

2 Microorganisms: Friend and Foe

Introduction

Microbes are all around us. They are in the air we breathe, in the soil and in untreated water. Microorganisms play an important role in our lives. Some of these living things are very useful to us, but others may be potentially harmful. As decomposers of organic material, they help to keep the soil fertile and recycle the living matters into valuable nutrients for plants. Some microorganisms damage and spoil food products, leather, paper and paints. In this chapter, you will study about microorganisms and their significance both as useful and harmful to us.

A number of organisms whether they are small or big, can be observed easily with naked eyes. There are also a number of living organisms that cannot be seen with the naked eyes. They can be seen only when they are magnified.

The scientists have made use of microscopes to observe them. Microscopes of different magnifications have been used to observe these small organisms. Such living organisms are known as **microorganisms or microbes**. These organisms that are too small to be seen with the naked eyes and can be seen only under a microscope. Microbiology is the branch of science that deals with the study of microorganisms.

Let us perform the following activity to understand the microbes clearly.

Activity

Observation of microorganisms present in water.

- 1 Collect water from different sources, like drain, well, canal, lake, pond and river in clean glass test tubes.
- 2 Allow these samples to settle down.
- 3 Observe first with naked eye and then with a magnifying glass.
- 4 Put a drop of water (from each sample one by one) on a glass slide and observe it under a microscope.
- 5 What do you observe?
- 6 You will observe that many small organisms may be seen under a microscope. These organisms could not be seen when observed through the naked eye.
- 7 Write the number and type of organisms observed in different sources of water.
- 8 Can you draw some conclusion from this activity?

Do You Know ?

Louis Pasteur, a microbiologist proved that yeasts are responsible for fermentation of grape sugar.

We conclude from this activity that the water is full of living organisms. These living organisms are very small and are not visible with the naked eye.

Habitat of Microorganism

Microorganisms are found all around us in all types of habitat such as in air, on land, under the soil, under water, in hot springs, in snowy regions and so on. There is no place devoid of microorganisms. They can survive in extreme heat and humid conditions such as hot springs, desert soil, saline water, ice-cold water, marshy lands and bottom of sea. It is also found in dead and decaying organisms, so it helps in the release of minerals to the soil after the death of living organisms by decomposing them. Some live as parasite either outside or inside the other organisms. Some microbes are useful to us and some cause diseases and hence are harmful to us. Microorganisms can be classified in the following groups:

- Bacteria
- Viruses
- Algae
- Fungi
- Protozoans

Let us discuss these one by one in detail:

Bacteria

Habitat

These are unicellular organisms found everywhere in air, in water, in hot springs, in soil and even inside the body of living organisms such as human beings, pigs, etc.

They differ in their shape and size.

The size

The average size of a bacterium is $1.25 \mu\text{m}$ ($1 \mu\text{m} = \frac{1}{1000} \text{ mm}$) in

diameter. The smallest is a rod-shaped bacteria measuring $0.15 \mu\text{m}$. The largest is spiral-shaped measuring upto $15 \mu\text{m}$ in length and $1.5 \mu\text{m}$ in diameter.

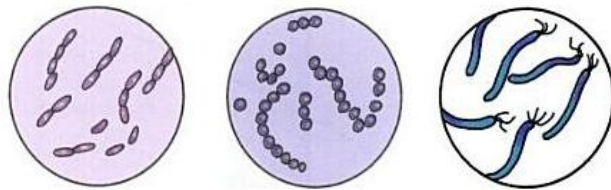
Shape

The bacterial cell may be rod-shaped, spherical, spiral-shaped or comma-shaped.

Rod-shaped bacilli meaning "little rod" without flagella. They may occur as single (bacillus), in pairs (diplobacillus) or in a chain (Streptobacillus). For example, *Lactobacillus* and *Pseudomonas*.

Oval or Spherical Cocci (Singular Coccus) meaning 'berry'. For example - *Streptococcus*, *Sarcina* and *Micrococcus*.

Spiral or Comma-Shaped called Spirilla, for example, *Vibrio*,

Triponema and Camphylobacter.

