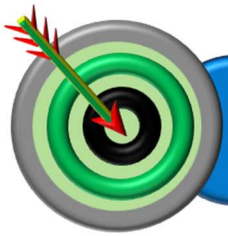
Chapter
08

Microbes in Human Welfare



OBJECTIVES

- INTRODUCTION
- MICROBES IN HOUSEHOLD PRODUCTS
- MICROBES IN INDUSTRIAL PRODUCTS
- MICROBES IN SEWAGE TREATMENT
- MICROBES IN PRODUCTION OF BIOGAS
- MICROBES AS BIOCONTROL AGENTS
- MICROBES AS BIOFERTILISERS

INTRODUCTION

Besides macroscopic plants and animals, microbes are major components of biological systems on this earth. Microbes are present everywhere in soil, water, air, inside our bodies and that of other animals and plants. They are present even at sites where no other life-form could possibly exist, e.g., deep inside the geysers (thermal vents) where the temperature may be as high as 100°C, deep in the soil, under the layers of snow several meters thick and in highly acidic environments.

Microbes belong to diverse groups of organisms like bacteria, fungi, protozoa, and microscopic plants. Viruses, viroids and prions (proteinaceous infectious agents) are also included among microbes. Some of the microbes are shown below.

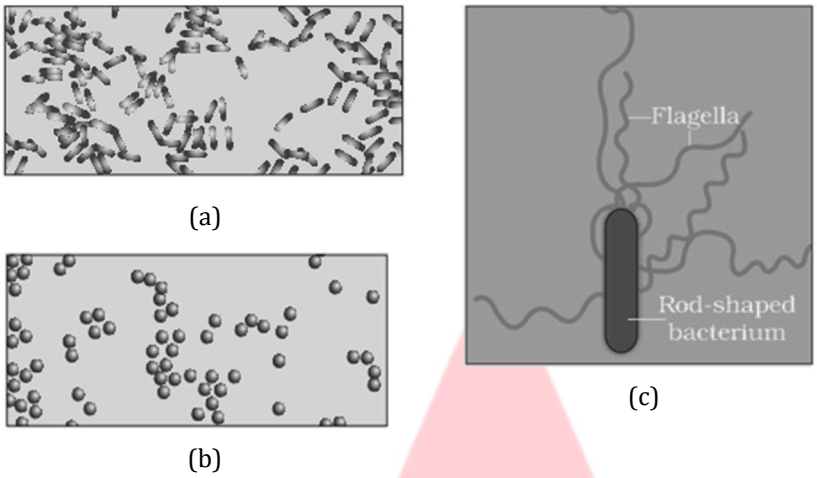


Fig. Bacteria: (a) Rod-shaped, magnified 1500X; (b) Spherical shaped, magnified 1500X; (c) A rod-shaped bacterium showing flagella, magnified 50,000X.

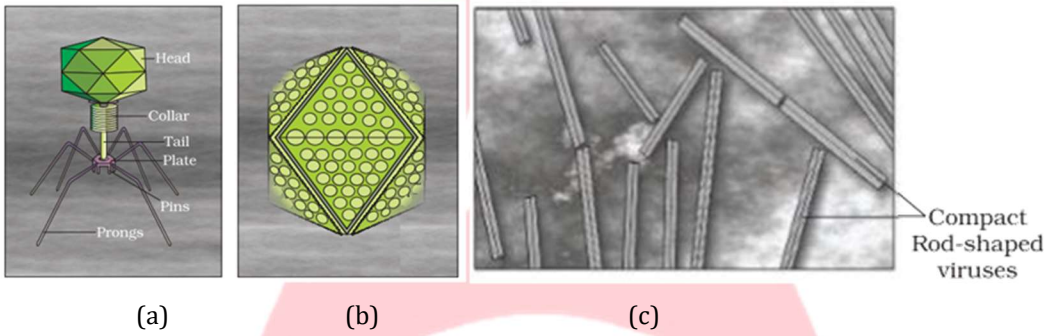


Fig.: Viruses: (a) A bacteriophage; (b) Adenovirus which causes respiratory infections; (c) Rod-shaped Tobacco Mosaic Virus (TMV). Magnified about 1,00,000 – 1,50,000X

Microbes like bacteria and many fungi can be grown on nutritive media to form colonies, that can be seen with naked eyes. Such cultures are useful in studies on micro-organisms

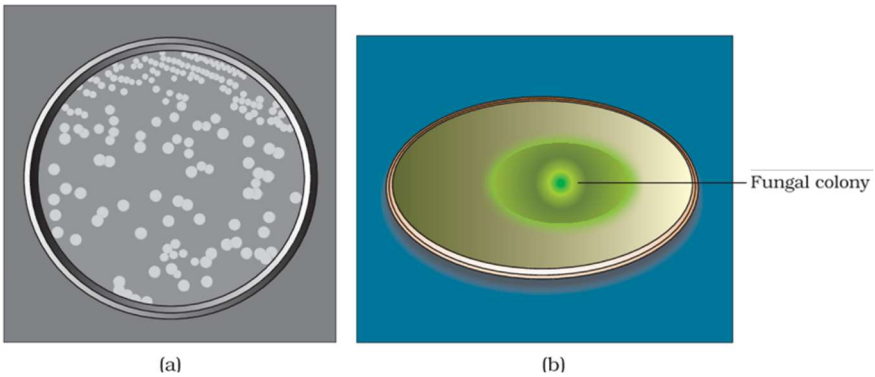


Fig.: (a) Colonies of bacteria growing in a petri dish; (b) Fungal colony growing in a petri dish

While microbes are causal agents of most of the infectious diseases, they are also useful to humans in many important processes at home, industries, agriculture and sevage treatment.

8.1 MICROBES IN HOUSEHOLD PRODUCTS

8.1.1 Dairy Product:-

Micro-organisms such as Lactobacillus and others commonly called **lactic acid bacteria (LAB)** grow in milk and convert it to curd. During growth, the LAB produce acids that coagulate and partially digest the milk protei n **casein**. Milk is changed into curd, yoghurt and cheese A small amount of curd added to the fresh milk as inoculum or starter contain millions of LAB, which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing vitamin B_{12}. In our stomach too, the LAB play very beneficial role in checking disease causing microbes.

Critical Thinking

The bacteria, ***Lactobacillus bulgaricus*** produces lactic acid and ethanol, a characteristic yogurt flavour and ***S. thermophilus*** adds a characteristic creamy flavour

8.1.2 Cheese

Cheese, is one of the oldest food items in which microbes were used. It is partially degraded concentrate of milk fat and casein

Different varieties of cheese are known by their characteristic texture, flavour and taste, the specificity coming from the microbes used.

The large holes in 'Swiss cheese' are due to production of a large amount of CO_2 by a bacterium named *Propionibacterium sharmanii*.

Critical Thinking

Nearly 400 varieties of cheese available which can be classified into following type –

	Types of cheese	Micro organism used for ripening
1.	**Soft** (Camembert cheese)	*Penicillium camemberti*
2.	**Semi-hard** (Roquefort cheese)	*Penicillium roqueforti*
3.	**Hard** (Swiss cheese)	*Propionibacterium sharmanii*

8.1.3 Other Product:-

- The dough, which is used for making food such as dosa and idli is also fermented by bacteria. The puffed-up appearance of dough is due to the production of CO_2 gas.
- Bread is prepared from dough, which is fermented using baker's yeast (*Saccharomyces cerevisiae*).
- A number of traditional drinks (e.g. 'Toddy' prepared from sap of palms) and foods are also made by fermentation by the microbes.
- Microbes are also used to ferment fish, soyabean and bamboo shoots to make foods.

TOPIC CENTRIC EXERCISE -01

Q1. Which of the following statements is incorrect?

(a) Besides microscopic plants and animals, microbes are the major components of biological systems on this earth.

(b) Microbes are present only at specific location.

(c) Microbes are diverse - protozoa, bacteria, fungi and microscopic plant viruses, viroids and also prions.

(d) Prions are infectious agents. Proteinaceous

Q2. If someone wants to make curd from milk, a small amount of curd is added to fresh small amount of curd containing millions of LAB is known as

(a) Accelerator (b) Promoter

(c) Inoculum (d) Germ

Q3. The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is:

(a) Vitamin C (b) Vitamin D

(c) Vitamin B_{12} (d) Vitamin E

Q4. Big holes in Swiss cheese are made by a:

(a) Machine

(b) Bacterium that produces methane gas

(c) Bacterium producing a large amount of carbon dioxide

(d) Fungus that releases a lot of gases during its metabolic activities.

Q5. Roquefort cheeses is ripened by growing a specific fungus on it which gives it a particular____.

(a) Texture (b) Large hole

(c) Flavour (d) Colour

8.2 MICROBES IN INDUSTRIAL PRODUCTS

8.2.1 Alcoholic Fermentation

Microbes especially yeasts have been used from time immemorial for the production of beverages like wine, beer, whisky, brandy or rum. For this purpose the same yeast Saccharomyces cerevisiae used for bread-making and 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

Clue Finder

Some other common products of yeast fermentation are –

- Beer - It is produced from Hordeum Vulgare [Barely] malt and alcohol content is 3-6%
- Wine - Produced from grapes, alcohol content is 10-20%.
- Brandy - Produced by distilation of wine and alcohol content is 60-70%
- Gin-Produced from European Rye-Scale cereal, alcohol content is 40%.
- Rum - Produced from Molasses of Sugarcane and alcohol contents is 40%

Fermentor

Fermentation plant

8.2.2 Antibiotics

Antibiotics produced by microbes are regarded as one of the most significant discoveries of the twentieth century and have greatly contributed towards the welfare of the human society. *Anti* is a Greek word that means 'against', and *bio* means 'life', together they mean 'against life' (in the context of disease causing organisms); whereas with reference to human beings, they are 'prolife' and not against.

