Enhancement of Food Production

EXERCISE [PAGES 270 - 271]

Exercise | Q 1.1 | Page 270

Multiple Choice Question

Antibiotic Chloromycetin is obtained from _____.

1. Streptomyces erythreus
2. Penicillium chrysogenum
3. **Streptomyces venezuelae**
4. Streptomyces griseus

Solution: Antibiotic Chloromycetin is obtained from **Streptomyces venezuelae**.

Exercise | Q 1.2 | Page 270

Multiple Choice Question

Removal of large pieces of floating debris, oily substances, etc. during sewage treatment is called _____.

1. **primary treatment**
2. secondary treatment
3. final treatment
4. amplification

Solution: Removal of large pieces of floating debris, oily substances, etc. during sewage treatment is called **primary treatment.**

Exercise | Q 1.3 | Page 270

Multiple Choice Question

Which one of the following is a free-living bacterial biofertilizer?

1. **Azotobacter**
2. Rhizobium
3. Nostoc
4. Bacillus thuringiensis

Solution: Azotobacter

Exercise | Q 1.4 | Page 270

Multiple Choice Question

Most commonly used substrate for industrial production of beer is _____.

1. **barley**
2. wheat
3. corn
4. sugarcane molasses

Solution: The most commonly used substrate for industrial production of beer is **barley**.

Exercise | Q 1.5 | Page 270

Multiple Choice Question

Ethanol is commercially produced through a particular species of _____.

1. Aspergillus
2. **Saccharomyces**
3. Clostridium
4. Trichoderma

Solution: Ethanol is commercially produced through a particular species of **Saccharomyces.**

Exercise | Q 1.6 | Page 270

Multiple Choice Question

One of the free-living anaerobic nitrogen-fixer is _____.

1. Azotobacter
2. Beijerinckia
3. **Rhodospirillum**
4. Rhizobium

Solution: One of the free-living anaerobic nitrogen-fixer is **Rhodospirillum**.

Exercise | Q 1.7 | Page 270

Multiple Choice Question

Microorganisms also help in production of food like _____.

1. **bread**
2. alcoholic beverages
3. vegetables
4. pulses

Solution: Microorganisms also help in the production of food like **bread.**

Exercise | Q 1.8 | Page 270

Multiple Choice Question

MOET technique is used for _____.

1. **production of hybrids**
2. inbreeding
3. outbreeding
4. outcrossing

Solution: MOET technique is used for the **production of hybrids.**

Exercise | Q 1.9 | Page 270

Multiple Choice Question

Mule is the outcome of _____.

1. inbreeding
2. artificial insemination
3. **interspecific hybridization**
4. outbreeding

Solution: Mule is the outcome of **interspecific hybridization.**

Exercise | Q 2.1 | Page 270

Very Short Answer Question

What does make idlies puffy?

Solution: The bubbles of CO_2 trapped in dough during fermentation make idlies puffy.

Exercise | Q 2.2 | Page 270

Very Short Answer Question

Name any two bacterial biofertilizers.

Solution:

Biofertilizers:

a. Rhizobium:

1. Rhizobia are rod-shaped, motile, aerobic, gram-negative, non-spore-forming, nitrogen-fixing bacteria containing Nod genes and Nif genes.

2. They form symbiotic associations with the roots of leguminous plants.

3. They bring about nodule formation on the roots and multiply inside the nodule.

4. They fix atmospheric nitrogen into organic forms, which can be used by plants as nutrients.

5. For e.g. R. leguminosarum is specific to pea and R. phaseoli to beans.

b. Azotobacter:

1. It is the important and well known free-living, nitrogen-fixing, aerobic, non-photosynthetic, non-nodule forming bacterium, intimately associated with roots of grasses and certain plants.

2. It is used as a bio-fertilizer for all non-leguminous plants especially rice, cotton, vegetables, etc.

c. Azospirillum:

1. It is a free-living, an aerobic nitrogen-fixing bacterium associated with roots of corn, wheat, and jowar.

2. It fixes the considerable quantity of nitrogen (20-40kg N/ha) in non–leguminous plants such as cereals, millets, cotton, oilseed, etc.

