- Some microbes can thrive in very adverse environments ranging from hot water geysers to heavily polluted areas. Additionally, many also produce unique enzymes and carry out metabolic pathways which may be absent in plants and animals. This makes them extremely important from the point of view of human welfare.
- Many microbes can be grown in the laboratory or in other set-ups, in the form of cultures.
- Microbes can be used for industrial production, sewage treatment etc. They can also be used as biocontrol agents and have been used extensively in research as well.



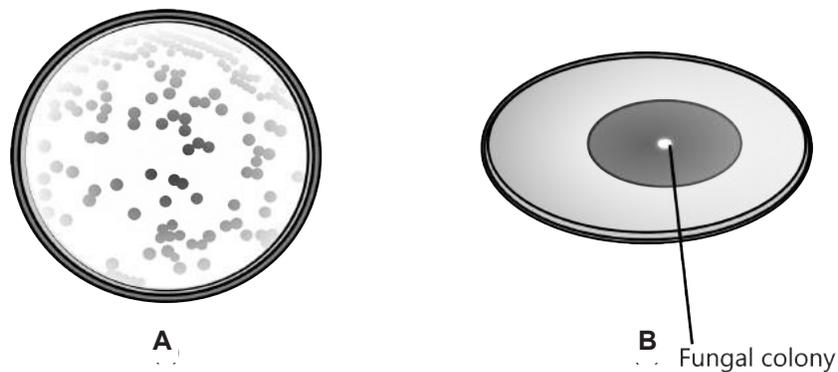
**Figure 10.1:** Bacteria of various shapes

**A.** Rod shaped bacteria (bacilli); **B.** Spherical bacteria (cocci) and **C.** A rod shaped bacteria with flagella



**Figure 10.2:** Viruses of various shapes

**A.** A bacteriophage; **B.** An adenovirus and **C.** Rod shaped Tobacco Mosaic virus



**Figure 10.3:** Microbial colonies on a petri plate

**A.** Bacterial colonies growing on a petri dish and **B.** Fungal colony on a petri dish

#### Did You Know

1. Microbiology is the science of microbes.
2. It is not possible to culture all microbes in the laboratory. Designing growth media to suit non-culturable microbes is one of the challenges of microbiology.
3. Microbes possess some amazing abilities. *D. radiodurans* is a bacterium that can survive high doses of radiation, high acidity, prolonged exposure to vacuum and desiccation.

### Objectives

At the end of this chapter, you will be able to:

- To know how microbes are used to produce house-hold products.
- To know about the industrial uses of microbes.
- To study the uses of microbes in sewage treatment.
- To study the use of microbes as biocontrol agents and bio-fertilizers.

## 2. Microbes in Household Products

Microbes are involved in the production of various household products, mostly food.

### 2.1 Curd

- Curd is made from milk. A small amount of curd (inoculum) is added to milk.
- Milk contains a sugar called lactose. Curd has bacteria called '**lactic acid bacteria**' or **LABs**.
- The lactobacilli convert the lactose to lactic acid. Thus the taste of the mixture changes from sweet to sour.

- The lactic acids leads to coagulation of milk proteins. Thus the consistency changes from liquid to semi-solid.
- Lactobacilli also colonize the human gut and help to protect it against infection by bacteria that cause enteric diseases.
- Additionally, curd contains vitamin A and vitamin B12.

## 2.2 Cheese

- Cheese is also made from milk. The processes themselves and their durations may vary according the type of cheese to be manufactured.
- Milk is acidified either with addition of an acid or by using **lactobacilli** (or some other microbes). This makes casein the milk protein to coagulate.
- An enzyme called **rennet** is added. Previously, rennet used to be isolated from slaughtered calves. Now it is manufactured using recombinant microbes.
- The liquid part is separated and the remaining solid part is heated and later kept aside for varying durations of time for 'maturation or ripening'.
- Cheese is regarded as a fatty food.
- Health benefits of cheese include a positive impact on dental health and sleep.

## 2.3 Bread

- Bread is prepared from dough.
- **Baker's yeast (*Saccharomyces cerevisiae*)** is added to dough. It produces carbon dioxide which is responsible for the typical spongy and porous consistency. This is also called leavening.
- Bread can also be flavored.

## 2.4 Other Foodstuffs

- Dosa and Idli batter are also fermentation products.
- Wine and some other beverages also involve the use of microbes.
- Fermented fish, grass etc. can be used as animal fodder.

**KNOWLEDGE BUILDER****Table 10.1:** Dairy products and microbes associated with them

Dairy products	Microbes
Yoghurt	<i>Lactobacillus bulgaricus</i>
Curd	<i>Lactobacillus acidophilus</i>
Butter milk	<i>Streptococcus cremoris</i>
Camembert cheese	<i>Penicillium camembertii</i>
Sour cream	<i>Streptococcus lactis</i>



### 3. Microbes in Industrial Products

Microbial fermentation is also carried out on an industrial scale to produce fermented substances which can be processed to produce commercial goods.

#### 3.1 Beverages

- *S. cerevisiae* is the preferred microbe of choice to produce fermented beverages.
- It ferments sugar to ethanol.
- The end product is different based on the starting products used. E.g. beer from grain mash, wine from grapes, mead from honey etc.
- Distillation may be used to concentrate the ethanol. Distilled beverages include whisky, brandy, vodka, tequila etc.

#### 3.2 Antibiotics

- Antibiotics are chemicals which inhibit the growth of or kill microbes.
- They are perhaps one of the most important products obtained from microbes.
- **Penicillin** was the first antibiotic to be used in medicine. It came to prominence at the end of World War II and is regarded as one of the greatest discoveries in medicine.
- It was obtained from *Penicillium notatum*.
- It can be chemically modified to produce several other variants.
- **Tetracycline** is manufactured using Streptomyces. It has saved several humans from deaths due to cholera.

## KNOWLEDGE BUILDER

Table 10.2: Antibiotics and their sources

Antibiotic		Source
From Eubacteria		
Bacitracin	-	<i>Bacillus licheniformis</i>
From Actinomycetes		
Chlorotetracycline/aureomycin/tetracycline	-	<i>Streptomyces aureofaciens</i>
i. Chloramphenicol or chloromycetin	-	<i>S. venezuelae</i>
ii. Erythromycin	-	<i>S. erythreus</i>
iii. Streptomycin	-	<i>S. griseus</i>
iv. Neomycin	-	<i>S. fradiae</i>
v. Oxytetracycline/Terramycin	-	<i>S. rimosus</i>
From Fungi		
i. Penicillin	-	<i>Penicillium chrysogenum</i>
ii. Griseofulvin	-	<i>P. griseofulvum</i>
iii. Fumagilin	-	<i>Aspergillus fumigatus</i>



### 3.3 Other Molecules

Apart from beverages and antibiotics microbes are used to produce a variety of compounds which are of tremendous importance and hence have high commercial value.

- **Enzymes** produced by bacteria may have various applications.
- **Lipases** are used in detergents to remove oily stains. They can be obtained from *Geotrichum candidum*.
- **Pectinases** are used in 'clearing' of fruit juices.
- **Streptokinase** is used in dissolving clots. (Used as TPA).
- *Trichoderma polysporum* produces cyclosporins which can be used as immunosuppressants.
- **Statins** produced by some bacteria are compounds that inhibit cholesterol synthesis.
- Bacteria can be genetically engineered to produce many other **proteins/hormones which are used in medicine**.
- **Organic acids** used in healthcare products can also be obtained from bacterial fermentation.