Antibiotics are chemical substances, which are produced by some microbes and can kill or retard the growth of other (disease-causing) microbes. The first antibiotic **Penicillin** was discovered by Alexander Fleming while working on *Staphylococci* bacteria, he observed a mould growing in one of his unwashed culture plates around which *Staphylococci* could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould *Penicillium notatum*.

However, its full potential as an effective antibiotic was established much later by **Ernest Chain** and **Howard Florey.** This antibiotic was extensively used to treat American soldiers wounded in World War II. Fleming, Chain and Florey were awarded the Nobel Prize in 1945, for this discovery.

After Penicillin, other antibiotics were also purified from other microbes. Antibiotics have greatly improved our capacity to treat deadly diseases such as plague, whooping cough (kali khansi), diphtheria (gal ghotu) and leprosy (kusht rog), which used to kill millions all over the globe.

Critical Thinking

The term "antibiotic" was coined by **Waksman** (1942), **Broad spectrum antibiotic** is an antibiotic which can kill or destroy a number of and wall composition. **Specific antibiotic** is an antibiotic which is effective only against one type of pathogens

8.2.3 Chemical, Enzymes and Other Bioactive Molecules

8.2.3.1 Organic Acids

Some organic acids are manufactured by employing fermentation activities of Fungi and others of Bacteria.

For example :-

	Organic acid	Source
1	Citric acid	Fungus *Aspergillus niger*
2	Acetic acid (Vinegar)	Bacterium *Acetobacter aceti*
3	Lactic acid	Bacterium *Lactobacillus bulgaris* and *Streptococcus lactis*
4	Butyric-acid	Bacterium *Clostidium butylicum*

8.2.3.2 Enzymes

(i) The bottlejuices are clarified by the use of protease and pectinases

(ii) Streptokinase– This enzyme utilized in medicinal field. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

8.2.3.3 Bioactive Molecule

(i) Cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*.

(ii) Statins produced by the yeast *Monascus purpureus* have been commercialised as blood -cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

TOPIC CENTRIC EXERCISE -02

Q1. How many of the following beverages are produced by distillation of the fermented broth?- Whisky wine rum, brandy, beer

(a) 5 (b) 4

(c) 3 (d) 1

Q2. Which of the following option is not true for penicillin?

(a) Its full potential as an effective antibiotic was established much later by Ernest chain and Howard Florey.

(b) This antibiotic was extensively used to treat American soldiers wounded in World War II.

(c) Produced by the bacteria

(d) Both b and c

Q3. Which industry products are synthesized from microbes?

(A) Antibiotics

(B) Fermented beverages

(C) Enzymes and chemicals

(D) Bioactive molecules

(a) A, C, D (b) A, B, C, D

(c) A, C (d) A, B, C

Q4. The bioactive molecule cyclosporin A is used in:

(a) Whooping cough (b) Diphtheria

(c) Leprosy (d) Organ-transplant patients

Q5. The enzymes streptokinase is used medicinally to

(a) Check growth of microbes in body fluids

(b) Remove blood clots from the blood vessels

(c) Weaken walls of blood vessels

(d) Create blood clots in blood vessels

8.3 MICROBES IN SEWAGE TREATMENT

We know that large quantities of waste water are generated everyday in cities and towns. A major component of this waste water is human excreta. This municipal waste-water is also called sewage. It contains large amounts of organic matter and microbes. Many of which are pathogenic. Therefore,sewage cannot be discharged into natural water bodies like rivers and streams directly. Before disposal, hence, sewage is treated in sewage treatment plants (STPs) to make it less polluting. Treatment of waste water is done by the heterotrophic microbes naturally present in the sewage. This treatment is carried out in two stages:

8.3.1 Primary treatment :

These treatment steps basically involve physical removal of particles – large and small – from the sewage through filtration and sedimentation. These are removed in stages; initially, floating debris is removed by sequential filtration. Then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle form the primary sludge, and the supernatant forms the effluent. The effluent from the primary settling tank is taken for secondary treatment.

8.3.2 Secondary treatment or Biological treatment:

The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into **flocs** (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the **BOD (biochemical oxygen demand)** of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria. The sewage water is treated till the BOD is reduced. The BOD test measures the rate of uptake of oxygen by micro-organisms in a sample of water and thus, indirectly, BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, more is its polluting potential.

Fig. Secondary Treatment

Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge.** 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 sludge is pumped into large tanks called **anaerobic sludge digesters**. Here, other kinds of bacteria, which grow anaerobically, 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 source of energy as it is inflammable.

The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

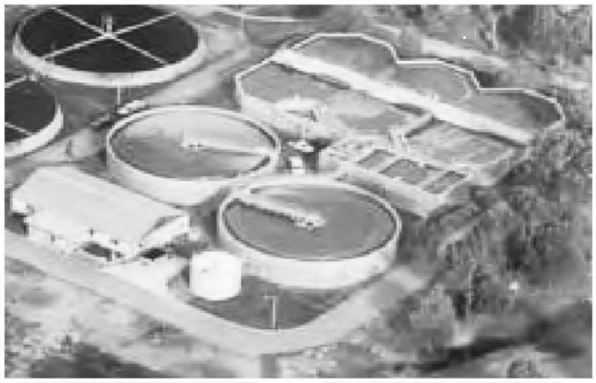


Fig. An aerial view of a sewage plant

Due to increasing urbanisation, sewage is being produced in much larger quantities than ever before. However the number of sewage treatment plants has not increased enough to treat such large quantities. So the untreated sewage is often discharged directly into rivers leading to their pollution and increase in water-borne diseases.

The Ministry of Environment and Forests has initiated **Ganga Action Plan** and **Yamuna Action Plan** to save these major rivers of our country from pollution. Under these plans, it is proposed to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

TOPIC CENTRIC EXERCISE -03

Q1. The primary treatment of sewage involves:

(a) Digestion (b) Decomposition

(c) Sedimentation and filtration (d) None of these

Q2. Microorganisms are used during which stage of the purification of the sewage water?

(a) Primary treatment (b) Secondary treatment

(c) None of the above (d) Both (a) and (b)

Q3. What would happen if oxygen availability to activated sludge flocs is reduced?

(a) It will slow down the rate of degradation of organic matter.

(b) The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.

(c) Flocs would increase in size as anaerobic bacteria would grow around flocs.

(d) Protozoa would grow in large numbers

Q4. What gases are produced in anaerobic sludge digesters?

(a) Methane and CO_2 only

(b) Methane, Hydrogen sulphide and CO_2

(c) Methane, hydrogen sulphide and O_2

(d) Hydrogen sulphide and CO_2

Q5. The domestic sewage in large cities

(a) Has a high BOD as it contains both aerobic and anaerobic bacteria

(b) Is processed by aerobic and then anaerobic bacteria in the secondary treatment in sewage treatment plants (STPs)

(c) When treated in STPs does not really require the aeration step as the sewage contains adequate oxygen

(d) Has very high amounts of suspended solids and dissolved salts

8.4 MICROBES IN PRODUCTION OF BIOGAS

Biogas is a mixture of gases (containing predominantly methane) produced by microbial activity and which may be used as fuel. Major component of biogas is methane (50-70%) which is highly inflammable, other gases are carbon dioxide (30-40%) and mixture of other gases H_2, H_2S etc. (10%).

1. Microbes produce different types of gaseous end-products during growth and metabolism. Certain bacteria, which grow anaerobically on cellulosic material, produce large amount of methane along with CO_2 and H_2.These bacteria are collectively called **Methanogens** and one such common bacterium is *Methanobacterium*.
2. These bacteria are commonly found in anaerobic sludge during sewage treatment. These bacteria are also present in the rumen of cattle where they help in the breakdown of cellulose and play an important role in the nutrition of cattle. Thus, the excreta (dung) of cattle, commonly called *gobar*, is rich in these bacteria. Dung can be used for generation of biogas, commonly called *gobar gas*.
3. The technology of biogas production was developed in India mainly due to the efforts of **Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC)**.

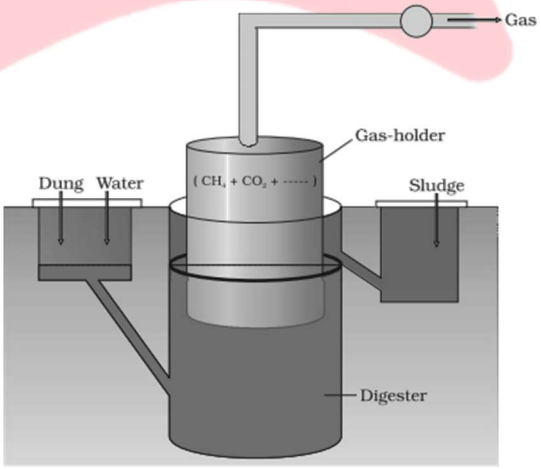


Fig. A typical biogas plant

4. The biogas plant consists of :
   - I. A concrete tank, 10-15 feet deep, in which bio-wastes are collected and a slurry of dung is fed.
   - II. A floating cover is placed over the slurry, which keeps on rising as the gas is produced in the tank due to microbial activity. It has an outlet, which is connected to a pipe to supply biogas to nearby houses.
   - III. The spent slurry is removed through another outlet and may be used as fertiliser.

5. Cattle dung is available in large quantities in rural areas where cattles are used for a variety of purposes. So, biogas plants are more often built in rural areas. The biogas thus produced, is used for cooking and lighting.

TOPIC CENTRIC EXERCISE -04

Q1. Which of the following statements about methanogens is not correct?
(a) They can be used to produce biogas
(b) They are found in the rumen of cattle and their excreta.
(c) They grow aerobically and breakdown cellulose-rich food
(d) They produce methane gas.