Exercise | Q 2.3 | Page 270

Very Short Answer Question

What is the microbial source of vitamin B_{12}?

Solution: Vitamin B_{12} - Pseudomonas denitrificans

Exercise | Q 2.4 | Page 270

Very Short Answer Question

What is the microbial source of enzyme Invertase?

Solution: Invertase - Saccharomyces cerevisiae

Exercise | Q 2.5 | Page 270

Very Short Answer Question

Milk starts to coagulate when Lactic Acid Bacteria (LAB) is added to warm milk as a starter. Mention any two other benefits of LAB.

Solution:

Production of dairy products:

i. Curd: Indian curd is prepared by inoculating milk with Lactobacillus acidophilus. It also checks the growth of disease-causing microbes.

ii. Yogurt (yogurt): It is produced by curdling milk with the help of Streptococcus thermophilus and Lactobacillus bulgaricus.

iii. Butter Milk: The acidulated liquid left after churning of butter from curd, is called buttermilk.

iv. Cheese:

a. The milk is coagulated with lactic acid bacteria and the curd formed is filtered to separate whey.

b. The solid mass is then ripened with the growth of mould that develops flavor in it.

c. Different varieties of cheese are known by their characteristic texture, flavor, and taste which are developed by different specific microbes.

d. The 'Roquefort and Camembert cheese' are ripened by Bluegreen molds Penicillium roqueforti and P. camemberti respectively.

e. The large holes in Swiss cheese are developed due to the production of a large amount of CO_2 by a bacterium known as Propionibacterium shermanii.

Exercise | Q 2.6 | Page 270

Very Short Answer Question

Name the enzyme produced by Streptococcus bacterium. Explain importance in medical sciences.

Solution:

Streptokinase:

a. Streptokinase enzyme (TPA) is produced by the bacterium Streptococcus spp.

b. It has a fibrinolytic effect. Hence, it is used as a 'clot buster' for clearing blood clots in the blood vessels of patients, which may cause a heart attack.

Exercise | Q 2.7 | Page 270

Very Short Answer Question

What is the breed?

Solution:

A group of animals related by descent and similar in most characters like general appearance, features, size, configuration, etc., are said to belong to a breed.

Exercise | Q 2.8 | Page 270

Very Short Answer Question

Define estuary.

Solution:

Estuaries are places where rivers meet the sea and may be defined as areas where saltwater is measurably diluted with freshwater.

Exercise | Q 2.9 | Page 270

Very Short Answer Question

What is shellac?

Solution:

Shellac is a pure form of lac obtained by washing and filtering.

Exercise | Q 3.1 | Page 270

Short Answer Question

Many microbes are used at home during the preparation of food items. Comment on such useful ones with examples.

Solution:

i. Many household preparations involve the use of microbes.

e.g. idli, dhokla, jalebi, dosa, etc.

ii. Microbes such as Leuconostoc and Streptococcus help in the fermentation of batter of idli and dosa.

iii. Microbes like Lactobacilli help in the preparation of jalebi and nan.

iv. Milk is fermented to make curd, yogurt, and cheese using lactobacilli.

v. Saccharomyces cerevisiae (yeast) is commonly used for making bread.

Exercise | Q 3.2 | Page 270

Short Answer Question

What is biogas?

Solution:

Biogas is a non-conventional and renewable source of energy and is obtained by microbial fermentation.

Exercise | Q 3.2 | Page 270

Short Answer Question

Write in brief about the production process.

Solution:

Process of biogas production:

Anaerobic digestion involves three processes:

a. Hydrolysis or solubilization:

1. In the initial stage, the raw material (cattle dung) is mixed with water in equal proportion to make a slurry which is then fed into the digester.