**Figure 10.4:** Fermenters



**Figure 10.5:** Fermentation plants

### TRY IT YOURSELF

1. Milk is more nutritious than curd. (True/False).
2. The process of the bread becoming spongy and porous is called hardening. (True/False).
3. Name 3 antibiotics and the organisms producing them.
4. Name 3 distilled alcoholic beverages.
5. Distillation reduces the ethanol concentration in the beverage. (True/False).
6. Lipases are commonly used in \_\_\_\_\_. (Detergents/Insulin production).

## 4. Microbes in Sewage Treatment

- Tremendous amount of wastes are generated by households and industries.
- Most of them are drained via the sewers. These wastes are termed as sewage.
- Sewage cannot be disposed/let into a larger waterbody directly without treatment.
- Bacteria play an important role in treatment of sewage water.

### Various stages of treatment-

#### 1. Pre-treatment

- It generally includes filtration based processes to separate out large solid chunks from the sewage.
- It can also include other processes for fat removal etc.

#### 2. Primary treatment

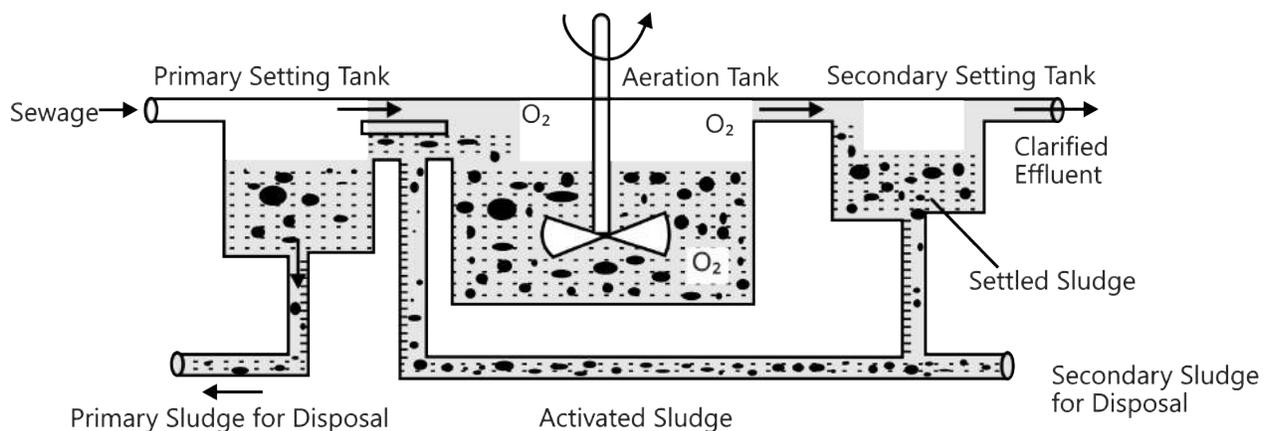
- It is basically a sludge removal phase.
- The sewage is kept in a series of settling tanks where heavier materials are allowed to sediment

out.

- These sediments are separated out and sent to sludge treatment plants. (Sludge can be subjected to anaerobic treatment to produce biogas).
- Generally no biological treatment is carried out.

### 3. Secondary treatment

- It is the phase of biological treatment.
- The liquid is kept in a tank and aerated to promote the growth of microbes in it.
- The microbes form flocs and consume the organic compounds present in the sewage.
- This process is carried out until the BOD (Biochemical Oxygen Demand) of the mixture becomes lesser than a stipulated value.
- In the later stage, the mixture is allowed to stand still and the flocs settle down. This sediment is called activated sludge.
- Activated sludge is separated out and some of it may be used for the next batch of sewage in the secondary treatment phase.



**Figure 10.6:** Activated sludge technique

### 4. Tertiary treatment

- Sand and other solids may be separated out.
- Nitrogen and phosphorus based compounds are targeted for degradation.
- Disinfection by chlorination or using UV rays may be carried out.
- Sometimes ozone is used in place of chlorine.

### 5. Quaternary treatment (In R & D stage)

- It can be noted that some micro-pollutants may not be degraded in the above three treatments.

- Therefore some pharmaceuticals which can have hazardous effects are targeted for removal.
- As this removal is expensive, this treatment is still in experimental stages. It is generally not carried out in normal sewage treatment plants.

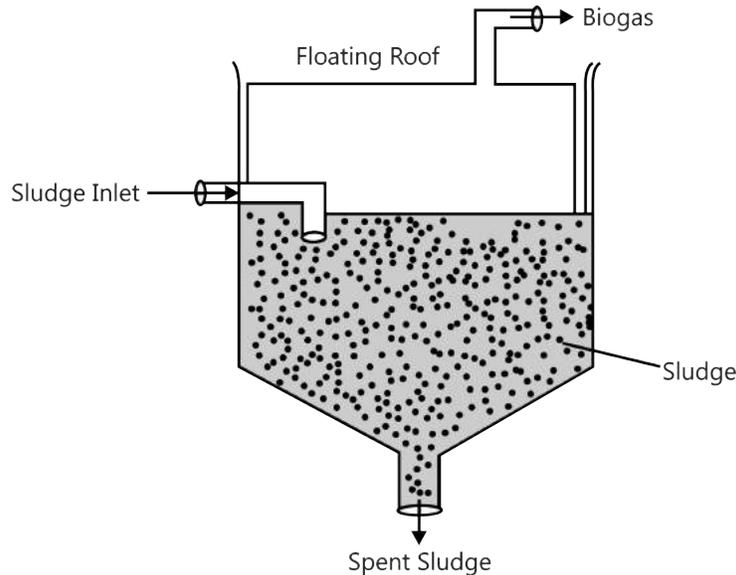


Figure 10.7: Anaerobic sludge digester

## 5. Microbes in Energy Production

- Microbes are used for anaerobic fermentation of biological wastes.
- Sludge, dung etc. are sent to a 10-15 feet deep tank.
- **Methanobacteria** are present in cow-dung. They begin to anaerobically ferment the sludge to produce methane, carbon dioxide and hydrogen sulfide.
- The top of the sludge layer is covered by a floating layer. As the sludge mixture increases in volume, this cover cannot be of 'fixed' type.
- The gas collected from the tank is called biogas. It has 50-70% methane and 30-40% carbon dioxide.
- The calorific value of this mixture is 4429 kcal/m<sup>3</sup>.
- This gas is combustible and can be used to power motors.

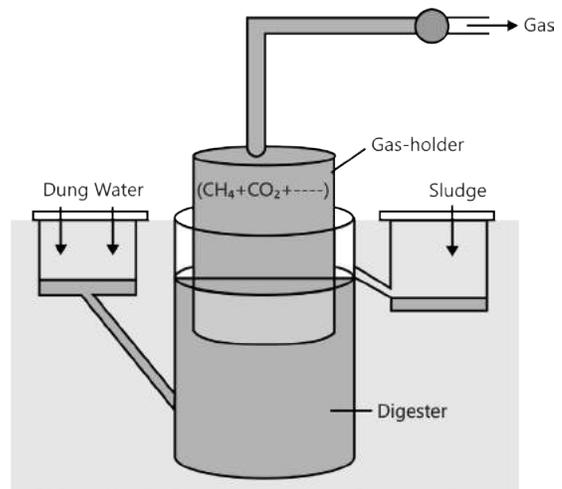


Figure 10.8: A schematic diagram of a biogas plant

- It has a great potential to be used in automobiles and electricity generation in a very significant manner.
- A newer technology called **MCF or microbial fuel cell** can be used directly to generate current from wastewater. This technology is in experimental stages but many companies have expressed interest in working on commercializing it in the near future.