Q2. Methanogens do not produce
(a) Oxygen (b) Methane
(c) Hydrogen sulphide (d) Carbon dioxide

Q3. The residue left after methane production from cattle dung is:
(a) Burnt (b) Buried in land fills
(c) Used as manure (d) Used civil construction

Q4. The depth of concrete tank, a part of biogas plant ranges from_____to_____.
(a) 10-15 feet (b) 10-15 metre
(c) 15-20 feet (d) 15-20 meter

Q5. Find out which one of the following statements is not correct with respect to gobar-gas plant?
(a) It has a floating cover which keeps on rising as gas produced
(b) It is developed by IARI and KVIC
(c) Main gas produced is butane, isobutene & propane
(d) Spent slurry may be used as fertilizer

8.5 MICROBES AS BIOCONTROL AGENTS

Biocontrol refers to the use of biological methods for controlling plant diseases and pests. In modern society, these problems have been tackled increasingly by the use of chemicals – by use of insecticides and pesticides. These chemicals are toxic and extremely harmful, to human beings and animals alike, and have been polluting our environment (soil, ground water), fruits, vegetables and crop plants. Our soil is also polluted through our use of weedicides to remove weeds.

8.5.1 Biological control of pests and diseases:

In agriculture, there is a method of controlling pests that relies on natural predation rather than introduced chemicals. A key belief of the organic farmer is that biodiversity furthers health. The more variety a landscape has, the more sustainable it is. The organic farmer, therefore, works to create a system where 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. Contrary to the 'conventional' farming practices which often use chemical methods to kill both useful and harmful life forms indiscriminately, this is a holistic approach that seeks to develop an understanding of the webs of interaction between the myriad of organisms that constitute the field fauna and flora.

The organic farmer holds the view that the eradication of the creatures that are often described as pests is not only possible, but also undesirable, for without them the beneficial predatory and parasitic insects which depend upon them as food or hosts would not be able to survive. Thus, the use of biocontrol measures will greatly reduce our dependence on toxic chemicals and pesticides. An important part of the biological farming approach is to become familiar with the various life forms that inhabit the field, predators as well as pests, and also their life cycles, patterns of feeding and the habitats that they prefer. This will help develop appropriate means of biocontrol.

8.5.2 Biopesticides

Biopesticides are those biological agents that are used for control of weeds, insects and pathogens.
The micro-organisms used as biopesticides include viruses, bacteria, fungi, protozoa and mites.
Example of biocontrol

I. ***Bacillus thuringiensis:***- It is the example of soil bacterium. Spores of the bacterium produce the insecticidal Cry protein. Therefore, spores of this bacterium kill larvae of certain insects.
The commercial preparations of *B. thuringiensis* contain a mixture of spores, Cry protein.
This bacterium was the first biopesticide to be used on a commercial scale in the world.
An example of microbial biocontrol agents that can be introduced in order to **control butterfly** caterpillars is the bacteria *Bacillus thuringiensis* (often written as Bt). These are available in sachets as dried spores which are mixed with water and sprayed onto vulnerable plants such as brassicas and fruit trees, where these are eaten by the insect larvae.
In the gut of the larvae, the toxin is released and the larvae get killed. The bacterial disease will kill the caterpillars, but leave other insects unharmed. Because of the development of methods of genetic engineering in the last decade or so, the scientists have introduced B. thuringiensis toxin genes into plants. Such plants are resistant to attack by insect pests.
Bt-cotton is one such example, which is being cultivated in some states of our country.

II. The very familiar beetle with red and black markings-the Ladybird are useful to get rid of aphids.

III. Dragonflies are useful to get rid of mosquitoes.

IV. Fungal pathogens are attractive biocontrol agents for weed control in view of their host specificity and ease in production and inoculation in the field.
A biological control being developed for use in the treatment of plant disease is the fungus Trichoderma. Trichoderma species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

V. **Baculoviruses**:- are pathogens that attack insects and other arthropods.
The majority of baculoviruses used as biological control agents are in the genus Nucleopolyhedrovirus. These viruses are excellent candidates for species-specific, narrow spectrum insecticidal application. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects. This is especially desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

TOPIC CENTRIC EXERCISE -05

Q1. Biological control agents is obtained from:-
(a) *Bacillus thruingiensis* (b) *Monascus purpureus*
(c) *Streptococcus* (d) *Aspergillus niger*

Q2. The free-living fungus Trichoderma can be used for:
(a) Killing insects (b) Biological control of plant diseases
(c) Controlling butterfly caterpillars (d) Producing antibiotics

Q3. Identify the incorrectly matched pair
(a) Baculoviruses — Species-specific broad-spectrum insecticides
(b) Trichoderma — Free living fungi common in root ecosystems
(c) Ladybird — Biocontrol of aphids
(d) Organic farming — Pests kept at manageable levels rather than completely eradicated

Q4. 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.

Q5. Bt-spores are mixed with _____ and sprayed on vulnerable plants
(a) Only alcohol (b) Any organic solvent
(c) Only water (d) Any aqueous solvent

8.6 MICROBES AS BIOFERTILISERS

Biofertilisers are organisms that entrich the nutrient quality (N, P) of the soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria.

1. ***Rhizobium*** (symbiotic bacteria) fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient.
   Other bacteria like *Azospirillum* and *Azotobacter* can fix atmospheric nitrogen while free-living in the soil thus enriching the nitrogen content of the soil.
2. Fungi are also known to form symbiotic associations with plants (mycorrhiza). Many members of the genus *Glomus* form mycorrhiza.
   Fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Also provide resistance to root-borne pathogens, tolerance to salinity and drought and cause an overall increase in plant growth and development.
3. Cyanobacteria are autotropic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen. (*e.g. Anabaena, Nostoc, Oscillatoria, etc.*)
   In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also add organic matter to the soil and increase its fertility.
   Biofertilisers are a low-cost input and they do not pollute the environment. They are use to replenish soil nutrients. They also reduce the dependence on chemical fertilisers and also help to use organic farming.

TOPIC CENTRIC EXERCISE -06

Q1. Which of the following cyanobacteria can fix atmospheric nitrogen
A. *Nostoc*
B. *Anabaena*
C. *Oscillatoria*
D. Yeast
(a) A, C, D (b) C, D
(c) A, C (d) A, B, C

Q2. Which of the following serve as biofertilizer in paddy fields?
(a) Bacteria (b) Yeast
(c) Cyanobacteria (blue-green algae (d) Fungi

Q3. Mycorrhiza does not help the plant in
(a) Providing tolerance to salinity and drought.
(b) Being susceptible to root borne pathogens.
(c) Overall increase in plant growth and development.
(d) Absorption of nutrients.

Q4. Among given microbes, how many are present in association
Anabaena, Oscillatoria, Rhizobium, Glomus, Azospirillum, Azotobactor
(a) Five (b) Three
(c) Two (d) One

Q5. Mycorrhiza absorbs _____ from soil and passes it to the plant.
(a) K (b) P
(c) Fe (d) Mg

Solved Examples

Ex: 1. Choose the correct option with regard to statement A and B.
A: Lactic Acid Bacteria (LAB) are responsible for converting milk into curd.
B: LAB creates acidic medium necessary to coagulate and fully digest the milk proteins.
(a) Statements A and B are correct (b) Statements A and B are incorrect.
(c) Statement A is correct but B is incorrect (d) Statement B is correct and A is incorrect

Sol. **(c)** Lactic Acid Bacteria (LAB) are responsible for converting milk into curd. LAB creates acidic medium necessary to coagulate and partially digest the milk proteins

Ex: 2. The fruit juices available commercially are clearer than ones which are homemade. Which ingredient is added in commercially available fruit juices?
(a) Lipase and protease (b) Pectinase and hydrolase
(c) Pectinase and protease (d) Hydrolase and protease

Sol. **(c)** The bottled juices are clarified by the use of pectinases and proteases that is why the fruit juices available commercially are clearer than ones which are homemade

Ex: 3. **The enzyme streptokinase is used medicinally to**

(a) Check growth of microbes in body fluids (b) Remove blood clots from the blood vessels

(c) Weaken walls of blood vessels (d) Create blood clots in blood vessels

Sol. **(b)** Streptokinase produced by the bacterium Streptococcus and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack

Ex: 4. **Which drug is generally administered at the time of organ-transplant procedure?**

(a) Actinomycin-D (b) Bleomycin

(c) Cyclosporin-A (d) Paclitaxel

Sol. **(c)** Cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*

Ex: 5. **The mechanism of action of statins is _____.**

(a) Allosteric inhibition of enzyme is responsible for the synthesis of cholesterol.

(b) Competitive inhibition of enzyme is responsible for the synthesis of cholesterol.

(c) Irreversible inhibition of enzyme is responsible for the synthesis of cholesterol.

(d) None of the above

Sol. **(b)** Statins acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol

Ex: 6. **Primary treatment of sewage waste involves which processes?**

(a) Filtration and incubation (b) Sedimentation and decantation

(c) Filtration and sedimentation (d) Sedimentation and microbial proliferation

Sol. **(c)** Physical treatment steps basically involve physical removal of particles – large and small – from the sewage through filtration and sedimentation

Ex: 7. **In primary treatment of sewage water, removal of grit involves which process?**

(a) Decantation (b) Picking

(c) Filtration (d) Sedimentation

Sol. **(d)** In primary treatment, the grit (soil and small pebbles) are removed by sedimentation.

Ex: 8. **BOD can be defined as**

(a) Amount of CO_2 consumed if all the inorganic matter in one litre of water is oxidized by bacteria.

(b) Amount of O_2 consumed if all the organic matter in one decilitre of water is reduced by bacteria.

(c) Amount of O_2 consumed if all the organic matter in one litre of water is oxidized by bacteria.

(d) Amount of O_2 consumed if all the inorganic matter in one litre of water is oxidized by bacteria.

Sol. **(c)** BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria

Ex: 9. **Once BOD from the sewage is reduced significantly, the 'flocs' are allowed to sediment and it is known as _____.**

(a) Primary sludge (b) Secondary sludge

(c) Activated sludge (d) Inactivated sludge

Sol. **(c)** Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge.