2. Here anaerobic hydrolytic bacteria (e.g. Clostridium, Pseudomonas) hydrolyse carbohydrates into simple sugars, proteins into amino acids, and lipids into fatty acids.

b. Acidogenesis: In this stage, facultatively anaerobic, acidogenic bacteria and obligate anaerobic organisms, convert simple organic material into acids like formic acid, acetic acid, H_2, and CO_2.

c. Methanogenesis: This is the last stage in which anaerobic Methanogenic bacteria like Methanobacterium, Methanococcus convert acetate, H_2, and CO_2 into Methane, CO_2 and H_2O, and other products.

$$1.\ 12\,\underset{\text{(Acetic acid)}}{\text{mol } CH_3COOH} \longrightarrow 12\,\underset{\text{Methane}}{CH_4} + 12\,CO_2$$

$$2.\ 4\,\underset{\text{(Formic acid)}}{\text{mol H.COOH}} \longrightarrow CH_4 + 3\,CO_2 + 2\,H_2O$$

$$3.\ CO_2 + 4\,H_2 \longrightarrow CH_4 + 2\,H_2O$$

Exercise | Q 3.3 | Page 270

Short Answer Question

Write a note on biocontrol agents.

Solution:

i. The agents which are employed for biological control are called **biocontrol agents**.

ii. Microbes like bacteria, fungi, viruses, and protozoans act as biocontrol agents. They act in three ways, either they cause the disease to the pest or compete or kill them.

Example:

i. Bacillus thuringiensis

a. It is used to get rid of the butterfly, caterpillars where dried spores of Bacillus thuringiensis are mixed with water and sprayed onto vulnerable plants such as Brassica and fruit trees.

b. These spores are then eaten by insect larvae.

c. In the gut of the larvae, the toxin (cry protein) is released and the larvae get killed eventually.

ii. Trichoderma

a. Trichoderma species are free-living fungi found in the root ecosystem (rhizosphere).

b. These are effective as biocontrol agents of several soil-borne fungal plant pathogens.

c. The fungus produces substances like viridin, gliotoxin, gliovirin, etc. that inhibit the other soil-borne pathogens attacking root, rhizomes, etc. causing rot disease.

Exercise | Q 3.4 | Page 270

Short Answer Question

Name any two enzymes and antibiotics with their microbial source.

Solution:

No.	Enzyme	Microbial Source
i.	Invertase	Saccharomyces cerevisiae
ii.	Pectinase	Sclerotiana libertine, Aspergillus niger
iii.	Lipase	Candida lipolytica
iv.	Cellulase	Trichoderma koningi

No.	Antibiotic	Microbial source
i.	Chloromycetin	Streptomyces venezuelae
ii.	Erythromycin	Streptomyces erythreus
iii.	Penicillin	Penicillium chrysogenum
iv.	Streptomycin	Streptomyces griseus

v.	Griseofulvin	Penicillium griseofulvum
vi.	Bacitracin	Bacillus licheniformis
vii.	Oxytetracycline/ Terramycin	Streptomyces aureofaciens

Exercise | Q 3.5 | Page 270

Short Answer Question

Write the principles of farm management.

Solution:

i. Farm management begins with the selection of high yielding breeds, food requirements, the supply of adequate nutritional sources, and cleanliness of the environment, and maintenance of health.

ii. Management of farm animals includes veterinary supervision, vaccination, high yielding crossbreed development, production and preservation of products, distribution, and marketing.

Exercise | Q 3.6 | Page 270

Short Answer Question

Give the economic importance of fishery.

Solution:

Economic importance of fishes:

i. Fishes are caught, processed, raised, and marketed under fisheries. It provides good job opportunities and self-employment.

ii. Culturing of fishes on a large scale in ponds, lakes, and reservoirs boost the productivity and economy of the nation.

iii. Fishes are a source of nutritious food as they are rich in proteins, vitamins (A, D, and K), carbohydrates, fats, and minerals.

iv. They also yield a number of by-products that hold commercial value.

v. The by-products obtained from fishes include fish oil, fish meal, fertilizers, fish guano, fish glue, and isinglass, which are widely used in paints, soaps, oils, and medicines.

vi. Prawns and lobsters have a market value all over the world.

Exercise | Q 3.7 | Page 270

Short Answer Question

Enlist the species of honey bee mentioning their specific uses.