### TRY IT YOURSELF

- 
1. Aquatic fern which is an excellent biofertilizer is  
 (A) Sahrinizr                      (B) A zaria                      (C) Marselia                      (D) Ptericckirr
  2. Third generation pesticides are  
 (A) Insects repellents                      (B) Pheromones  
 (C) Pathogens                      (D) Insect hormone analogues

## 6. Microbes as Biocontrol Agents

- Insects and pests cause huge losses to farmers.
- Hence some farmers resort to the spraying of chemicals called insecticides and pesticides.
- These chemicals generally aim to poison the insects that consume the plant.
- Though effective, these chemicals have tremendous hazardous effects on the environment. They tend to accumulate in humans or animals consuming the plants on which they were sprayed upon. This accumulation can be toxic and can cause various disorders.
- Hence some farmers prefer to harness the natural predators or pathogens of these insects to keep their population in check. These natural agents are called biocontrol agents. Microbes can be used as biocontrol agents.

### 6.1 *Bacillus Thuringiensis*

- This bacterium produces *cry* toxins which are endo-toxins to some insects like moths, butterflies, beetles, sawflies etc. which feed on crop plants. Consumption of *cry* toxins will lead to death of the insects.
- Spores of this bacterium can be mixed with water and sprayed on vulnerable plants.
- The gene for the *cry* toxin can be inserted into the plant genome thereby making the plant pest resistant.

## 6.2 *Trichoderma*

It is fungus which inhibits growth of harmful fungi by generation of antibiotics or by competition or by inducing host plant resistance or by parasitism.

## 6.3 Baculoviruses

- They are viruses infecting some insects.
- Thus they can be used as biocontrol agents to reduce insect population.
- These viruses cannot infect plant cells or cells of animals other than the insects they are targeted against.
- The genus *Nucleopolyhedrovirus* (NPV) is mostly used for biocontrol.

## 7. Microbes as Biofertilisers

- Fertilizers are used to enhance the nutrient profile of the soil with an aim to increase the quality and quantity of the produce.
- Chemical fertilizers have a lot of harmful effects on the environment which include eutrophication of water bodies in which they accumulate, acidification of soil or accumulation of toxic metals in the soil.
- Bacteria, fungi and cyanobacteria are microbes that can be used as biofertilisers.

### 7.1 Bacteria

- ***Rhizobia*** are nitrogen fixing bacteria that form symbiotic association with root nodules of leguminous plants.
- These bacteria fix atmospheric nitrogen into organic forms, which can be efficiently used by plants as nutrients.
- ***Azospirillum* and *Azotobacter*** are bacteria that can fix nitrogen without being associated with plant roots and thereby enrich the nutrient profile of the small region of soil surrounding them.

### 7.2 Fungi

- Some fungi can form symbiotic associations with roots of higher plants. These association are known as Mycorrhiza.
- Many members of the genus ***Glomus*** form mycorrhiza.

- The fungus absorbs phosphorus from the soil and passes it to plant roots.
- Plants having such associations also show an overall increase in plant growth and development along with resistance to root pathogens and a tolerance to high salinity.

### 7.3 Cyanobacteria

- They are a phylum of bacteria that obtain energy by photosynthesis.
- The genera ***Nostoc***, ***Anabaena***, ***Oscillatoria*** live in soil and carry out nitrogen fixation.
- They tend to improve the nutrient profile of the soil.



#### TRY IT YOURSELF

1. Baculoviruses are pathogenic to humans. (True/False)
2. ***Bacillus thuringiensis*** are commonly used as biofertilisers. (True/False)
3. Name three microbes that can improve the nutrient profile of the soil.



#### DID YOU KNOW

1. ***Pseudomonas putida*** is used to degrade hydrocarbons after oil spills.
2. ***Rhizobium*** is used as fertilizer to grow soyabean.
3. Florey and Chain shared the Nobel Prize with Fleming as they optimized methods for the mass production of penicillin.
4. IARI and KVIC played a major role in the initiation of development of biogas infrastructure in India.

## Summary

- Some microbes can live in very challenging environment like hot water springs or polluted water-bodies while some can produce unique enzymes and carry out unique metabolic pathways.
- These abilities make them suitable to tackle various environmental and other such problems faced by humans.
- Lactobacilli are used in production of curd and cheese while *S. cerevisiae* is used in the production of bread and alcoholic beverages.
- Some organisms from the genus *Aspergillus* and *Streptomyces* are used in the commercial production of antibiotics like penicillin, tetracycline etc.
- Lipases are used in detergents to remove oily stains. They can be obtained from *Geotrichum candidum*.
- *Trichoderma polysporum* produces cyclosporins which can be used as immunosuppressants.
- Statins produced by some bacteria are compounds that inhibit cholesterol synthesis.
- Bacteria can be genetically engineered to produce many other proteins/hormones which are used in medicine.
- Organic acids used in healthcare products can also be obtained from bacterial fermentation.
- Microbes are used in the aerobic fermentation stage of sewage treatment.
- Microbes are used in the production of biogas.
- *Bacillus thuringiensis* produce a protein which is an endo-toxin to some insects that feed on crops. They can thus be used to keep the pest population in check.
- The fungus *Trichoderma* can also be used as a biocontrol agent.
- Additionally, Baculoviruses which affect insects can be used to reduce their population.
- Some bacteria and cyanobacteria can improve the nutrient profile of the soil by carrying out nitrogen fixation.
- Some fungi form associations with plant roots. These associations called mycorrhizae improve phosphorous intake by plants and also offer resistance to root borne pathogens.

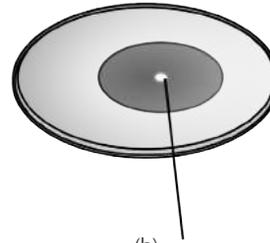
## EXERCISE

### Objective Questions

**Q.1** Identify the colonies labelled as a and b



(a)



(b)

(A) a-Fungal; b-Bacterial

(B) a-Bacterial; b-Fungal

(C) a-Algal; b-Viral

(D) a-Fungal; b-Algal

**Q.2** Which of the following microbe is made up of protein only?

(A) Virus

(B) Bacteria

(C) Viroid's

(D) Prions

**Q.3** The infectious agents made up of RNA only are

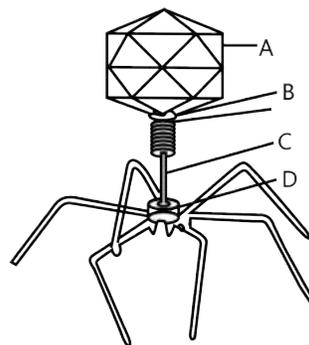
(A) Viroids

(B) Bacteria

(C) Fungi

(D) Virus

**Q.4** Identify the parts labelled as A, B, C and D



(A) Head, Neck, Collar, Tail

(B) Capsule, Tail, Collar, Pins

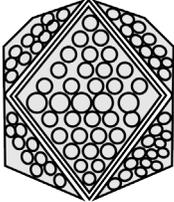
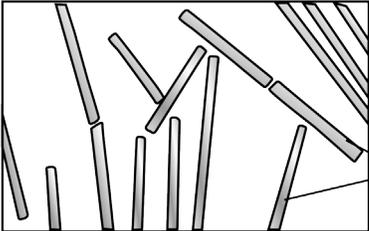
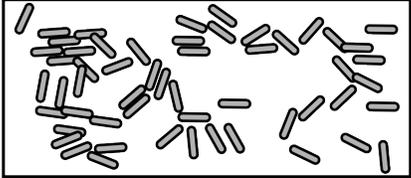
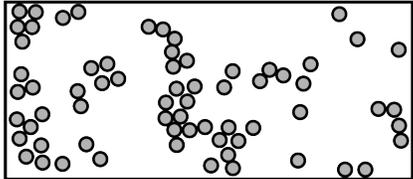
(C) Head, Collar, Tail, Plate