Ex: 10. **In an anaerobic sludge digester, anaerobically digesting bacteria digest which microbes?**

(a) Fungi (b) Bacteria

(c) Algae (d) Both (a) and (b)

Sol. **(d)** In an anaerobic sludge digester, anaerobically digesting bacteria digest the bacteria and the fungi in the sludge.

Exercise-01 Level -01

1. Microbe which is made up of protein only is-
(a) Bacteria (b) Virus
(c) Viroids (d) Prions

2. Select the correct statement-
(a) Microbes like protozoa can be grown on nutritive media to form colonies.
(b) Microbes can cause diseases in animals but not in plants.
(c) Microbes are not found in highly acidic environments.
(d) All microbes are not harmful; several microbes are useful to human beings in diverse ways.

3. To prevent curd from getting sour, which parameter should be essentially controlled?
(a) Quantity of milk
(b) Amount of LAB added initially
(c) Temperature of the surrounding
(d) Amount of O_2 in surrounding air

4. What is the beneficial role of LAB in our stomach?
(a) It causes souring of milk decreasing nutritional quality.
(b) It increases the amount of vitamin D.
(c) It checks disease causing microbes.
(d) It produces alkali which coagulates and partially digests the milk proteins.

5. The puffed-up dough of dosa and idli is due to _____
(a) Growth of LAB
(b) Production of O_2 & ethanol
(c) Production of CO_2
(d) Growth of fungi *Trichoderma*

6. Yeast is used in the production of
(a) Citric acid and lactic acid
(b) Lipases and pectinase.
(c) Bread
(d) Cheese and butter

7. Which of the following are fermented using microbes?
(a) Fish (b) Bamboo
(c) Soyabean (d) All of these

8. Which of the following is traditional drink of some parts of southern India, made by fermenting sap from palms?
(a) Toddy (b) Coffee
(c) Beer (d) Whisky

9. Which microorganism is involved in the production of Swiss cheese?
(a) *Aspergillus niger*
(b) *Propionibacterium shermanii*
(c) *Saccharomyces cerevisiae*
(d) *Rhizobium*

10. Which of the following organism is used in the production of beverages like wine, beer, whisky brandy or rum?
(a) *Clostridium butylicum*
(b) *Aspergillus niger*
(c) *Saccharomyces cerevisiae*
(d) *Penicillium notatum*

11. The alcoholic beverages produced by the distillation of the fermented broth are
(a) Wine and beer
(b) Wine, whisky and brandy
(c) Whisky, brandy and rum
(d) Whisky, beer and brandy

12. The first antibiotic was a chance discovery which was discovered by ___A___ while working on ___B____
(a) A-Fleming; B-*Penicillium notatum*
(b) A-Waksman; B-*Streptococcus*
(c) A-Fleming; B-*Staphylococci*
(d) A-Waksman; B-*Bacillus brevis*

13. With reference to human beings, the chemicals which are "pro-life" -
(a) Are considered one of the most important discoveries of the 21st 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

14. Acetic acid is commercially produced by:
(a) *Lactobacillus*
(b) *Acetobacter aceti*
(c) *Saccharomyces cerevisiae*
(d) *Clostridium*

15. The fruit juices available commercially are clearer than ones which are homemade. Which ingredient is added in commercially available fruit juices?
(a) Lipase and Protease
(b) Pectinase and Hydrolase
(c) Pectinase and Protease
(d) Hydrolase and Protease

16. Which drug is generally administered at the time of organ-transplant procedure?
(a) Actinomycin-D (b) Bleomycin
(c) Cyclosporin-A (d) Paclitaxel

17. Blood cholesterol lowering agents are known as _____.
(a) Steroids (b) Statins
(c) Lipolytics (d) Diuretics

18. Why is *Monascus purpureus* considered a significant microbe in biotechnology?
(a) It acts as an immunosuppressive agent in organ-transplant patients
(b) It is used in genetic engineering experiments.
(c) It produces statins that lower blood cholesterol levels.
(d) It helps in the production of alcoholic beverages

19. Waste-water treatment 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

20. Primary treatment of wastes is the
(a) Physical removal of large and small particles from sewage
(b) Biological removal of large and small particles from sewage
(c) Both (a) and (b)
(d) Chemical removal of large and small particles from sewage

21. Which one of the following in sewage treatment removes suspended solids?
(a) Tertiary treatment
(b) Secondary treatment
(c) Primary treatment
(d) Sludge treatment

22. The supernatant left after sedimentation of sewage water during primary treatment is known as
(a) Affluent (b) Flocs
(c) Sludge (d) Effluent

23. 'Flocs' refer to
(a) Masses of bacteria associated with fungal filaments to form a mesh-like structure
(b) Primary sludge formed in the sewage treatment plant
(c) The remaining part of the sludge
(d) Biogas' formed from the fermentation of organic wastes.

24. Secondary treatment requires-
(a) Small aeration tanks
(b) Primary effluents
(c) Primary sludge
(d) All of them

25. Activated sludge-
(a) Is generally released into natural water bodies like rivers and streams
(b) Is completely pumped back into aeration tank to serve as inoculum
(c) The major part of the sludge is pumped into large tanks called anaerobic sludge digesters
(d) Undergoes sequential filtration

26. The greater BOD of sample water, relates
(a) Increases oxygen content of water
(b) Decreases oxygen content of water
(c) Decrease carbon dioxide of water
(d) The decrease of temperature of water

27. Microbes are used in
I. Primary treatment of sewage.
II. Secondary treatment of sewage.
III. Anaerobic sludge digesters.
IV. Production of biogas.
Choose the correct option.
(a) I, II and III
(b) I, III and IV
(c) II, III and IV
(d) All of the above

28. BOD is reduced during sewage treatment due to:
(a) Chlorination
(b) Microbial activity in decomposing organic matter
(c) Chemical coagulation
(d) Filtration of solids

29. Which initiative by the Ministry of Environment and Forests aims to prevent river water pollution?
(a) Ganga action plan
(b) Yamuna action plan
(c) Both (a) and (b)
(d) None of the above

30. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the
(a) Thermoacidophiles (b) Methanogens
(c) Eubacteria (d) Halophiles

31. Bacteria producing biogas are found in-
I. Aerobic sludge
II. Rumen of cattle
III. Carnivores
IV. Anaerobic sludge
Choose the correct option.
(a) I and II (b) II and III
(c) II and IV (d) III and IV

32. The technology of biogas production was developed in India mainly due to the efforts of-
(a) Indian Oil Corporation
(b) Indian Agricultural Research Institute and Khadi and Village Industries Commission
(c) Gas Authority of India

(d) Oil and Natural Gas Commission

33. Trichoderma species, free-living fungi, are present in root ecosystems are potentially useful as
(a) Biopesticides
(b) Biofertilisers
(c) Methanogens
(d) Vectors for genetic engineering

34. Which one of the following is an example of carrying out biological control of pests/diseases using microbes?
(a) Trichoderma sp., against certain plant pathogens
(b) Dragonflies against aphids in mustard
(c) Bt cotton to increase cotton yield
(d) Ladybird beetle against aphids in mustard

35. A biocontrol agent to be a part of an integrated pest management should be
(a) Broad spectrum and symbiotic
(b) Free-living and broad spectrum
(c) Narrow spectrum and symbiotic
(d) Species-specific and inactive on non-target organisms

36. Select the correct combination of microbes is for their respective applications-

	Microbe	**Application**
(a)	*Bacillus thuringiensis*	Bioinsecticide
(b)	*Methanobacterium*	Cheese ripening
(c)	*Trichoderma*	Antibiotic production
(d)	*Lactobacillus*	Biogas production

37. The biopesticide *Bacillus thuringiensis* (Bt) is effective because it:
(a) Competes with insects for food.
(b) Produces toxins that kill specific insect larvae.
(c) Fixes nitrogen, reducing pest attacks.
(d) Enhances soil fertility.

38. Ladybird is useful to get rid of:
(a) Aphids (b) Mosquitoes
(c) Boll worm (d) Jassids

39. Mycorrhiza is formed by many members of genus-
(a) *Azotobacter* (b) *Aspergillus*
(c) *Glomus* (d) *Rhizobium*

40. ……. forms the ……. on the roots of leguminous plants respectively
(a) Nodules, Rhizobium
(b) Rhizobium, Nodules
(c) Glomus, Nodules
(d) Glomus, Mycorrhiza

41. The bacteria which can fix atmospheric nitrogen in its free-living form in the soil are –
(a) *Azospirillum* and *Azorhizobium*
(b) *Azospirillum* and *Azotobacter*
(c) *Azotobacter* and *Rhizobium*
(d) *Rhizobium* and *Azospirillum*

42. Conversion of milk to curd which is mediated by Lactobacillus occurs due to
(a) Coagulation and complete digestion of milk proteins
(b) Coagulation and partial digestion of milk proteins
(c) Coagulation of milk proteins and complete digestion of milk fats
(d) Coagulation and partial digestion of milk fats

43. Which of the following are common names of diphtheria, whooping cough and leprosy respectively?
(a) Gal ghotu, kali khansi and kusht rog
(b) Kali khansi, kusht rog and gal ghotu
(c) Kali khansi, gal ghotu and kusht rog
(d) Kusht rog, kali khansi and gal ghotu

44. Which of the following statement is incorrect?
(a) Biofertilizers are used to maintain and improve soil fertility
(b) Chemical fertilizers pollute soil and water resources
(c) Chemical fertilizers are expensive
(d) Most pesticide used these days are specific in nature

45. All of the following are bacteria, except
(a) *Clostridium butylicum*
(b) *Aspergillus niger*
(c) *Lactobacillus*
(d) *Acetobacter aceti*

46. On commercial basis, all of the following organic acids are produced by bacteria, except
(a) Lactic acid (b) Butyric acid
(c) Acetic acid (d) Citric acid

47. Yeast is not used in preparation of
(a) Dough (b) Curd
(c) Whisky (d) Rum

48. Mycorrhiza does not help the host plant in
(a) Enhancing its phosphorus uptake capacity
(b) Increasing its tolerance to drought
(c) Enhancing its resistance to root pathogens
(d) Increasing its resistance to insects.