Solution:

Apiculture or beekeeping deals with an artificial rearing of honey bees to obtain bee products like honey, wax, pollen, bee venom, propolis (bee glue), and royal jelly as well as pollinating agents for crop plants.

The four species of honey bees commonly found in India are Apis dorsata (rock bee or wild bee), Apis florea (little bee), Apis mellifera (European bee), and Apis indica (Indian bee).

For beekeeping, Apis mellifera and Apis indica are the suitable species and are known as domesticated species.

Exercise | Q 3.8 | Page 271

Short Answer Question

What are A, B, C, and D in the table given below :

Types of microbe	Name	Commercial product
Fungus	A	Penicillin
Bacterium	Acetobacter aceti	B
C	Aspergillus niger	Citric acid
Yeast	D	Ethanol

Solution:

Types of microbe	Name	Commercial product
Fungus	**Penicillium chrysogenum**	Penicillin
Bacterium	Acetobacter aceti	**Acetic acid (vinegar)**
Fungus	Aspergillus niger	Citric acid
Yeast	**Saccharomyces cerevisiae**	Ethanol

Exercise | Q 4.1 | Page 271

Long Answer Question

Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential?

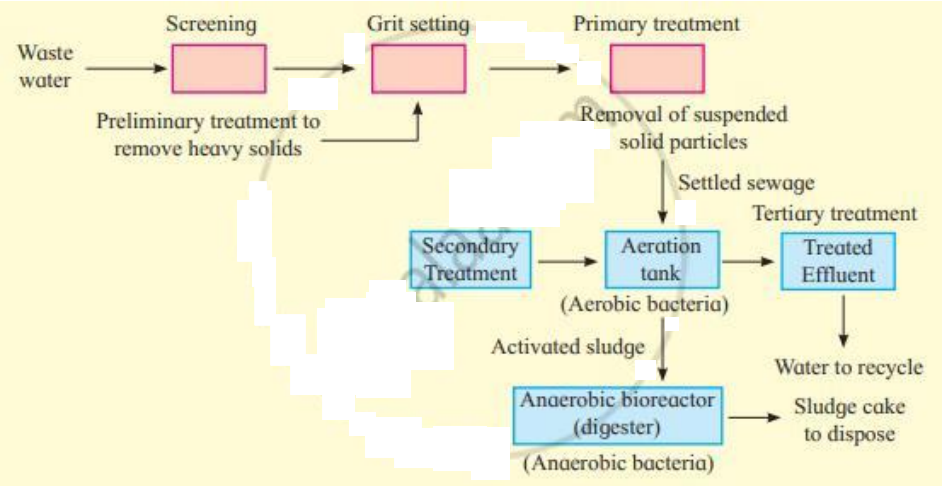
Solution1:

The sewage in sewage treatment plants is carried out in two ways:

(a) Primary treatment: It involves the physical removal of particles from sewage through filtration and sedimentation. Floating debris is removed by filtration and grit is removed by sedimentation. Thus, all solids which settle form the primary sludge and the supernatant forms the effluent.

Secondary treatment: The effluent from primary treatment is passed to aeration tanks where the air is pumped into it. This allows the growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments) and microbes consume the major part of the organic matter in the effluent. This reduces the BOD (biological oxygen demand) of the effluent. The effluent is then passed into the settling tank where bacterial flocs are allowed to sediment. This sediment is called activated sludge. The small portion of this activated sludge is again passed to the aeration tank to serve as inocula. The remaining major part of this sludge is pumped into large anaerobic sludge digesters. Here, anaerobic bacteria digest bacteria and fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as methane, H_2S, and CO_2. This treatment is essential as the sewage or municipal waste discharged into rivers, streams and other water bodies contains human excreta, organic wastes, and several pathogenic microbes.

Solution2:



Before wastewater is made available for human use, it has to be treated properly, so as to remove organic matter, inorganic salts, and pathogens as well.

The sewage treatment process includes four basic steps as follows:

i. Preliminary Treatment: The preliminary treatment includes Screening and Grit Chamber.

a. Screening:

1. Sewage and wastewater contains plenty of suspended, floating materials, coarse and solid particles along with dissolved substances.