(D) Head, Tail, Collar, Prongs

**Q.5** Microbial colonies

- (A) Can be grown on nutritive media  
 (B) Can be seen by naked eyes  
 (C) Are useful in study of microbes  
 (D) More than one option is correct

**Q.6** Match the following (column – I with column -II)

Column – I	Column – II
(A) 	i. Bacillus
(B) 	ii. Cocci
(C) 	iii. Tobacco Mosaic Virus (TMV)
(D) 	iv. Adenovirus

- (A) a(ii), b(iv), c(i), d(ii)    (B) a(iv), b(iii), c(i), d(ii)    (C) a(iii), b(i), c(iv), d(ii)    (D) a(i), b(ii), c(ii), d(iv)

**Q.7** What is the beneficial role of LAB in our stomach?

- (A) Causing souring of milk by decreasing nutritional quality  
 (B) Increases the amount of vitamin-D  
 (C) Checks disease causing microbes  
 (D) It produces alkali which coagulate and partially digest the milk proteins

**Q.8** The microbe used for making bread is

- (A) *Saccharomyces cerevisiae* (B) *Saccharomyces ellipsoidens*  
(C) *Saccharomyces pireformis* (D) *Saccharomyces sake*

**Q.9** Which of the following is traditional drink from some parts of southern India, made by fermenting sap from palms?

- (A) Tea (B) Toddy (C) Beer (D) Cashew apple

**Q.10** Which of the following microbe is used for ripening of Swiss cheese?

- (A) *Penicillium roquefortii* (B) *P. camembertii*  
(C) *Propionibacterium sharmanii* (D) *Streptomyces griseus*

**Q.11** Production of beverages at industrial scale requires growing microbes in very large containers known as

- (A) Digesters (B) Fermenters (C) Dough (D) Concrete tank

**Q.12** Find the one w.r.t. distilled alcoholic beverages

- (A) Rum (B) Beer (C) Brandy (D) Whisky

**Q.13** Brewer's yeast is used for \_\_\_\_A\_\_\_\_ of malted cereals and fruit juices to produce \_\_\_\_B\_\_\_\_.

- (A) A-Distillation; B- CO<sub>2</sub> (B) A-Distillation; B- organic acid  
(C) A-Fermentation; B- CO (D) A-Fermentation ; B-Alcohol

**Q.14** The chemicals which are "pro-life" with reference to human beings

- (A) Are regarded as one of the most significant discovery of twenty first century  
(B) Have rarely contributed to human welfare  
(C) Are produced by some plants and all animals  
(D) Can kill or retard the growth of disease-causing microbes

**Q.15** Which of the following microbe is the source of first antibiotic?

- (A) *Penicillium notatum* (B) *Staphylococci* (C) *Aspergillus niger* (D) *Bacillus brevis*

**Q.16** The first antibiotic was discovered accidentally by \_\_\_\_A\_\_\_\_ while working on \_\_\_\_B\_\_\_\_

- (A) A-Waksman; B-*Streptococcus*
- (B) A-Fleming; B-*Penicillium notatum*
- (C) A-Waksman; B-*Bacillus brevis*
- (D) A-Fleming; B-*Staphylococci*

**Q.17** Commercial extraction of penicillin was done by

- (A) Alexander Fleming
- (B) Ernest Chain
- (C) Howard Florey
- (D) More than one option is correct

**Q.18** Identify the correct statements w.r.t. antibiotics

- i. Fleming, Chain and Florey were awarded the Nobel Prize in 1945.
- ii. Antibiotics have greatly improved our capacity to treat deadly diseases
- iii. Penicillin was used to treat American soldiers wounded in World War I

- (A) (i) and (ii)
- (B) (i) and (iii)
- (C) (ii) and (iii)
- (D) All are correct

**Q.19** Match the following (column – I with column - II)

Column I (microbes)	Column II (organic acid)
(A) <i>Aspergillus niger</i>	i. Butyric acid
(B) <i>Clostridium butylicum</i>	ii. Citric acid
(C) <i>Acetobacter aceti</i>	iii. Lactic acid
(D) <i>Lactobacillus</i>	iv. Acetic acid

- (A) a(i), b(ii), c(iii), d(iv)
- (B) a(ii), b(i), c(iv), d(iii)
- (C) a(ii), b(iv), c(iii), d(i)
- (D) a(iii), b(i), c(iv),d(ii)

**Q.20** \_\_\_\_\_are used in detergent formulations and are helpful in removing oily stains from laundry.

- (A) Ligases
- (B) Proteases
- (C) Lipases
- (D) Pectinases

**Q.21** Select the microbe which is the source of 'clot buster' enzyme.

- (A) Bacterium; *Lactobacillus*
- (B) Fungi; *Aspergillus niger*
- (C) Fungi; *Penicillium notatum*
- (D) Bacterium; *Streptococcus*

**Q.22** \_\_\_\_A\_\_\_\_enzyme is used to remove clots from the blood vessels of patients who have undergone \_\_\_\_B\_\_\_\_leading to heart attack.

- (A) A-Streptokinase; B-Myocardial infraction
- (B) A-Lipases; B-Arteriosclerosis
- (C) A-Proteases; B-Myocardial infraction
- (D) A-Pectinases; B-Atherosclerosis

**Q.23** The bottled juices are clarified by the use of

- (A) Pectinases                      (B) Proteases                      (C) Lipases                      (D) Both A & B

**Q.24** An immunosuppressive agent used in organ-transplant patients is

- (A) Streptokinase                      (B) Statins                      (C) Cyclosporine-A                      (D) Lipases

**Q.25** *Trichoderma polysporum* is a source of

- (A) Cyclosporine – A                      (B) Streptokinase                      (C) Statins                      (D) Clot buster

**Q.26** The product of *Monascus purpureus* has been commercialized as

- (A) Immunosuppressive agent                      (B) Blood- cholesterol lowering agent  
(C) Clot buster                      (D) Bottled juices clarifying agents

**Q.27** \_\_\_\_\_ are produced by yeast and act by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

- (A) Cyclosporine-A                      (B) Penicillin                      (C) Statins                      (D) Alcohol

**Q.28** Which of the following statement for sewage is correct?

- (A) Municipal waste-water, whose major component is human excreta  
(B) Contains large amount of organic matter and non-pathogenic microbes  
(C) Can be discharged directly into natural water bodies like rivers and streams  
(D) It is generated in less quantities in cities and villages as compared to towns

**Q.29** Treatment of waste-water is done by the

- (A) Photoautotrophic microbes, naturally present in sewage  
(B) Chemoautotrophic microbes, naturally present in sewage  
(C) Heterotrophic microbes naturally present in sewage  
(D) Heterotrophic microbes inoculated in the sewage from outside only

**Q.30** In a sewage from treatment plant, primary treatment is

- (A) Physical process which involves sedimentation only.  
(B) Physical process which involves both filtration and sedimentation.  
(C) Biological process which involves formation of primary sludge and effluent  
(D) Biological process which involves both filtration and sedimentation.