49. Which of the following statements is **correct** regarding microbes in human welfare?
(a) Saccharomyces cereviceae is useful in industries for production of citric acid
(b) Trichoderma polysporum is used as blood cholesterol lowering agent
(c) Aspergillus niger used to obtain acetic acid
(d) In sewage treatment CO_2, H_2 and CH_4 gases are produced from activated sludge by bacteria such as Methanobacterium

50. Biowaste and slurry of dung in a biogas plant are added to-
(a) Gas holder (b) Floating cover
(c) Digester (d) Outlet pipe

Exercise-02 Level -02

1. (A) Used for making foods such as dosa and idli
(B) Its puffed-up appearance is due to production of CO_2 appearance
Both statements are related with:
(a) Sour cream (b) Yoghurt
(c) Dough (d) Toddy

2. Which of the following organic acid is produced by the fermentation of sugary syrups by *Aspergillus niger*?
(a) Glucose acid (b) lactic acid
(c) Citric acid (d) Acetic acid

3. Statins have been commercialized as blood-cholesterol lowering agent which is obtained by the action of-
(a) Yeast (b) Bacteria
(c) Protozoa (d) Viruses

4. Mark the **incorrect** matched pair:

(a)	Cyclosporin A	-	Removal of clots from blood vessel
(b)	LAB	-	Increases vitamin B_{12}
(c)	Acetic acid	-	Produced by a bacterium
(d)	Butyric acid	-	Produced by a bacteria

5. Large holes in Swiss cheese are due to-
(a) A bacterium which produces methane gas
(b) A fungus which produces oxygen
(c) A bacterium that produces a large amount of carbon dioxide
(d) A fungus that releases a lot of gases during its metabolic activities

6. Mark the **incorrect** statement-
(a) Saccharomyces cerevisiae is used for making both bread and alcohol
(b) Whisky is prepared without distillation
(c) Fleming received Nobel Prize in 1945
(d) BOD is directly proportional to the organic pollution in sewage

7. Primary treatment of waste water involves the removal of:
(a) Harmful bacteria
(b) Particles
(c) Toxic substances
(d) Dissolved impurities

8. Choose the **incorrect** match.
(a) Dragonflies - Get rid of both aphids and mosquitoes
(b) Roquefort cheese - Ripened by growing a specific fungi on them
(c) Statins - *Monascus purpureus*
(d) *Glomus* - Absorbs phosphorus from soil

9. Which of the following bacteria grows anaerobically on cellulosic material and produces large amount of methane along with CO_2 and H_2 is
(a) Thermococcus
(b) Methanobacterium
(c) Streptococcus
(d) Halobacterium

10. Which of the following correctly describes the benefits shown by the plants having mycorrhizal association?
(a) Overall increase in plant growth and development
(b) Tolerance to salinity and drought
(c) Resistance to root-borne pathogens
(d) All of these

11. BOD of waste water is directly estimated by measuring the amount of _____
(a) Oxygen evolution
(b) Oxygen consumption
(c) Biodegradable organic matter
(d) Total organic matter

12. Read the following statements-
A: In our stomach, lactic acid bacteria play very beneficial role in checking disease-causing microbes
B: The dough, which is used for making foods such as dosa and idli, is fermented by fungi and algae
(a) Only A is correct
(b) Only B is correct
(c) Both A and B are correct
(d) Both A and B are incorrect

13. State true (T) or false (F) and choose the correct option.

A. *Bacillus thuringiensis* is a biocontrol agent which controls butterfly caterpillars
B. A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*

	A	B
(a)	T	F
(b)	F	T
(c)	F	F
(d)	T	T

14. 'Flocs' in secondary treatment contain-
(a) Anaerobic heterotrophic bacteria and fungi
(b) Anaerobic heterotrophic bacteria only
(c) Aerobic heterotrophic bacteria and fungi
(d) Aerobic autotropic bacteria.

15. _____ are used in detergent formulations and are helpful in removing oily stains
(a) Amylase (b) Pectinases
(c) Lipases (d) Proteases

16. Methanogens do not produce-
(a) Methane (b) Hydrogen sulphide
(c) Carbon dioxide (d) Oxygen

17. Which bioactive molecule is produced by a fungus and used as an immunosuppressive agent in organ-transplant patients?
(a) Cyclosporin-A (b) Penicillin
(c) Statins (d) Alcohol

18. Bacterium which converts milk into curd is-
(a) Autotrophic (b) Heterotrophic
(c) Chemosynthetic (d) Parasitic

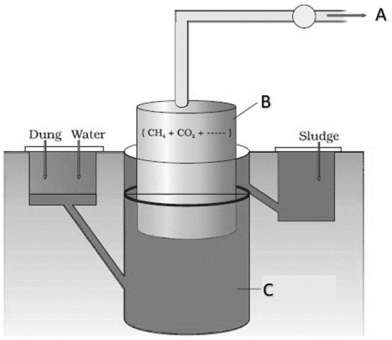
19. Primary treatment in a sewage treatment plant is-
(a) Physical process which involves sedimentation only
(b) Biological process which involves formation of primary sludge and effluent
(c) Physical process which involves both filtration and sedimentation
(d) Biological process which involves both filtration and sedimentation

20. Match the following columns.

	Column I		Column II
A.	Lady bird	i.	*Methano bacterium*
B.	Mycorrhiza	ii.	*Trichoderma*
C.	Biological control	iii.	Aphids
D.	Biogas	iv.	*Glomus*

The correct answer is:
(a) A-ii, B-iv, C-iii, D-i (b) A-iii, B-iv, C-ii, D-i
(c) A-iv, B-i, C-ii, D-iii (d) A-iii, B-ii, C-i, D-i

21. Given below is the diagram of a biogas plant. Identify the parts labelled A, B & C



	A	B	C
(a)	Gas	Sludge	Drug water
(b)	Gas	Gas holder	Digester
(c)	Gas holder	Sludge	Dung water
(d)	Gas holder	Digester	Dung water

22. The major part of Activated sludge is -
(a) Generally released into natural water bodies like rivers and streams
(b) Completely pumped back into aeration tank to serve as inoculum
(c) Pumped into large tanks called anaerobic sludge digesters
(d) Undergoes sequential filtration

23. Which of the following statement is **incorrect?**
(a) Streptokinase is given to patients who have undergone myocardial infarction leading to heart attack
(b) Bacteria Bacillus thuringiensis can control earthworm caterpillars
(c) The scientists are able to introduce Bt toxin genes in to plants, in order to produce pest resistant plants
(d) Antibiotics mean 'against life' but with reference to human beings, they are 'pro life' and not against.

24. The main sources of biofertilizers are
(1) Fungi
(2) Cyanobacteria
(3) Bacteria
(4) Protists
(a) (1), (2), (3) (b) (1), (2), (4)
(c) (2), (3), (4) (d) (1), (3), (4)

25. Methanogens are not found in-
(a) Gobar gas plant
(b) Rumen of cattle
(c) Activated sludge
(d) Bottom of water-logged paddy fields

26. Biofertilizers play an important role in increasing the soil fertility. They are
(a) Microbes used to produce antibiotics only
(b) Organisms that reduce organic matter in paddy fields

(c) Organisms that enrich the nutrient quality of the soil
(d) Chemicals which improve soil quality

27. Which of the following pairs is wrongly matched?

(a)	Activated sludge	:	Secondary treatment
(b)	Fermenter	:	Large vessels for growing microbes
(c)	Biopesticide	:	*Streptococcus*
(d)	Detergent formulations	:	*Lipases*

28. Select the correct statement from the following.
(a) NPV shows no negative impacts on non-target insects
(b) The greater the BOD of waste water, less is its polluting potential
(c) Flocs are masses of bacteria and virus
(d) Biogas is nonflammable hence can be used as source of energy

29. The organism which is used commercially for the production of statins is
(a) *Monascus purpureus*
(b) *Trichoderma polysporum*
(c) *Streptococcus*
(d) *Aspergillus niger*

30. Which of the following statement is ***incorrect*** w.r.t biogas?
(a) Dung can be used for generation of biogas
(b) Production involves anaerobic digestion of organic wastes
(c) It predominantly contains methane
(d) It does not contain hydrogen sulphide

31. State True (T) or False (F) for the following statements.
A. The spent slurry in biogas is used as a fertilizer
B. Microbes like bacteria and many fungi can be grown on nutritive media to form colonies which cannot be seen with naked eyes.
C. Free living nitrogen fixing bacteria are Azospirillum and Azotobacter, enriching the nitrogen content of the soil

	A	B	C
(a)	T	F	T
(b)	T	T	T
(c)	F	T	T
(d)	F	F	T

32. The Ministry of Environment and Forests has initiated Ganga and Yamuna Action Plan to
(a) Prevent water-borne diseases
(b) Discharge untreated sewage into these rivers
(c) Prevent the discharge of untreated sewage into these rivers
(d) Treat waste water biologically only

33. Consider the following four statements (ad) related to organic farming and select the correct option stating which ones are true (T) and which ones are false (F). The statements:
(a) Produces food crops rich in lipids, vitamins and iron.
(b) Uses biofertilisers which increases soil fertility.
(c) There is more use of chemical fertilisers and pesticides.
(d) Raising unpolluted crops through the use of bacteria, fungi and cyanobacteria.
(a) (a) -T, (b) -T, (c) – F, (d) - F
(b) (a) -F, (b) -T, (c) – F, (d) - F
(c) (a) -T, (b) -F, (c) – T, (d) - F
(d) (a) -T, (b) -F, (c) – F, (d) - F