Bacilli

Cocci

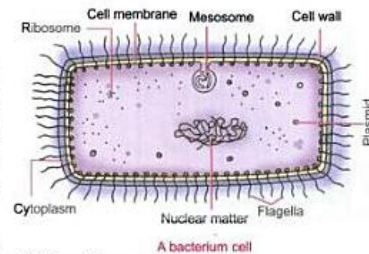
Spirilla

Different shapes of bacterial cells

Structure

The bacteria are single-celled microorganisms. The cell is covered by a protective layer called cell wall. This is the reason because of which bacteria were classified under plants. A bacterial cell does not have a well-defined nucleus. There is no nuclear membrane. The nuclear matter is present in the cytoplasm.

Bacteria move with the help of flagella, which is a hair-like structure. The number of flagella is different in different types of bacteria.



A bacterium cell

Nutrition

On the basis of mode of taking food, bacteria are of two types:

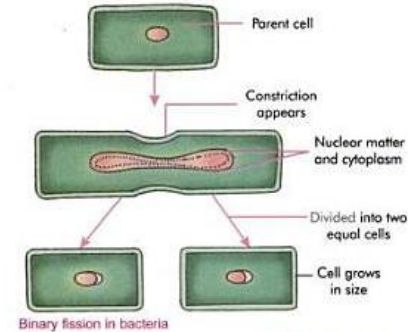
- **Autotrophic bacteria (or self feeders):** These are the bacteria which synthesise their own food.
- **Heterotrophic (or other feeders):** Bacteria that are unable to synthesise their own metabolites and obtain their food from preformed organic compound. Most bacteria are heterotrophs.

Some bacteria are known as **Saprophytes**. They obtain their food from the dead and decaying matter that surrounds them. Some bacteria are **parasitic** which means they live inside the body of hosts. They obtain nutrition from the body of their hosts. Many bacteria (such as *E. Coli*) live in our intestines and cause no harm to us.

Growth and reproduction

Bacteria require moist environment for their growth. The most suitable temperature range for their growth is 25°C to 37°C (though some bacteria may thrive in extreme temperatures also).

Bacteria reproduce at a very fast rate. The most common method of reproduction is **binary fission**. During binary fission, bacterial cell grows in size, its nucleus splits into two and with the division of



Binary fission in bacteria

cytoplasm the cell divides into two equal daughter cells. In one day, bacteria can produce millions of cells.

It is interesting to note that during unfavourable conditions the bacterial cell can survive in a protective cover called **Cyst**. On the arrival of the favourable conditions, the cyst can burst to release a number of bacterial cells. This is the reason that a number of bacteria that surround us may remain ineffective. They start growing and multiplying only when they get the favourable conditions for their growth. Bacteria also reproduce sexually.

Activity**Observation of microorganisms present in soil.**

- ▶ Take some moist soil from the garden. Prepare some agar gel and boil it in water.
 - ▶ Now, dissolve some sugar and transfer it in a glass tumbler. Keep the tumbler open for a few hours.
 - ▶ You will observe some patches developing on the agar. Now take a small piece of this patch and observe it under the microscope.
 - ▶ It will attract spores of fungi or bacteria present in the air.
 - ▶ Now keep it in a warm and dark place for a few days.
 - ▶ What do you observe? You will observe some spots on the culture medium. These spots are colonies of fungi or bacteria.
 - ▶ Take a small part of the colony and observe it under a compound microscope. Try to identify it.
- A number of bacteria cause diseases to the animals, plants and human beings whereas some bacteria are very useful.

Do You Know ?

E. Coli takes 20 minutes to produce daughter cells. *Pseudomonas* forms daughter cells in 10 minutes

Do You Know ?

Like all living organisms bacteria also need oxygen to break down food material and release energy for growth. They are called aerobic bacteria. Some kinds of bacteria cannot live in the presence of oxygen i.e., they do not need oxygen to break down food. These bacteria are called anaerobic bacteria.

Useful bacteria

Bacteria are very useful to us. Some of the uses are mentioned below:

- The curdling of milk is facilitated by using the bacteria named *Lactobacillus*.