**Q.31** During primary treatment, all solids that settle forms \_\_\_A\_\_\_ and the supernatant forms \_\_\_B\_\_\_

- (A) A-Primary sludge; B-effluent  
(B) A-Primary sludge; B-secondary effluent  
(C) A-Activated sludge; B-clarified effluent  
(D) A-Activated sludge; B-effluent

**Q.32** What are flocs?

- (A) Masses of anaerobic bacteria.  
(B) Masses of aerobic fungi only.  
(C) Masses of anaerobic bacteria and fungi.  
(D) Masses of aerobic bacteria associated with fungal filaments.

**Q.33** Which of the following is a bacteria?

- (A) *Paramoecium*  
(B) *E. Coli*  
(C) *Amoeba*  
(D) *Plasmodium vivax*

**Q.34** All are correct w.r.t. BOD (Biochemical Oxygen Demand), except

- (A) It refers to the amount of oxygen that would be consumed if all the organic matter in one liter of water were oxidized by bacteria.  
(B) The BOD test is a measure of the organic matter present in the water.  
(C) The greater the BOD of waste water, less is its polluting potential.  
(D) Waste water is treated till BOD is reduced significantly.

**Q.35** What happens to activated sludge?

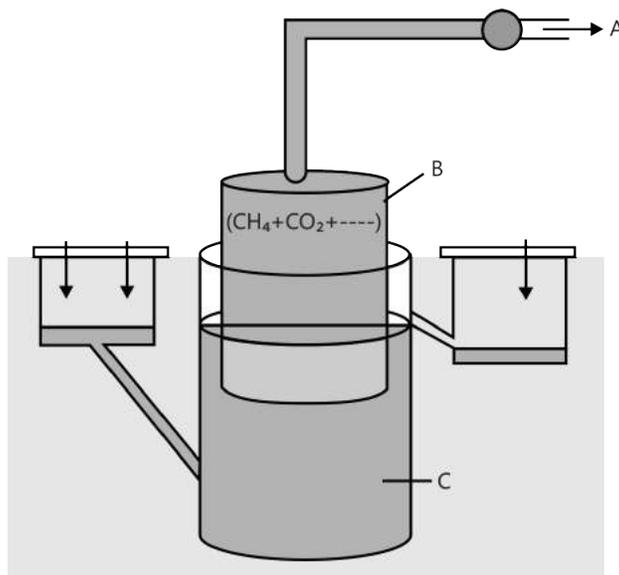
- (A) It is generally released into natural water bodies like rivers and streams.  
(B) It is completely pumped back into aeration tank to serve as inoculums.  
(C) The major part of the sludge is pumped into large tanks called anaerobic sludge digesters.  
(D) It undergoes sequential filtration.

**Q.36** The Ministry of Environment and forest has initiated Ganga action plan and Yamuna plan

- i. to save these major rivers of our country from pollution
- ii. it is proposed to build a large number of sewage treatment plants
- iii. under these plans, only treated sewage may be discharged in the river

- (A) (i) and (ii) are correct  
(B) (ii) and (iii) are correct  
(C) (i) and (iii) are correct  
(D) All are correct

**Q.37** Identify the parts labelled A, B & C w.r.t. biogas plant



- (A) Gas, Sludge, Dung water  
 (B) Gas, Gas holder, Digester  
 (C) Gas holder, Sludge, Dung water  
 (D) Gas holder, Digester, Dung water

**Q.38** What is the composition of the biogas?

- (A) Methane, carbon dioxide, oxygen etc.  
 (B) Methane, carbon dioxide, hydrogen, nitrogen dioxide etc.  
 (C) Methane, carbon dioxide, hydrogen etc.  
 (D) Methane, carbon dioxide, sulphur dioxide etc.

**Q.39** The bacterium responsible for biogas production are collectively called

- (A) Methanogens      (B) Thermoacidophiles      (C) Halophiles      (D) Cyanobacterium

**Q.40** The technology of biogas production was developed in India mainly due to the efforts of

- (A) IPM      (B) IARI and KVIC      (C) IRRI      (D) ICAR

**Q.41** Identify the incorrect statement w.r.t. biogas plant

- (A) It consists of a concrete tank, 10-15 feet deep in which bio-wastes are collected and a slurry of dung is fed  
 (B) A floating cover is placed over the slurry, which keeps on rising as the gas is consumed in the tank  
 (C) It has an outlet, which is connected to pipe to supply to nearby houses  
 (D) The spent slurry is removed and may be used as fertilizer

**Q.42** Which of the following is not the belief of an organic farmer?

- (A) The more variety a landscape has, the more sustainable it is
- (B) The insects that are sometimes called pests are not eradicated, but instead are kept at manageable levels by a complex system of checks and balances within a living and vibrant ecosystem
- (C) For controlling plant diseases and pests, chemicals like insecticides and pesticides should be used extensively
- (D) Eradication of the pests is undesirable because they act as food or hosts for beneficial predatory and parasitic insects

**Q.43** The ladybird beetle and dragonflies are useful to get rid of \_\_\_\_ and \_\_\_\_ respectively

- (A) Caterpillars and mosquitoes
- (B) Mosquitoes and fruit borer
- (C) Mosquitoes and aphids
- (D) Aphids and mosquitoes

**Q.44** The effective biocontrol agents of several plant pathogens are species of

- (A) *Aspergillus*
- (B) Baculoviruses
- (C) *Trichoderma*
- (D) Dragonflies

**Q.45** Baculoviruses are /have

- (A) Pathogens that attack insects and other arthropods
- (B) Members of genus Nucleopolyhedrovirus that are never used as biocontrol
- (C) Species – specific, broad spectrum insecticides
- (D) Few negative impacts on plants, mammals, birds, fishes or even on non-target insects

**Q.46** Identify the incorrect statement

- i. *Bacillus thuringiensis* are available in sachets as dried spores which are mixed with kerosene and sprayed on to vulnerable plants
- ii. *B. thuringiensis* are used to control butterfly caterpillars, but leave other insects unharmed
- iii. The toxin of *B. thuringiensis* is released in the blood of larvae and the larvae get killed.
- iv. By the development of methods of genetic engineering *B. thuringiensis* toxin genes have been introduced into plants

- (A) (i) and (ii)
- (B) (ii) and (iii)
- (C) (i) and (iii)
- (D) (ii) and (iv)

**Q.47** Biofertilisers

- (A) Increase dependence on chemical fertilizers
- (B) Are organisms that enrich the nutrient quality of soil
- (C) Include potash, phosphatic and nitrogenous organic and chemical compounds
- (D) Are used regularly in the fields to deplete soil nutrients

**Q.48** The main sources of biofertilisers are

- i. Bacteria                      ii. Cyanobacteria                      iii. Fungi                      iv. Protists
- (A) (i), (ii), (iii)                      (B) (i), (ii), (iv)                      (C) (ii), (iii), (iv)                      (D) (i), (iii), (iv)

**Q.49** The symbiotic association of fungi with plants is known as \_\_\_\_\_ which is formed by many members of the fungal genus\_\_\_\_\_.