34. Biocontrol agents are preferred over chemical methods of pests and disease control because
(A) They keep pests at manageable level
(B) They do not kill useful organisms
(C) They are non-toxic for non-targeted organisms
(a) Only A (b) Only B
(c) Only B and C (d) Only A, B and C

35. Which of the following statements are correct regarding Swiss cheese?
(a) Swiss cheese contains large holes.
(b) Large holes are due to the production of a large amount of O_2, by a bacterium named *Propionibacterium sharmanii*.
(c) Large holes are due to the production of a large amount of O_2, by a bacterium named *Acetobacter*.
(d) Large holes are due to the production of a large amount of CO_2, by a bacterium named *Propionibacterium sharmanii*.
(a) (a), (b) & (c) (b) (a) & (d)
(c) (a), (c) & (d) (d) (b), (c) & (d)

36. Choose the correct option for A and B -

Type of microbes	**Name**	**Commercial product**
A	*Saccharomyces*	Ethanol
Bacteria	B	Clot buster enzyme

	A	**B**
(a)	Bacterium	*Streptococcus*
(b)	Bacterium	*Acetobacter*
(c)	Yeast	*Clostridium*
(d)	Yeast	*Streptococcus*

37. From the given below microbes, identify those which are used in biological treatment of sewage-
(1) Autotrophic bacteria
(2) Aerobic bacteria
(3) Fungi
(4) Heterotrophic bacteria
(a) Only (1) and (2)
(b) Only (2) and (3)
(c) Only (2), (3) and (4)
(d) Only (1), (2) and (3)

38. All of the following can be biofertilizers, except
(a) Viruses (b) Azotobacter
(c) Glomus (d) Anabaena

39. Read the following four statements.
(a) Dough, which is used for making foods such as dosa and idli, is fermented by fungi and algae.
(b) Toddy, a traditional drink of southern India is made by fermenting sap from palms.
(c) Large holes in Swiss cheese are due to production of large amount of methane by *Propionibacterium sharmanii*
(d) In our stomach, lactic acid bacteria play very beneficial role in checking disease-causing microbes
Choose the incorrect statements.
(a) (a) & (c) (b) (a) & (b)
(c) (b) & (c) (d) (c) & (d)

40. The steps in sewage treatment which removes large and small particles through filtration and sedimentation is-
(a) Biological treatment
(b) Primary treatment
(c) Secondary treatment
(d) Tertiary treatment

41. Select the mismatched pair

(a)	*Azospirillum*	-	Free living N_2-fixing bacteria in soil
(b)	*Glomus*	-	Form mycorrhiza
(c)	BGA	-	Increases soil fertility
(d)	*Azotobacter*	-	Form symbiotic association for N_2-fixation

42. Read the following statements and identify the correct one related to BOD
(1) BOD is directly proportional to polluting potential
(2) The BOD test measures the rate of uptake of oxygen by microorganisms.
(3) BOD is the indirect measure of inorganic matter present in water.
(a) Only (1)
(b) Only (1) and (2)
(c) Only (2) and (3)
(d) All (1), (2) and (3)

43. Which of the following microbial biocontrol agent used to control butterfly caterpillars?
(a) *Bacillus thuringiensis*
(b) *Nucleopolyhedrovirus*
(c) Ladybird
(d) Dragonflies

44. Select the **incorrect** matched pair-
(a) Penicillin - A. Fleming
(b) KVIC - Biogas plant
(c) Flocs - Anaerobic sludge digester
(d) Sedimentation - Primary treatment

45. Correct statements are
(a) The excreta of cattle, commonly called gobar, is rich in Rhizobium.
(b) In rumen, methanogens help in breakdown of cellulose.
(c) Methanogens play an important role in the nutrition of cattle.
(d) Methane, CO, and traces of nitrogen, hydrogen sulphide, and hydrogen make up biogas.
(a) (a) & (b) (b) (b), (c) & (d)
(c) (a) & (d) (d) (b) & (c)

46. Which of the following statements is/are **correct?**
(a) In paddy fields, cyanobacteria serve as an important biofertilizer.
(b) Plants having mycorrhizal associations show functions like tolerance to drought, salinity and resistance to root-borne pathogens.
(c) The important examples of cyanobacteria as biofertilizers are Anabaena, Nostoc and Oscillatoria.
(d) All of these

47. How many statements are correct?
(a) Streptokinase is given to patients who have undergone myocardial infarction leading to heart attack.
(b) Streptokinase is used as a 'clot buster' for removing clots from the blood vessels of patients.
(c) It aids in the clearance of blood clots within blood arteries.
(d) Streptokinase is used as a 'clot buster' for development of clots in the blood vessels of patients.
(a) One (b) Three
(c) Two (d) Four

48. How many statements are incorrect?
(a) The minority of baculoviruses used as biological control agents are in the genus Nucleopolyhedrovirus.

(b) Nucleopolyhedrovirus are excellent candidates for species-specific, broad spectrum insecticidal applications
(c) When vulnerable hosts consume virus particles found on leaves, baculovirus infection develops.
(d) These play a crucial role in organic farming.

(a) One (b) Three
(c) Two (d) Four

49. Consider the following statements.

I. Antibiotics are chemical substances produced by some microorganisms which can kill or retard the growth of other disease-causing microorganisms.
II. Penicillin was the first antibiotic discovered by Alexander Fleming (1928), while working on bacterium Staphylococcus aureus.
III. The function of penicillin as an antibiotic was established by Ernst Chain and Howard Florey.

Which of the statements given above are correct?

(a) I and II (b) I and III
(c) II and III (d) I, II and III

50. Consider the following statements about Bt.

I. The bacteria Bacillus thuringiensis (Bt) are used to control butterfly catterpillars.
II. Fresh spores of Bt are mixed with water and sprayed on to vulnerable plants such as brassicas and fruit trees.
III. Insect larvae, after eating Bt, are killed by the toxin released in their gut.
IV. Bt toxin genes have been introduced into plants to provide resistance to pests.

Which of the statements given above are correct?

(a) I, II and III (b) I, III and IV
(c) II, III and IV (d) I, II, III and IV

Exercise-03 Level -03

Assertion & Reason Based Questions

1. **Assertion:** Antibiotics often accelerates the growth of disease-causing microbes
Reason: Antibiotics have been developed to treat deadly diseases such as plague, whooping cough, diphtheria and leprosy.
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion
(c) If assertion is true but reason is false.
(d) If assertion is false but reason is true.

2. **Assertion:** Biofertilizers are preferred over chemical fertilizers.
Reason: Biofertilizers enrich the nutrient quality of the soil.
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion
(c) If assertion is true but reason is false.
(d) If assertion is false but reason is true.

3. **Assertion:** Secondary treatment of sewage is also called biological treatment.
Reason: Microbes are involved during secondary sewage treatment.
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion
(c) If assertion is true but reason is false.
(d) If assertion is false but reason is true.

4. **Assertion:** *Rhizobium* is symbiotically associated with the root nodules of legume plants.
Reason: *Rhizobium* fix atmospheric nitrogen into inorganic forms, which is used by the plant as nutrient
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion
(c) If assertion is true but reason is false.
(d) If assertion is false but reason is true.

5. **Assertion:** Prions are proteinaceous infectious agents.
Reason: Prions are made up of nucleoproteins.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

6. **Assertion:** LAB grows in milk and converts milk into curd.
Reason: LAB produces acid that coagulate and partially digest the milk protein.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

7. **Assertion:** Large holes are present in Swiss cheese.
Reason: Large holes are produced due to the production of large amount of SO_2 by *Propionibacterium shermanii*.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

8. **Assertion:** Bottled fruit juices bought from the market are clearer as compared to those made at home.
Reason: Bottled juices are clarified by the use of lipases and proteases.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

9. **Assertion:** Patients suffering from myocardial infarction are given streptokinase.
Reason: Streptokinase acts as a clot -buster.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

10. **Assertion:** Bacterial colony cannot be seen with the naked eyes
Reason: Bacteria are macro-organism.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

11. **Assertion:** Antibiotics are chemical substance produces by some microbes and can kill or retard the growth of non-disease causing microbes.
Reason: Meaning of antibiotic is against life for human.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

12. **Assertion:** Statins reduces blood cholesterol level.
Reason: They competitively inhibit the enzyme responsible for synthesis of cholesterol.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

13. **Assertion:** Cyclosporin A is given to organ transplanted patients.
Reason: It is an immunosuppressive agent.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

14. **Assertion:** A small part of activated sludge is pumped back into aeration tank.
Reason: It serves as inoculum.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

15. **Assertion:** Wine and beer are produced without distillation.
Reason: Whisky, brandy and rum are produced by distillation of the fermented broth.
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

Statement Based Questions

16. **Statement I:** The 'Roquefort cheese' are ripened by growing a specific bacteria on them, which gives them a particular flavour.
Statement II: During growth, LAB produces acids that coagulate and digest the milk proteins.
(a) Both Statement I and Statement II are correct
(b) Both Statement I and Statement II are incorrect
(c) Statement I is correct & Statement II is incorrect
(d) Statement I is incorrect & Statement II is correct

17. **Statement A:** Antibiotics have played a major role in controlling infectious diseases like diphtheria, whooping cough and plague.
Statement B: Statins acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol
(a) Only A is correct
(b) Only B is correct
(c) Both A and B are correct
(d) Both A and B are incorrect

18. **Statement A:** Ladybird is useful to get rid of aphids.
Statement B: Trichoderma species are effective biocontrol agents of several plant pathogens.
(a) Only statement A is correct
(b) Only statement B is correct
(c) Both statements are correct
(d) Both statements are incorrect

19. **Statement I:** When dough is kept for some time, it shows puffed-up appearance.
Statement II: O_2 is produced due to microbial action and gets accumulated in dough.
(a) Both Statement I and II are correct.
(b) Statement I is correct but Statement II is incorrect
(c) Statement I is incorrect but Statement II is incorrect.
(d) Both Statement I and II are incorrect.