2. The suspended objects are filtered and removed. This is done in screening chambers.

3. The sewage is passed through screens or nets in the chambers. Larger suspended or floating objects are held back in the screening chambers.

4. These have to be removed before the biological treatment.

b. Grit Chamber:

1. After screening, the filtered sewage is then passed into a series of grit chambers that contain large stones (pebbles) and brick ballast.

2. Coarse particles settle down by gravity.

3. Thus, the passage of filtered sewage removes much of the coarse particulate matter.

ii. Primary treatment (physical treatment):

a. After the preliminary treatment, the sewage water is pumped into the primary sedimentation tank.

b. The sedimentation of suspended solids or organic matter occurs in this tank.

c. About 50-70% of the solids settle down. There is a reduction of about 30-40% (in number) of coliform organisms.

d. The organic matter which is settled down is called primary sludge which is removed by mechanically operated devices.

e. The supernatant (effluent) in the primary sedimentation tank still contains a large amount of dissolved organic matter and micro-organisms which can then be removed by the secondary treatment.

iii. Secondary treatment (biological treatment):

a. The primary effluent is passed into large aeration tanks. Here it is constantly agitated mechanically and the air is pumped into it.

b. Aerobic bacteria grow vigorously and form flocs.

c. Flocs are the masses of bacteria held together by slime and fungal hyphae to form mesh-like masses.

d. These aerobic microbes consume the major part of the organic matter present in the effluent, as they grow.

e. Due to this BOD (Biochemical Oxygen Demand) of the effluent is significantly reduced.

iv. Tertiary treatment:

a. Once the BOD of wastewater is reduced, it is passed into a settling tank.

b. Here the bacterial flocs are allowed to sediment which is now called activated sludge.

c. A small part of this is passed back into the aeration tank and the major part is pumped into large tanks called anaerobic sludge digesters.

d. In these tanks, anaerobic bacteria grow and digest the bacteria and fungi in the sludge.

e. During this anaerobic digestion, gases such as methane, hydrogen sulphide, CO_2, etc. are produced.

f. Effluents from these plants (digester) after chlorination are released in natural water bodies like rivers and streams.

g. Chlorination kills pathogenic bacteria. h. Digested sludge is then disposed of.

Importance of sewage water treatment:

i. The sewage water contains pathogenic microorganisms like bacteria, viruses, protozoa, and parasitic worms, which can spread a variety of diseases.

ii. Also, it contains harmful chemicals that may cause toxicity if mixed with natural resources of water. Therefore, sewage water treatment is essential before it can be discharged into natural bodies.

Exercise | Q 4.2 | Page 271

Long Answer Question

Write a note on lac culture.

Solution:

i. Lac is produced by an insect Tachardia lacca, which is quite small in size and colonial inhabit.

ii. Resin like substance is produced by the dermal glands of female lac insect.

iii. The insect feeds on succulent twigs of certain plants like ber, peepal, palas, Kusum, babool, etc. and secretes pink coloured resin, that hardens on coming in contact with air forming lac.

iv. Lac is a complex substance having a large amount of resin together with sugar, water, minerals, and alkaline substances.

v. Natural lac is always contaminated. vi. Shellac is a pure form of lac obtained by washing and filtering.

vii. Products of lac play a vital role in the economy of the farmers.

viii. Lac is used in bangles, toys, woodwork, inks, mirrors, etc. ix. Production of lac requires an artificial inoculation of plants which gives a better and regular supply of good quality and quantity of lac.

Exercise | Q 4.3 | Page 271

Long Answer Question

Describe various methods of fish preservation.

Solution:

After catching the fishes, fish spoilage is prevented by different preservation methods like:

i. Chilling with ice: It is a method of refrigeration. Due to the lowering of temperature, putrefaction is prevented and the quality of fish is maintained.

ii. Freezing: Freezing of fishes helps to retain the natural appearance of fishes.

iii. Freeze drying: Fishes are frozen and dried.

iv. Smoke drying: This removes the moisture and prevents the growth of bacteria.

v. Sun-drying: Fishes are dried in sun to remove moisture.

vi. Salting: By adding salt, dehydration takes place by osmosis.

vii. Canning: Fishes are preserved in cans with salt or other artificial preservatives.