- (A) Mycorrhiza; *Glomus*                      (B) Mycorrhiza; *Penicillium*  
(C) Lichen; *Trebauxia*                      (D) Lichen; *Rhizocarpon*

**Q.50** In paddy fields, \_\_\_\_\_ serves as an important biofertilisers.

- (A) *Rhizobium*                      (B) *Anabaena*                      (C) *Glomus*                      (D) *Azospirillum*

**Q.51** Which one of the following is an example of carrying out biological control of pests/ diseases using microbes?

- (A) Bt-cotton to increase cotton yield
- (B) Lady bird beetle against aphids in mustard
- (C) *Trichoderma* sp. Against certain plant pathogens
- (D) Nucleopolyhedrovirus against white rust in *Brassica*

**Q. 52** Cyanobacteria helps farmers by

- (A) Increasing the alkalinity of soil                      (B) Reducing the acidity of soil  
(C) Reducing the alkalinity of soil                      (D) Water logging

**Q.53** One of the major difficulties in the biological control of insect/ pest is that

- (A) The method is less effective as compared with the use of insecticides
- (B) The practical difficulty of introducing the predator to specific areas
- (C) The predator develops a preference to other diets and may itself become a pest.
- (D) The predator does not always survive when transferred to a new environment

**Q.54** Cochineal insects have proved very useful for the control of

- (A) Cactus                      (B) *Eichhornia*                      (C) Milk weeds                      (D) *Parthenium*

**Q.55** Which of the following is not used as a biopesticide?

- (A) *Xanthomonas campestris*                      (B) *Bacillus thuringiensis*  
(C) *Trichoderma harzianum*                      (D) Nuclear Polyhedrosis Virus (NPV)

**Q.56** Natural insecticide pyrethrum is obtained from

- (A) *Derris elliptica*                      (B) *Chrysanthemum cinerarifolium*  
(C) *Azadirachta indica*                      (D) *Nicotiana tobaccum*

**Q.57** *Trichoderma harzianum* has proved a useful microorganism for

- (A) Biological control of plant pathogens                      (B) Bioremediation of contaminated soils  
(C) Reclamation of wastelands                      (D) Gene transfer in higher plants

**Q.58** When a natural predator is applied on the other pathogen organism to control them, this process is called

- (A) Artificial control                      (B) Biological control                      (C) Confusion technique                      (D) Genetic engineering

**Q.59** Which one of the following pairs is wrongly matched?

- (A) Textile - Amylase                      (B) Detergents - Lipase  
(C) Alcohol - Nitrogenase                      (D) Fruit juice - Pectinase

**Q.60** Match column I and column II and choose the correct option.

Column I	Column II
(A) Curd	i. <i>Saccharomyces cerevisiae</i>
(B) Cyclosporine	ii. <i>Monascus purpureus</i>
(C) Statins	iii. <i>Lactobacillus acidophilus</i>
(D) Bread making	iv. <i>Trichoderma polysporum</i>

- (A) a(iii), b(i), c(ii), d(iv)                      (B) a(iii), b(iv), c(ii), d(i)                      (C) a(i), b(iii), c(iv), d(ii)                      (D) a(i), b(iv), c(ii), d(iii)

**Q.61** Read the following statement having two blanks (A) and (B). A drug named as \_\_\_\_A\_\_\_\_ produced by \_\_\_\_B\_\_\_\_ has been commercialized as blood-cholesterol lowering agents, which acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol

Blank (A)	Blank (B)
(A) Cyclosporine A	i. <i>Trichoderma polysporum</i>
(B) Statins	ii. <i>Monascus purpureus</i>
(C) Penicillin	iii. <i>Penicillium notatum</i>
(D) Streptokinase	iv. <i>Streptococcus</i>

**Q.62** Read the following four statements (A-D) about certain mistakes in two of them:

- (i) Dough, which is used for preparing foods such as Dosa and Idli is fermented by fungi and algae.
- (ii) Toddy, a traditional drink of southern India is made by fermenting sap from palms.
- (iii) Large holes in 'Swiss cheese' are due to production of large amount of methane by *Propionibacterium sharmanii*.
- (iv) In our stomach, lactic acid bacteria play very beneficial role in checking disease- causing microbes.

Which of the two statements have mistakes?

- (A) Statements (i) and (iii)
- (B) Statements (i) and (ii)
- (C) Statements (ii) and (iii)
- (D) Statements (iii) and (iv)

**Q.63** Vigorous growth of microbes in sewage treatment significantly.

- (A) Reduced BOD
- (B) Increased BOD
- (C) No effect on BOD
- (D) Decreased in beginning but reduced later on

**Q.64** The fungus used to control plant disease is

- (A) *Trichoderma*
- (B) *Aspergillus*
- (C) *Penicillium*
- (D) *Rhizopus*

**Q.65** Nucleopolyhedrovirus used as biological control against

- (A) Insect
- (B) Bacteria
- (C) Fungi
- (D) All of these

**Q.66** Yeast is used in the production of

- (A) Bread and beer
- (B) Cheese and butter
- (C) Citric acid and lactic acid
- (D) Lipase and pectinase

**Q.67** *Monascus purpureus* is a yeast used commercially in the production of

- (A) Citric acid
- (B) Blood cholesterol lowering statins
- (C) Ethanol
- (D) Streptokinase for removing clots from the blood vessels

**Q.68** Measuring biochemical oxygen demand (BOD) is a method used for

- (A) Measuring the activity of *Saccharomyces cerevisiae* in producing curd on a commercial scale
- (B) Working out the efficiency of R.B.Cs. about their capacity to carry oxygen.
- (C) Estimating the amount of organic matter in sewage water.
- (D) Working out the efficiency of oil driven automobile engines

**Q.69** Ethanol is commercially produced through a particular species of

- (A) *Aspergillus*
- (B) *Saccharomyces*
- (C) *Clostridium*
- (D) *Trichoderma*

**Q.70** The most common substrate used in distilleries for the production of ethanol is

- (A) Molasses
- (B) Corn meal
- (C) Soya meal
- (D) Ground gram

**Q.71** Secondary sewage treatment is mainly a

- (A) Biological process
- (B) Physical process
- (C) Mechanical process
- (D) Chemical process

**Q.72** Secondary treatment of sewage

- (A) Removes grit and large pieces of organic matter
- (B) Involves shredding, churning, filtration and sedimentation
- (C) Does not require aeration
- (D) Involves microbial digestion of organic matter

**Q.73** In gobar gas, the maximum amount is that of

- (A) Butane
- (B) Methane
- (C) Propane
- (D) Carbon dioxide

**Q.74** Which bacteria is utilized in gobar gas plant?

- (A) Methanogens
- (B) Nitrifying bacteria
- (C) Ammonifying bacteria
- (D) Denitrifying bacteria

**Q.75** During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undergraded?

- (A) Lipids                      (B) Lignin                      (C) Hemi-cellulose                      (D) Cellulose

**Q.76** Bottled fruit juices are clarified by use of

- (A) Pectinases and Lipases                      (B) Pectinases and Proteases  
(C) Proteases and Cellulose                      (D) Cellulose and Amylase

**Q.77** Select the correct statement from the following

- (A) Activated sludge-sediment in settlement tanks of sewage treatment plant is rich source of aerobic bacteria  
(B) Biogas is produced by the activity of aerobic bacteria on animal waste  
(C) Methanobacterium is an aerobic bacterium found in rumen of cattle  
(D) Biogas, commonly called gobar gas, is pure methane

**Q.78** Farmers have reported over 50% higher yields of rice by using which of the following biofertilizer?

- (A) *Frankia*                      (B) Legume-*Rhizobium* symbiosis  
(C) Mycorrhiza                      (D) *Azolla pinnata*

**Q.79** Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?

- (A) *Glomus*                      (B) *Trichoderma*                      (C) *Azotobacter*                      (D) *Aspergillus*

**Q.80** A nitrogen fixing microbe associated with *Azolla* in rice fields is

- (A) *Frankia*                      (B) *Tolypothrix*                      (C) *Spirulina*                      (D) *Anabaena*

**Q.81** Which one of the following is not a biofertilizer?

- (A) *Mycorrhiza*                      (B) *Agrobacterium*                      (C) *Rhizobium*                      (D) *Nostoc*

**Q.82** Which one of the following helps in absorption of phosphorus from soil by plants?

- (A) *Anabaena*                      (B) *Glomus*                      (C) *Rhizobium*                      (D) *Frankia*

**Q.83** An organism used as biofertilizer for raising soyabean crop is

- (A) *Nostoc*                      (B) *Azotobacter*                      (C) *Azospirillum*                      (D) *Rhizobium*

**Q.84** Consider the following statement (i-iv) about organic farming

- (i) Utilizes genetically modified crops like Bt cotton
- (ii) Uses only naturally produced inputs like compost
- (iii) Does not use pesticides and urea
- (iv) Produces vegetables rich in vitamins and minerals

Which of the above statements are correct?