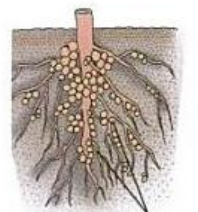
How is curd made?

The curd contains *Lactobacillus* bacteria.

When the boiled milk is mixed with curd, the *Lactobacillus* bacteria starts growing to convert milk sugar into lactic acid. The milk turns thicker. Finally **curd is formed**. When the curd is formed, it is transferred to a cooler place in order to reduce further growth of bacteria. Otherwise, these bacteria make the curd sour due to excessive production of lactic acid.

- Bacteria living in the intestine of the herbivorous animals such as cows and buffaloes are those that help in the breakdown of cellulose and make the **digestion of food** simpler.

- One of the important functions of bacteria is fixing atmospheric nitrogen. This process is called **nitrogen fixation**. Some plants have nodules in their roots in which the bacteria grow. They convert the nitrogen of air into compounds of nitrogen such as nitrates which are useful for the growth of plants. The nitrogen fixing bacteria are natural fertilisers of the soil and because of their ability of fixing atmospheric nitrogen, the leguminous plants are commonly used in crop rotation.
- Bacteria are important decomposers that help in the breakdown of dead remains of plants and animals. The decomposed remains become a part of soil thus increasing the **fertility of the soil**.
- Bacteria also decompose the waste matter found in sewage lines and waterpipes.
- The action of bacteria on excreta of cows and buffaloes results in the production of biogas called methane that is used as fuel for cooking.
- Bacteria are also used in manufacturing some **medicines**.



Root nodules in a legume
Bacteria help in nitrogen fixation

Do You Know ?

Virus was discovered by Dmitri Iwanowski in 1892.

Harmful bacteria

Bacteria are also harmful in many ways. Some of these are mentioned below:

- The action of bacteria on vegetables, fruits and other food products results in the spoilage of food. Bacteria act upon food maximum at temperatures between 25°C to 40°C. They produce toxic substances and spoil the food.
- The most harmful bacteria are disease-causing bacteria. They cause diseases in human, plants and animals.

Viruses (Latin, Virus means Poison)

Viruses are the smallest known living things. Viruses are seen only with the help of electron microscope. It has an important position in comparative study of living and non-living, because they are an entity sharing the characters of both. They cause a wide range of diseases in plants and animals.

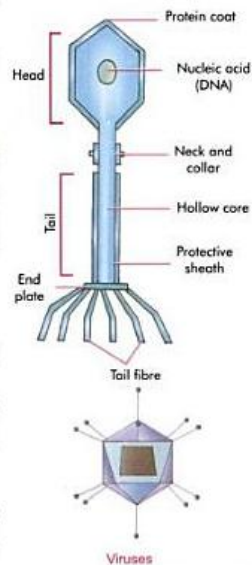
Habitat

Viruses are found everywhere namely, air, water, soil and even in the living things.

Inside the body of living organisms they behave as living beings but when they are outside the living body they behave as non-living things.

Structure

Viruses are just like particles. They can be compared with sugar crystals when they are outside the living body. They do not have cell



membrane, cytoplasm and nucleus. Each cell consists of single strand of nuclear matter (DNA or RNA) and is surrounded by a protein coat. They exhibit variety of shapes. They may be spherical, rod-shaped, cuboidal or polygonal.

Nutrition

The virus needs nutrition only inside the body of the host, outside the host it is like a non-living particle and needs no nutrition. While inside the body of the host it derives its nutrition from the host.

Growth and reproduction

A virus reproduces and grows only inside the body of the host cell. When a number of new viruses are produced inside the host cell, it bursts and new virus particles are released which infect new host cells.

Harmful viruses

The viruses cause a number of diseases like poliomyelitis, measles, AIDS (Acquired Immune Deficiency Syndrome), and the common cold.