Exercise | Q 4.4 | Page 271

Long Answer Question

Give an account of poultry diseases.

Solution:

Following are the different types of poultry diseases:

i. Viral diseases like Ranikhet, Bronchitis, Avian influenza (bird flu), etc.

ii. Bacterial diseases mainly include Pullorum, Cholera, Typhoid, TB, CRD (chronic respiratory disease), Enteritis, etc.

iii. Fungal diseases are Aspergillosis, Favus, and Thrush.

iv. Parasitic diseases include lice infection, roundworm, caecal worm infections, etc.

v. Protozoan diseases e.g. Coccidiosis is a protozoan disease.

Exercise | Q 4.5 | Page 271

Long Answer Question

Give an account of mutation breeding with examples.

Solution:

The mutation is a sudden heritable change in the genotype. In mutation breeding, desirable mutations are induced in crop plants with the use of physical or chemical mutagens.

i. Natural (physical) mutagens are:

High temperature, high concentration of CO2, X rays, UV rays.

ii. Chemical mutagens are:

Nitrous acid, EMS (Ethyl- Methyl- Sulphonate), Mustard gas, Colchicine, etc.

iii. Seedlings or seeds are irradiated by CO-60, exposed to UV bulbs, X-ray machines, etc.

iv. Mutagens cause gene mutations and chromosomal aberrations.

v. The treated seedlings are then screened for resistance to diseases/ pests, high yield, etc.

e.g. Jagannath variety of rice, NP 836 variety of wheat (rust-resistant), Indore-2 variety of cotton (resistant to bollworm), Regina-II variety of cabbage (resistant to bacterial rot), etc.

Exercise | Q 4.6 | Page 271

Long Answer Question

Describe briefly various steps of plant breeding methods.

Solution:

Hybridization involves the following steps:

i. Collection of variability:

a. Wild species and relatives of the cultivated species having desired traits are collected and preserved.

b. The entire collection having all the diverse alleles (i.e. variations) for all genes in a given crop is called germplasm collection.

c. Variations are useful in the selection. Germplasm conservation can be done in the following ways.

a. In situ conservation: It can be done with the help of forests and natural reserves.

b. Ex-situ conservation: It is done through botanical gardens, seed banks, etc.

ii. Evaluation and selection of parents:

a. The collected germplasm is evaluated (screened) to identify plants with desirable characters.

b. The selected parents must be healthy, vigorous, and should show desirable but complementary features.

c. The selected parents are selfed for three to four generations to make them pure or homozygous.

d. It is made sure that only pure lines are selected, multiplied, and used in the hybridization.

iii. Hybridization:

a. The variety showing maximum desirable features is selected as a female (recurrent) parent and the other one as male parent (donor) which lacks good characters found in a recurrent parent.

b. The pollen grains from anthers of male parents are collected and then artificially dusted over stigmas of emasculated flowers of the female parents.

c. Pollination is followed by seed and fruit formation in due course.

d. The seed thus obtained represents the hybrid generation.

e. The hybrid F_1 progeny is selected and evaluated for the desired combinations of characters.

iv. Selection and testing of superior recombinants:

a. The F_1 hybrid plants showing superiority over both the parents and having high hybrid vigour are selected.

b. Such hybrids are then selfed for a few generations to make them homozygous for the said desirable characters till there is a state of uniformity so that the characters will not segregate further.

v. Testing, release, and commercialization of new cultivars:

a. The newly selected lines are evaluated for productivity and other features like disease resistance, pest resistance, quality, etc.

b. Initially, these plants are grown under controlled conditions of water, fertilizers, etc. and their performance is recorded.

c. The selected lines are then grown for three generations at least in the natural field, in different agroclimatic zones.

d. Finally, variety is released as a new variety for use by the farmers.