20. **Statement-I:** Cyanobacteria are heterotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen.
Statement-II: Blue green algae also add inorganic matter to the soil and thus decrease its fertility.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

21. **Statement-I:** Cyclosporin A prevents transplant rejection.
Statement-II: Baculoviruses are pathogens that attack insects and other arthropods.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

22. **Statement-I:** *Methanobacterium* breakdown cellulose in rumen of cattle.
Statement-II: *Methanobacterium* plays an important role in the nutrition of cattle.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

23. **Statement-I:** Primary sewage treatment basically involve physical removal of particles through filtration and sedimentation.
Statement-II: Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into the large aeration tanks where the fungal 'flocs' are allowed to sediment.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

24. **Statement-I:** Treatment of waste water is done by autotrophic microbes naturally present in the sewage.
Statement-II: Treatment of waste water is carried out in two stages.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

25. **Statement-I:** All microbes can be grown on nutritive media.
Statement-II: Microbes like bacteria and fungi can be grown on culture media for study.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

26. **Statement-I:** Specificity of cheese isformed by using different microbes.
Statement-II: Cheese is one of the oldestfood items, in which microbes were used.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

27. **Statement-I:** Full potential of penicillin asan effective antibiotic was established by Fleming and Florey.
Statement-II: Chain and Florey were awarded by Nobel prize in 1954 for discovery of penicillin potential.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

28. **Statement-I:** Statins have been commercialised as blood- cholesterol lowering agents.
Statement-II: Baculoviruses are shown to have negative impacts on non-target insects.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

29. **Statement-I:** Greater the BOD of wastewater, less is its polluting potential.
Statement-II: BOD is a measure of the organic matter present in the water.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

30. **Statement I:** Besides curdling of milk, LAB improve its nutritional quality by increasing vitamin B_{12}.
Statement II: LAB, when present in human stomach, check disease causing microbes.
(a) Both Statement-I and Statement-II are correct.
(b) Statement-I is the correct but Statement II is correct.
(c) Statement-I is incorrect but Statement-II is correct.
(d) Both statement I and II are incorrect.

Match up Based Questions

31. Match the following columns.

	Column I (Organisms)		Column II (Uses)
A.	*Lactobacillus*	1.	Roquefort cheese
B	*Saccharomyces cerevisiae*	2.	Swiss cheese
C.	*Propionibacterium shermanii*	3.	Bread
D.	*Penicillium roqueforti*	4.	Milk into curd

Codes
(a) A–4, B–3, C–2, D–1
(b) A–3, B–2, C–1, D–4
(c) A–4, B–1, C–2, D–3
(d) A–1, B–4, C–3, D–2

32. Match the following columns.

	Column I		Column II
A.	*Azolla*	1.	Free living N_2-fixer
B	*Rhizobium*	2.	Symbiotic association with N_2 -fixing cyanobacteria
C.	*Glomus*	3.	Roots of leguminous plants
D.	*Azotobacter*	4.	Form mycorrhiza

Codes
(a) A–2, B–3, C–4, D–1
(b) A–2, B–4, C–3, D–1
(c) A–2, B–1, C–4, D–3
(d) A–1, B–3, C–4, D–2

33. Match the following columns.

	Column I		Column II
A.	Citric acid	1.	*Trichoderma*
B	Cyclosporin	2.	*Clostridium*
C.	Statins	3.	*Aspergillus*
D.	Butyric acid	4.	*Monascus*

Codes
(a) A–1, B–4, C–2, D–3
(b) A–3, B–1, C–4, D–2
(c) A–3, B–1, C–2, D–4
(d) A–3, B–4, C–1, D–2

34. Match the following columns.

	Column I		Column II
A.	*Mycorrhiza*	1.	*Nucleopolyhedrovirus*
B	*Bacillus thuringiensis*	2.	Rhizobium
C.	Root nodules	3.	Bt cotton
D.	Baculovirus	4.	Phosphorus nutrition

Codes
(a) A–4, B–3, C–2, D–1
(b) A–3, B–2, C–1, D–4

(c) A–3, B–4, C–1, D–2
(d) A–4, B–1, C–2, D–3

35. Match the following list of microbes and their importance.

	Column I		Column II
A.	*Saccharomyces cerevisiae*	1.	Production of immunosuppressive agents
B	*Monascus purpureus*	2.	Ripening of Swiss cheese
C.	*Trichoderma polysporum*	3.	Commercial production of ethanol
D.	*Propionibacterium shermanii*	4.	Production of blood-cholesterol lowering agents

Codes
(a) A–3, B–4, C–1, D–2
(b) A–1, B–3, C–2, D–4
(c) A–2, B–4, C–1, D–3
(d) A–3, B–1, C–4, D–2

36. Match the following columns.

	Column I		Column II
A.	Ladybird	1.	Mosquitoes
B	Dragonflies	2.	Aphids
C.	*Bacillus thuringiensis*	3.	*Azospirillum*
D.	Free-living N_2-fixing bacteria	4.	Butterfly caterpillars

Codes
(a) A–1, B–4, C–3, D–2
(b) A–4, B–3, C–2, D–1
(c) A–2, B–1, C–4, D–3
(d) A–2, B–1, C–3, D–4

37. Match the following columns.

	Column I		Column II
A.	Lipase	1.	Cheese
B	Pectinase	2.	Detergent formulation
C.	Cyclosporin A	3.	Immunosuppressive agent
D.	*Acetobacter aceti*	4.	Clarification in bottled juice
		5.	Acetic acid

Codes
(a) A–2, B–4, C–3, D–5
(b) A–3, B–4, C–5, D–1
(c) A–2, B–1, C–3, D–5
(d) A–2, B–4, C–5, D–3

38. Match Column I with Column II.

	Column I		Column II
A.	Toddy	1.	Fermented by bacteria
B	Wine	2.	Distillation of fermented broth
C.	Rum	3.	No distillation of fermented broth
D.	Dosa	4.	Fermentation of palm sap

Codes
(a) A–1, B–2, C–3, D–4
(b) A–4, B–3, C–2, D–1
(c) A–3, B–1, C–4, D–2
(d) A–2, B–3, C–1, D–4

39. Match the following list of microbes and their importance:

A.	Leprosy	1.	Gal ghotu
B.	Whooping cough	2.	Kusht rog
C.	Diptheria	3.	Kali khansi

(a) A–1, B–3, C–2
(b) A–3, B–2, C–1
(c) A–3, B–1, C–2
(d) A–2, B–3, C–1

40. Match Column – I with Column – II and select the correct options using the codes given below:

	Column I		Column II
A.	Statins	1.	Ripened by growing specific fungi
B	Roquefort cheese	2.	Fermented by bacteria
C.	LAB	3.	Competitively inhibiting the enzyme responsible for synthesis of cholesterol
D.	Idli	4.	Improves nutritional quality by increasing vitamin B_{12}

(a) A–3, B–1, C–4, D–2
(b) A–1, B–4, C–2, D–3
(c) A–3, B–4, C–1, D–2
(d) A–3, B–1, C–2, D–4

41. Match the following list of bacteria and their commercially important products.

	Bacterium		Product
A.	*Aspergillus niger*	1.	Lactic acid
B	*Acetobacter aceti*	2.	Butyric acid
C.	*Clostridium butylicum*	3.	Acetic acid
D.	*Lactobacillus*	4.	Citric acid

Choose the correct match:

(a) A–2, B–3, C–4, D–1
(b) A–2, B–4, C–3, D–1
(c) A–4, B–3, C–2, D–1
(d) A–4, B–1, C–3, D–2

42. Match the following columns-

	Column I		Column II
A.	Baker's yeast	1.	Removal of oil stains
B	Cyclosporin A	2.	Produced by bacteria
C.	Streptokinase	3.	*Saccharomyces cerevisiae*
D.	Lipase	4.	Given to organ-transplant patients

Choose the correct match:
(a) A–2, B–3, C–1, D–4
(b) A–4, B–2, C–1, D–3
(c) A–4, B–1, C–2, D–3
(d) A–3, B–4, C–2, D–1

43. Match the items in 'Column-A' and 'Column-B' and choose the correct answer.

	Column-A		Column-B
A.	Lady bird	1.	*Methanobacterium*
B	Bt-cotton	2.	Narrow spectrum insecticidal applications
C.	NPV	3.	Aphids
D.	Biogas	4.	Introduction of toxin genes into plants by genetic engineering

(a) A–2, B–4, C–3, D–1
(b) A–3, B–4, C–2, D–1
(c) A–4, B–1, C–2, D–C
(d) A–3, B–2, C–1, D–4

44. Match the columns and find out the correct combination:

	Column-I		Column-II
A.	Flocs	1.	Association of fungi and bacteria during sewage treatment
B	Mycorrhizae	2.	Association of fungi and higher plant root
C.	*Rhizobium*	3.	Association of bacteria with plant root

(a) A–3, B–1, C–2
(b) A–2, B–3, C–1
(c) A–1, B–3, C–2
(d) A–1, B–2, C–3

45. Match the following columns.

	Column I		Column II
A.	Mycorrhizae	1.	Autotrophic cyanobacteria
B	Root nodules of leguminous plants	2.	Symbiotic association of rhizobium with legume root
C.	In paddy field	3.	Symbiotic association of glomus and plants

(a) A–3, B–1, C–2
(b) A–2, B–3, C–1
(c) A–1, B–3, C–2
(d) A–3, B–2, C–1

46. Match the column-I with Column-II

	Column-I		Column-II
A.	NPV	1.	Have large holes
B	Spent slurry	2.	No negative impact on plants
C.	Biogas	3.	Used for cooking and lighting
D.	Swiss cheese	4.	Can be used as fertiliser