Algae

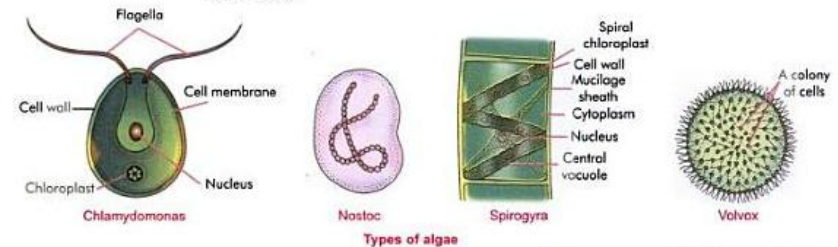
The word 'algae' is derived from a latin word 'alga' (meaning sea weeds). Algae (singular 'alga') are the most primitive and simple plants that make their own food with the help of green colouring pigment called **chlorophyll** present in them.

Habitat

They live in moist places such as crevices of rocks, barks of trees, ditches, lakes, ponds and stagnant water. Some algae may float in water and some may remain submerged in water.

Structure

The plant body of an alga is not divided into root, stem and leaves. The algae may be found in colonies or in the form of multi-cellular filaments.



The following figures show some examples of different types of algae:

The algae may be unicellular or multicellular. *Chlamydomonas* is a unicellular alga. Some multicellular examples of algae are volvox and spirogyra.

Nutrition

Algae can prepare their own food with the help of chlorophyll present in them. Even the algae that do not have chlorophyll are able to make their food with the help of other colouring pigments. Algae are the major food producers for the aquatic environment.

Reproduction

The algae reproduce by binary fission which means splitting into two by fragmentation. Some of the algae may also reproduce by sexual means, the details of which you will study in your higher classes. Some of the algae are very useful whereas some cause harm to the environment.

Useful algae

The algae are useful in many ways:

- They are the main source of food for many animals.
- They are rich source of many minerals and proteins. Therefore, they are used as natural manures for plants. They do not cause any harm to the plants as some of the chemical fertilisers do.
- Some of the algae such as sea weeds are used as food.
- An important substance agar is obtained from red algae and is used as a thickening agent for the preparation of medicines, soups, pudding, etc. This agar is obtained from red algae. The substance **Algin** is extracted from red and brown algae and is used in manufacturing medicines, fabric, paints, creams and also in leather industry.

Harmful algae

Algae may cause harm too in the following ways:

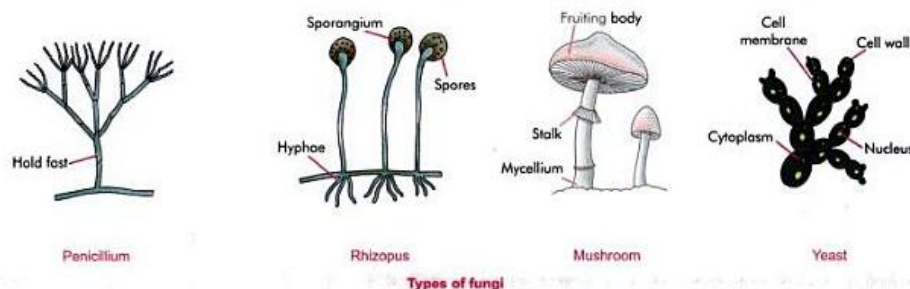
- It can cause harm by releasing some toxins that pollute the water making it unfit for drinking.
- Due to increase in the amount of algae in water, the underlying plants and animals fail to have contact with sunlight and environment which is harmful for their growth and hence may even prove fatal sometimes.

Fungi

Fungi (singular 'fungus') have similarity with plants due to the



Fucus— an alga



Types of fungi

presence of cell wall, but unlike plants they do not have chlorophyll and therefore cannot synthesise their own food by photosynthesis.

Habitat

Fungi grow best in dark moist places and at moderate temperature. Therefore, they are found in moist food material, damp clothes, damp shoes and so on.

Structure

As mentioned before each cell of a fungus has a cell wall as its outermost covering. This is where the fungi show similarity with the plants. The cell wall is made up of cellulose. Fungi may be unicellular or multicellular.

Some common types of fungi are shown in following figure:

The unicellular fungus such as yeast lives in colonies. The multicellular fungi includes mushrooms and moulds.