- (A) (ii) and (iii) only      (B) (i) and (ii) only      (C) (ii), (iii) and (iv)      (D) (iii) and (iv) only

**Q.85** Which of the following fern is an excellent biofertilizer?

- (A) *Marsilea*      (B) *Pteridium*      (C) *Azolla*      (D) *Salvinia*

**Q.86** Which of the following species does not have the ability to fix atmospheric nitrogen?

- (A) *Azotobacter*      (B) *Anabaena*      (C) *Nostoc*      (D) *Spirogyra*

**Q.87** The biofertilizers are

- (A) *Anabaena* and *Azolla*      (B) Plants belonging to family Fabaceae  
(C) Quick growing crop ploughed under soil      (D) More than one option is correct

**Q.88** Consider the following four statements (i-iv) related to organic farming and select the correct option stating which ones are true (T) and which ones are false (F).

The statements:

- (i) Produces food crops rich in lipids, vitamins and iron
- (ii) Uses biofertilisers which increases soil fertility
- (iii) There is more use of chemical fertilizers and pesticides
- (iv) Raising unpolluted crops through the use of bacteria, fungi and cyanobacteria

- (A) T, T, F, F      (B) F, T, F, T      (C) T, F, T, F      (D) T, F, F, F

**Q.89** Continuous degradation of soil fertility is mainly due to

- (A) Excessive use of chemical fertilizers      (B) No crop rotation  
(C) Water logging in soil      (D) Water logging in soil

**Q.90** Smoother crops are plants which

- (A) Can absorb ground water  
(B) Show succulent nature of stem, root and leaf  
(C) Do not allow weeds to grow  
(D) Have disease resistance gene

**Q.91** The fungal partner of ectomycorrhiza belongs to the class

- (A) Basidiomycetes      (B) Ascomycetes      (C) Zygomycetes      (D) Deuteromycetes

**Q.92** Choose the correct statement

- I. Biofertilisers are chemicals of biological origin.  
II. *Azospirillum* and *Azotobacter* are symbiotic N<sub>2</sub>-fixing bacteria.  
III. Members of the genus *Glomus* form mycorrhiza.  
IV. *Anabaena*, *Nostoc* and *Oscillatoria* are found in paddy field.
- (A) I, II are incorrect but III, IV are correct      (B) III, IV are incorrect but I, II are correct  
(C) I, III are incorrect but II, IV are correct      (D) II, IV are incorrect but I, III are correct

**Q.93** Due to which of the following organism, yield of rice increased?

- (A) *Sesbania*      (B) *Bacillus papilliae*      (C) *Anabaena*      (D) *Bacillus subtilis*

**Q.94** Which of the following is a correct matching of a microbe and its industrial product?

- (A) *Mortierella renispora* - Pectinase  
(B) *Aspergillus niger* - Streptokinase  
(C) *Streptococci* - Tissue plasminogen activator  
(D) *Lactobacillus bulgaricus* - Gluconic acid

**Q.95** A highly aerobic and metabolically versatile organism used in oil-spill clearing is

- (A) *Mycobacterium smegmatis*      (B) *Azotobacter vinelandii*  
(C) *Pseudomonas putida*      (D) *Leuonostoc mesenteroides*

## Previous Years' Questions

- Q.1** *Lactobacillus* mediated conversion of milk to curd results because of: **[DPMT 2010]**
- (A) Coagulation and partial digestion of milk fats  
(B) Coagulation and partial digestion of milk proteins  
(C) Coagulation of milk proteins and complete digestion of milk fats  
(D) Coagulation of milk fats and complete digestion of milk proteins
- Q.2** *Bacillus thuringiensis* is used to control: **[DPMT 2010]**
- (A) Bacterial pathogens (B) Fungal pathogens  
(C) Nematodes (D) Insect pests
- Q.3** Probiotics are: **[DPMT 2010]**
- (A) Cancer-inducing microbes (B) Safe antibiotics  
(C) Live microbial food supplements (D) Food allergens
- Q.4** Which of the following microbes is used for commercial production of ethanol? **[DPMT 2010]**
- (A) *Clostridium butylinum* (B) *Streptococcus*  
(C) *Trichoderma polysporum* (D) *Saccharomyces cerevisiae*
- Q.5** Penicillin was discovered by: **[DPMT 2010]**
- (A) A. Flemming (B) W. Flemming (C) Blackslee (D) Dodge
- Q.6** A prokaryotic autotrophic nitrogen-fixing symbiont is found in: **[CBSE 2011]**
- (A) *Alnus* (B) *Cycas* (C) *Cicer* (D) *Pisum*
- Q.7** Which one of the following is not a biofertilizer? **[CBSE 2011]**
- (A) *Agrobacterium* (B) *Rhizobium* (C) *Nostoc* (D) Mycorrhiza
- Q.8** An organism used as a biofertilizer for raising soyabean crop is: **[CBSE 2011]**
- (A) *Azotobacter* (B) *Azospirillum* (C) *Rhizobium* (D) *Nostoc*

**Q.9** The function of leghaemoglobin in the root nodules of legumes is: **[CBSE 2011]**

- (A) Inhibition of nitrogenase activity                      (B) Oxygen removal  
(C) Nodule differentiation                                      (D) Expression of nif gene

**Q.10** Which one of the following helps in absorption of phosphorus from soil by plants? **[CBSE 2011]**

- (A) *Glomus*                      (B) *Rhizobium*                      (C) *Frankia*                      (D) *Anabaena*

**Q.11** Organisms called methanogens are most abundant in a: **[CBSE 2011]**

- (A) Sulphur rock    (B) Cattle yard  
(C) Polluted stream    (D) Hot spring

**Q.12** Cyclosporin – A, which is used as an immunosuppressive agent, is produced by: **[Kerala PMT 2011]**

- (A) *Aspergillus*                      (B) *Clostridium*                      (C) *Saccharomyces*                      (D) *Monascus*  
(E) *Trichoderma*

**Q.13** Flemming, Chain and Florey were awarded the Noble Prize in 1945 for the discovery of:

**[Kerala PMT 2011]**

- (A) HIV                      (B) CT-scan                      (C) Penicillin                      (D) Staphylococcus  
(E) Antibodies

**Q.14** Which among these are produced by distillation of fermented broth? **[Kerala PMT 2011]**

- (i) Whisky                      (ii) Wine                      (iii) Beer                      (iv) Rum                      (v) Brandy  
(A) (ii) and (iii)    (B) (i) and (ii) alone  
(C) (iii) and (v) alone    (D) (i), (iv) and (v) alone  
(E) (iii) and (iv) alone