(a) A–3, B–1, C–2, D–4
(b) A–4, B–3, C–1, D–2
(c) A–4, B–2, C–3, D–1
(d) A–2, B–4, C–3, D–1

47. Match the columns and select the correct option.

	Column-I		Column-II
A.	Cellulose digestion	1.	Dung
B	Excreta of cattle	2.	Anerobic bacteria
C.	Methanogen	3.	Rumen of cattle
D.	*Aspergillus niger*	4.	Fungi

(a) A–3, B–1, C–2, D–4
(b) A–4, B–2, C–3, D–1
(c) A–2, B–1, C–4, D–3
(d) A–4, B–3, C–2, D–1

48. Match the following.

	Column-I		Column-II
A.	KVIC	1.	Biogas plant
B	Biogas	2.	Biological treatment
C.	Sedimentation	3.	Primary treatment
D.	Flocs	4.	Anaerobic sludge digester

(a) A–1, B–4, C–3, D–2
(b) A–4, B–1, C–2, D–3
(c) A–2, B–3, C–4, D–1
(d) A–1, B–4, C–3, D–2

49. Match the following.

	Column-I		Column-II
A.	Physical treatment of sewage	1.	Activated sludge
B	Biological treatment of sewage	2.	Secondary treatment
C.	Sediment in primary treatment	3.	Primary sludge
D.	Sediment in secondary treatment	4.	Primary treatment

(a) A–1, B–3, C–4, D–2
(b) A–4, B–2, C–3, D–1
(c) A–1, B–4, C–2, D–3
(d) A–1, B–2, C–4, D–3

50. Match columns-I and II.

	Column-I		Column-II
A.	Mixture of gases such as methane, hydrogen sulphide and carbon dioxide	1.	Fermenter
B	Organic waste in water	2.	Initiated by Ministry of Environment and Forests
C.	Large vessel for growing microbes	3.	BOD
D.	Ganga Action Plan	4.	Biogas

(a) A–2, B–1, C–3, D–4
(b) A–2, B–1, C–4, D–3
(c) A–4, B–1, C–3, D–2
(d) A–4, B–3, C–1, D–2

Exercise-04 Previous Year Questions

1. Match List I with List II **(2024)**

List – I		List – II	
A.	*Clostridium butylicum*	I.	Ethanol
B.	*Saccharomyces cerevisiae*	II.	Streptokinase
C.	*Trichoderma polysporum*	III.	Butyric acid
D.	*Streptococcus sp.*	IV.	Cyclosporin – A

Choose the correct answer from the options given below:
(a) A – II, B – IV, C – III, D – I
(b) A – III, B – I, C – IV, D – II
(c) A – IV, B – I, C – III, D – II
(d) A – III, B – I, C – II, D – IV

2. Identify the microorganism which is responsible for the production of an immunosuppressive molecule cyclosporin A: **(2022)**
(a) Clostridium butylicum
(b) Aspergillus niger
(c) Streptococcus cerevisiae
(d) Trichoderma polysporum

3. Match List-I with List-II. **(2021)**

List-I		List-II	
(A)	Aspergillus niger	(i)	Acetic Acid
(B)	Acetobacter aceti	(ii)	Lactic Acid
(C)	Clostridium butylicum	(iii)	Citric Acid
(D)	Lactobacillus	(iv)	Butyric acid

Choose the correct answer from the options given below.
(a) A-i B-ii C-iii D-iv (b) A-ii B-iii C-i D-iv
(c) A-iv B-ii C-i D-iii (d) A-iii B-i C-iv D-ii

4. Which of the following is put into Anaerobic sludge digester for further sewage treatment? **(2020)**
(a) Floating debris
(b) Effluents of primary treatment
(c) Activated sludge
(d) Primary sludge

5. Match the following columns and select the correct option. **(2020)**

Column - I		Column - II	
1.	Clostridium butylicum	(i)	Cyclosporin-A
2.	Trichoderma polysporum	(ii)	Butyric acid
3.	Monascus purpureus	(iii)	Citric acid
4.	Aspergillus niger	(iv)	Blood cholesterol lowering agent

(1) (2) (3) (4)
(a) (ii) (i) (iv) (iii)
(b) (i) (ii) (iv) (iii)
(c) (iv) (iii) (ii) (i)
(d) (iii) (iv) (ii) (i)

6. Secondary metabolites such as nicotine, strychnine and caffeine are produced by plants for their: **(2020)**
(a) Growth response
(b) Defence action
(c) Effect on reproduction
(d) Nutritive value

7. For the commercial and industrial production of Citric Acid, which of the following microbes is used? **(2020)**

(a) Lactobacillus sp
(b) Saccharomyces cerevisiae
(c) Clostridium butylicum
(d) Aspergillus niger

8. Match the following columns and select the correct option: **(2020)**

Column-I		Column-II	
1.	Dragonflies	(i)	Biocontrol agents of several plant pathogens
2.	Bacillus thuringiensis	(ii)	Get rid of Aphids and mosquitoes
3.	Glomus	(iii)	Narrow spectrum insecticidal applications
4.	Baculoviruses	(iv)	Biocontrol agents of lepidopteran plant pests
		(v)	Absorb phosphorus from soil

(1) (2) (3) (4)

(a) (ii) (i) (iii) (iv)
(b) (ii) (iii) (iv) (v)
(c) (ii) (iv) (v) (iii)
(d) (iii) (v) (iv) (i)

9. Cyclosporin A, used as immuno-suppression agent, is produced from: **(2020)**

(a) Saccharomyces cerevisiae
(b) Penicillium notatum
(c) Trichoderma polysporum
(d) Monascus purpureus

Answer keys

TOPIC CENTRIC EXERCISE -01 Answer Key

1. (b)	**2.** (c)	**3.** (c)	**4.** (c)	**5.** (c)

TOPIC CENTRIC EXERCISE -02 Answer Key

1. (c)	**2.** (c)	**3.** (b)	**4.** (d)	**5.** (b)

TOPIC CENTRIC EXERCISE -03 Answer Key

1. (c)	**2.** (b)	**3.** (b)	**4.** (b)	**5.** (b)

TOPIC CENTRIC EXERCISE -04 Answer Key

1. (c)	**2.** (a)	**3.** (c)	**4.** (a)	**5.** (c)

TOPIC CENTRIC EXERCISE -05 Answer Key

1. (a)	**2.** (b)	**3.** (a)	**4.** (a)	**5.** (c)

TOPIC CENTRIC EXERCISE- 06 Answer Key

1. (d)	**2.** (c)	**3.** (b)	**4.** (b)	**5.** (b)

Exercise-01 Level -01 Answer Key

1. (d)	**6.** (c)	**11.** (c)	**16.** (c)	**21.** (c)	**26.** (b)	**31.** (c)	**36.** (a)	**41.** (b)	**46.** (d)
2. (d)	**7.** (d)	**12.** (c)	**17.** (b)	**22.** (d)	**27.** (c)	**32.** (b)	**37.** (b)	**42.** (b)	**47.** (b)
3. (c)	**8.** (a)	**13.** (d)	**18.** (c)	**23.** (a)	**28.** (b)	**33.** (b)	**38.** (a)	**43.** (a)	**48.** (d)
4. (c)	**9.** (b)	**14.** (b)	**19.** (c)	**24.** (b)	**29.** (c)	**34.** (a)	**39.** (c)	**44.** (d)	**49.** (d)
5. (c)	**10.** (c)	**15.** (c)	**20.** (a)	**25.** (c)	**30.** (b)	**35.** (d)	**40.** (b)	**45.** (b)	**50.** (c)

Exercise-02 Level -02 Answer Key

1. (c)	**6.** (a)	**11.** (a)	**16.** (d)	**21.** (b)	**26.** (c)	**31.** (a)	**36.** (d)	**41.** (d)	**46.** (d)
2. (a)	**7.** (b)	**12.** (a)	**17.** (d)	**22.** (c)	**27.** (c)	**32.** (c)	**37.** (c)	**42.** (b)	**47.** (b)
3. (a)	**8.** (a)	**13.** (d)	**18.** (b)	**23.** (b)	**28.** (a)	**33.** (b)	**38.** (a)	**43.** (a)	**48.** (c)
4. (a)	**9.** (b)	**14.** (c)	**19.** (a)	**24.** (a)	**29.** (a)	**34.** (d)	**39.** (a)	**44.** (c)	**49.** (b)
5. (c)	**10.** (d)	**15.** (c)	**20.** (b)	**25.** (a)	**30.** (d)	**35.** (b)	**40.** (b)	**45.** (d)	**50.** (d)

Exercise-03 Level -03 Answer Key

1. (d)	**6.** (a)	**11.** (d)	**16.** (d)	**21.** (a)	**26.** (a)	**31.** (a)	**36.** (c)	**41.** (c)	**46.** (d)
2. (a)	**7.** (c)	**12.** (a)	**17.** (c)	**22.** (a)	**27.** (b)	**32.** (a)	**37.** (a)	**42.** (d)	**47.** (a)
3. (a)	**8.** (c)	**13.** (a)	**18.** (c)	**23.** (c)	**28.** (c)	**33.** (b)	**38.** (b)	**43.** (b)	**48.** (d)
4. (c)	**9.** (a)	**14.** (a)	**19.** (b)	**24.** (d)	**29.** (d)	**34.** (a)	**39.** (d)	**44.** (d)	**49.** (b)
5. (c)	**10.** (d)	**15.** (b)	**20.** (b)	**25.** (d)	**30.** (a)	**35.** (a)	**40.** (a)	**45.** (d)	**50.** (d)

Exercise-04 Previous Year Questions

1. (b)	**2.** (d)	**3.** (d)	**4.** (c)	**5.** (a)	**6.** (b)	**7.** (d)	**8.** (c)	**9.** (c)