Nutrition

Since fungi do not have chlorophyll, they cannot prepare their own food. They have to depend upon other organisms for their food. Some fungi such as mushrooms and moulds obtain their food from substratum on which they grow. These fungi are known as **saprophytes**. The moulds therefore get food from the moist bread whereas mushrooms obtain their food from the damp soil.

Some of the fungi are parasitic because they live in the body of other living organisms to obtain their food from the host.

Growth and reproduction

The fungi reproduce by budding and by spore formation. Alongside is the figure of yeast showing the process of adding new buds. This process is known as **budding**. The fungus, bread mould reproduces by spore formation. The spores can remain alive during



Yeast cells showing budding

unfavourable conditions and on the onset of favourable conditions they germinate to form new fungi. The fungi are useful in many ways but they also cause some diseases to the plants and human beings.

Useful fungi

When we respire we use oxygen. It reacts with our food to make carbon dioxide, water and energy. But some living things can respire without oxygen. For example, yeast, a type of fungus, does not require oxygen. It breaks down the sugar present in fruit and convert it to alcohol. By doing so it gets energy for its various activities. So, yeast can be used to make alcohol. This process is called **fermentation**.

Activity

To show that yeast produces alcohol.

- ▶ Take a flask and add about 10 mL tap water.
- ▶ Dissolve about 5 gram of sugar in it.
- ▶ Mix some yeast with the solution.
- ▶ Keep the flask for 3-4 hours.
- ▶ Now taste the solutions and feel the difference of the taste with respect to tap water.
- ▶ The solution becomes alcoholic in taste. This is because sugar has been converted into alcohol due to the presence of yeast.
- ▶ The word equation for fermentation is:

$$\text{Sugar} \xrightarrow{\text{(with yeast)}} \text{Alcohol} + \text{Carbon dioxide} + \text{Energy}$$

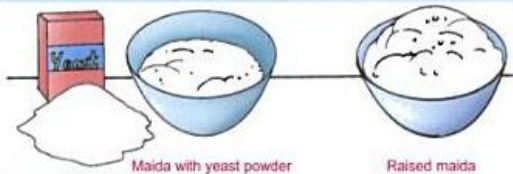
The uses of fungi are given below:

- The most common use of fungi is in the preparation of bread, cake, idli, dosa, pastries, etc. with the help of yeasts.

Activity

To show that yeast produces carbon dioxide (CO₂).

- ▶ Take about 500 g flour (atta or maida).
 - ▶ Add some sugar and mix with warm water.
 - ▶ Add a small amount of yeast powder to it.
 - ▶ Now knead it to make a soft dough.
 - ▶ What do you observe after two or three hours?
- You find that the dough is rising. During respiration, yeast reproduces rapidly and produces carbon dioxide. Bubbles of this gas increase its volume and make it soft and spongy. This is why yeast is used in the baking industry for making breads, cakes and pastries.



Do You Know ?

Antibiotics are not effective against cold and flu as they are caused by viruses.

- Fungi have also been used for the manufacture of medicines such as **antibiotic penicillin**. It is extracted from the fungus *Penicillium*. The first **antibiotic** was discovered by **Alexander Fleming** in 1928. Antibiotics kill some bacteria or stop them from growing. However, they do not work against a virus, therefore, they cannot cure cold.
- Some of the mushrooms are edible and are therefore eaten as food.
- Since the fungi are saprophytic in nature. They help in decomposition of the plant and animal wastes thus, enriching the soil with nutrients.
- Yeast is used for the production of alcohol, wine and vinegar.

Harmful fungi

When fungi get moderate temperature and humidity they spoil the fruits and vegetables by fermentation.

They also harm plants and animals by causing a number of diseases to them. The human skin suffers from the ringworm fungal infection. A disease called **athlete's foot** is also caused by a fungus. This leads to the itching between toes.

Protozoa

The word Protozoa is derived from two Greek words (Protos and zoans), 'protos' meaning primitive and 'zoans' meaning animals. Protozoa (singular 'protozoan') are considered to be the most primitive living organisms. In fact, living organisms seem to have been evolved from cyanobacteria to protozoans and then to higher organisms.