**Q.15** Nitrifying bacteria: **[CBSE 2011]**

- (A) Convert free nitrogen to nitrogen compounds  
(B) Convert proteins into ammonia  
(C) Reduce nitrates to free nitrogen  
(D) Oxidise ammonia to nitrates

**Q.16** Ethanol is commercially produced through a peculiar species of: **[CBSE 2011]**

- (A) *Clostridium* (B) *Trichoderma*  
(C) *Aspergillus* (D) *Saccharomyces*

**Q.17** Rotenone is a: **[DUMET 2011]**

- (A) Bioherbicide (B) Commonly used biofertilizer  
(C) Bioinsecticide (D) Juvenile hormone

**Q.18** Which of the following plants are used as green manure in crop fields and in sandy soils? **[Mah. CET 2011]**

- (A) *Crotalaria juncea* and *Alhali comelorum*  
(B) *Crotalaria procera* and *Phyllanthus niruri*  
(C) *Saccharum munja* and *Lantana camara*  
(D) *Dichanthum annulatum* and *Acacia nilotica*

**Q.19** A common biocontrol agent for the control of plant disease is: **[RPMT 2011]**

- (A) *Agrobacterium* (B) *Glomus*  
(C) *Trichoderma* (D) Baculovirus

**Q.20** In paddy fields, biological nitrogen fixation is chiefly brought by: **[RPMT 2011]**

- (A) Cyanobacteria (B) Green algae  
(C) Mycorrhizae (D) *Rhizobium*

**Q.21** Cyclosporin-A, which is used as an immunosuppressant agent, is produced by: **[Kerala PMT 2011]**

- (A) *Aspergillus* (B) *Closteridium* (C) *Saccharomyces*  
(D) *Monascus* (E) *Trichoderma*

**Q.22** Food poisoning is caused by: **[Mah. CET 2011]**

- (A) *Nitrosomonas* (B) *Lactobacillus*  
(C) *Escherichia coli* (D) None of these

**Q.23** The most abundant prokaryotes helpful to human in making curd from milk and in production of antibiotics are the ones categorised as: **[CBSE 2012]**

- (A) Cyanobacteria (B) Archaeobacteria  
(C) Chemosynthesis autotrophs (D) Heterotrophic bacteria

**Q.24** *Monascus purpureus* is a yeast commonly used commercially in production of: **[CBSE 2012]**

- (A) Ethanol  
(B) Streptokinase for removing clots from blood vessels  
(C) Citric acid  
(D) Blood cholesterol lowering statins

**Q.25** Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition? **[CBSE 2012]**

- (A) *Azotobacter* (B) *Aspergillus* (C) *Glomus* (D) *Trichoderma*

**Q.26** Yeast is used in the production of: **[CBSE 2012]**

- (A) Citric acid and lactic acid (B) Lipase and pectinase  
(C) Bread and beer (D) Cheese and butter

**Q.27** A nitrogen-fixing microbe associated with *Azolla* in the rice fields is: **[CBSE 2012]**

- (A) *Spirulina* (B) *Anabaena* (C) *Frankia* (D) *Tolypothrix*

**Q.28** Which one of the following is an example of carrying out biological of pests/diseases using microbes? **[CBSE 2012]**

- (A) *Trichoderma* spp. against certain plant pathogens  
(B) Nucleopolyhedrovirus against white rust in *Brassica*  
(C) Bt-cotton to increase cotton yield  
(D) Lady bird beetle against aphids in mustard

**Q.29** *Trichoderma* is an example of which of the following group of Fungi? **[J & K CET 2012]**

- (A) Phycomycetes (B) Zygomycetes  
(C) Deuteromycetes (D) Basidiomycetes

**Q.30** To speed up the malting process in brewing industry, the growth hormone used is: **[AMU 2012]**

- (A) Auxin (B) Gibberlic acid  
(C) Kinetin (D) Ethylene

**Q.31** Lactic acid bacteria (LAB) grow in milk and convert it to curd and improve its nutritional quality by increasing: **[AMU 2012]**

- (A) Vitamin-A (B) Vitamin-B<sub>12</sub>  
(C) Vitamin – B<sub>1</sub> (D) Vitamin – C and A

**Q.32** An alga which can be employed as food for human being is: **[AIPMT 2014]**

- (A) *Spirogyra* (B) *Polysiphonia*  
(C) *Ulothrix* (D) *Chlorella*

**Q.33** What gases are produced in anaerobic sludge digesters? **[AIPMT 2014]**

- (A) methane, Hydrogen sulphide and CO<sub>2</sub>  
(B) Hydrogen sulphide and CO<sub>2</sub>  
(C) Methane and CO<sub>2</sub> only  
(D) methane, Hydrogen sulphide and CO<sub>2</sub>

**Q.34** Which of the following is included in bioinsecticide? **[Manipur Board 2014]**

- (A) Viruses and bacteria  
(B) Viruses, bacteria and fungi  
(C) Viruses, bacteria, fungi, protozoans and mites  
(D) Viruses, bacteria, fungi and protozoa

**ANSWER KEY****Objective Questions**

Q.1 B	Q.2 D	Q.3 A	Q.4 C	Q.5 D	Q.6 B
Q.7 C	Q.8 A	Q.9 B	Q.10 C	Q.11 B	Q.12 B
Q.13 D	Q.14 D	Q.15 A	Q.16 D	Q.17 D	Q.18 A
Q.19 B	Q.20 C	Q.21 D	Q.22 A	Q.23 D	Q.24 C
Q.25 A	Q.26 B	Q.27 C	Q.28 A	Q.29 C	Q.30 B
Q.31 A	Q.32 D	Q.33 B	Q.34 C	Q.35 C	Q.36 D
Q.37 B	Q.38 C	Q.39 A	Q.40 B	Q.41 B	Q.42 C
Q.43 D	Q.44 C	Q.45 A	Q.46 C	Q.47 B	Q.48 A
Q.49 A	Q.50 B	Q.51 A	Q.52 C	Q.53 D	Q.54 A
Q.55 A	Q.56 B	Q.57 A	Q.58 B	Q.59 C	Q.60 B
Q.61 B	Q.62 A	Q.63 A	Q.64 A	Q.65 A	Q.66 A
Q.67 B	Q.68 C	Q.69 B	Q.70 A	Q.71 A	Q.72 D
Q.73 B	Q.74 A	Q.75 B	Q.76 B	Q.77 A	Q.78 D
Q.79 A	Q.80 D	Q.81 B	Q.82 B	Q.83 D	Q.84 A
Q.85 C	Q.86 D	Q.87 A	Q.88 B	Q.89 D	Q.90 C
Q.91 A	Q.92 A	Q.93 C	Q.94 C	Q.95 C	

**Previous Years' Questions**

Q.1 B	Q.2 D	Q.3 C	Q.4 D	Q.5 A	Q.6 B
Q.7 A	Q.8 C	Q.9 B	Q.10 A	Q.11 B	Q.12 E
Q.13 C	Q.14 D	Q.15 D	Q.16 D	Q.17 C	Q.18 A
Q.19 C	Q.20 A	Q.21 E	Q.22 B	Q.23 D	Q.24 D
Q.25 C	Q.26 C	Q.27 B	Q.28 A	Q.29 C	Q.30 B
Q.31 B	Q.32 D	Q.33 D	Q.34 B		