Habitat

Protozoans live in fresh and marine water and also in the soil. Some of them live as parasites in living organisms. The aquatic protozoans show locomotion with the help of cilia or flagella.

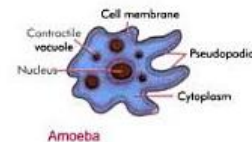
Structure

Protozoans are unicellular living organisms and have different shapes and sizes. Examples of protozoans are *Amoeba*, *Paramecium* and *Euglena*.

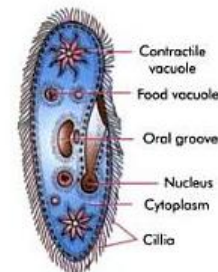
Nutrition

They obtain their nutrition by living inside the body of hosts as a parasite. Some of them are saprozoic which means they obtain nutrition from the dead and decaying matter.

Euglena as mentioned before, prepares its own food with the help of photosynthesis.



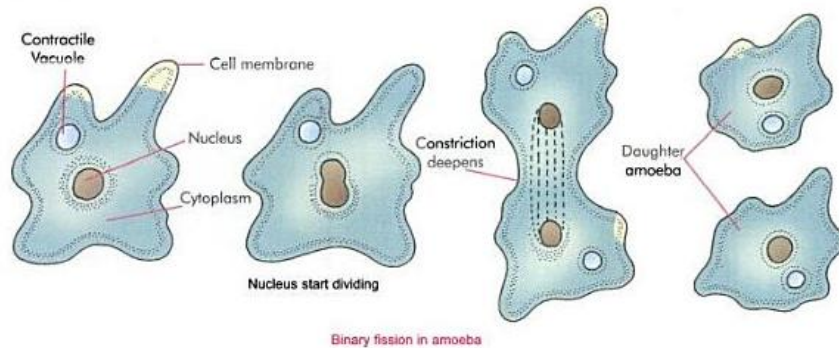
Amoeba



Paramecium

Reproduction

The protozoans reproduce by binary fission, budding and by spore formation. The following figures show the process of binary fission in amoeba.



Uses of protozoan

The small protozoans also known as zooplanktons complete the food chain by feeding on algae, the producers and being eaten up by the larger aquatic consumers.

By feeding on fungi and bacteria they breakdown the organic matter.

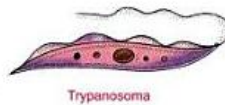
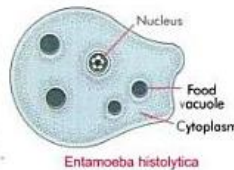
Some of the protozoans live in the digestive system of animals and help them to digest cellulose in their food.

Harmful protozoans

Some protozoans live as parasites and cause diseases to the human beings. Some of these are mentioned below:

- *Entamoeba* lives in the large intestine of human beings and causes amoebic dysentery.
- *Trypanosoma* lives in the bloodstream of human beings and cattle and causes the disease known as sleeping sickness.
- The malarial parasite, *Plasmodium* lives in the red blood corpuscles of human blood and causes a disease known as malaria.

Some insects and animals are carriers of disease causing microbes. For example, housefly, mosquito. Pathogens stick to the bodies of houseflies when they sit on garbage, animal excreta and get transferred on to the uncovered food the flies set on. People who eat this contaminated food fall sick. Female *Anopheles* mosquito is a carrier of malarial parasite. Female *Aedes* mosquito is a carrier of dengue virus.



Do You Know ?
Plasmodium parasite is carried by the female Anopheles mosquito to a healthy person and causes malaria.



Do You Know ?

Robert Koch discovered Bacillus anthracis which causes anthrax disease.

Disease causing Microorganisms in Humans

Diseases that can be spread from an infected person to a healthy person are called communicable diseases. They are caused by pathogens that can enter the body through the air we breathe, water we drink and food we eat.

Some common diseases in humans caused by microorganisms

Name of the Diseases	Pathogen	Mode of Transmission	Preventive Method
Tuberculosis	Bacteria	Air/Personal contact	Vaccination, isolation of the patient.
Cholera	Bacteria	Water	Prevention of eating exposed food. Drinking boiled water, Personal hygiene.
Typhoid	Bacteria	Water	Good sanitary habits. Prevention of consumption of exposed food to flies. Drinking boiled water.
Measles	Virus	Air/Personal contact	Vaccination, isolation of the patient.
Hepatitis B	Virus	Water	Vaccination, drinking boiled water.
Malaria	Protozoa	Mosquito	Prevention of breeding of mosquitoes, use of repellent creams, use of mosquito nets, etc.
Chicken Pox	Virus	Air/Personal contact	Vaccination, isolation of the patient.
Polio	Virus	Air/Personal contact	Vaccination at a suitable age.

Disease Causing Microorganisms in Plants

Some common plant diseases caused by microorganisms are:

Citrus canker – It is caused by bacteria and is spread by air.

Rust of wheat – It is caused by fungi and spreads through air and seeds.

Yellow vein mosaic of okra (bhindi) – It is caused by virus and spread by insects.



Disease Causing Microorganisms in Animals

Anthrax – It is a fatal disease of humans and cattle caused by a bacterium.

Foot and mouth disease – It is a disease that affects cattle and is caused by a virus.

Spoilage of Food by Microorganisms

Foods are spoilt by microorganisms when they get favourable conditions of air, warmth and moisture. These microorganisms increase in number and produce toxic substances that are harmful and poisonous. While buying packed food items it is important to read the expiry date.

Food Preservation

What is meant by food preservation? Food preservation essentially means longer retention of the nutritive value of perishable materials. The wastage of perishable food materials can be reduced by using appropriate methods and techniques of preservation. Let us take an example, you use a refrigerator at home, not only for cooling water, but also to store food items. These food items when kept at room temperature start producing foul smell. In other words, the food gets spoilt and becomes unfit for consumption. This is true for both cooked and raw food. Why does spoilage of food take place? This is because of the action of certain microorganisms such as bacteria and fungi. Thus, the refrigerator prevents the food from the action of microorganisms like bacteria and fungi.

Uncooked food or raw food is also spoilt by insects and rats. Thus, quantities of potential food are wasted. In addition to spoilage of food, its nutritive value and quality is also affected.

Advantages of food preservation

- Reducing food wastage.
- Availability of food supply especially out of season at every place.
- Increasing the storage period of foodstuff.
- Making up for dietary inadequacies.

Methods of Food Preservation

(i) Dehydration and Sun-drying

Removal of water from fruits and vegetables is called **dehydration**.

Dedhydration can be done by drying fruits and vegetables in the sun or by removing their water content under controlled conditions of temperature and humidity. For example, vegetables like spinach, cauliflower and methi leaves are generally preserved by sun-drying. The growth of microorganisms can be minimized in dry condition.

(ii) Smoking

It is used for dehydration of food items such as meat, fish and their products. In this process, small pieces of meat are first rubbed with salt and then hung from the ceiling or kept on wooden rafters. These pieces are then dehydrated with the heat and smoke of fire lit below.

(iii) Heating

It is used for killing germs in milk at home. Thus, milk is prevented from spoilage by boiling.

(iv) Salt and sugar

Salt: The presence of high concentration of salts (15% to 18%) drains out the water from food materials through a process called **osmosis** and it prevents bacterial growth which spoils the food. The vegetable and fruits such as tamarind, beans, raw mango, amla, and non-vegetable items like fish and meat are often preserved by using salt.

Sugar: Sugar syrup containing more than 68% sugar also stops bacterial growth as little free moisture is available for it. Microorganisms already present in the food materials, therefore, gradually die due to lack of moisture.

Oil and vinegar: Oil and vinegar are also used as preservatives. You might have noticed them being used in the preparation of pickles, chutney, ketchups and squashes. These preservatives do not allow the growth of microorganisms and thus, help in preserving the food.

Chemical Method

Chemical preservatives like sodium benzoate and sodium metabisulphite are used in jams and squashes.

Refrigeration

Refrigeration keeps the food at low temperature, inhibits the growth of microbes and prevents food from getting spoilt.

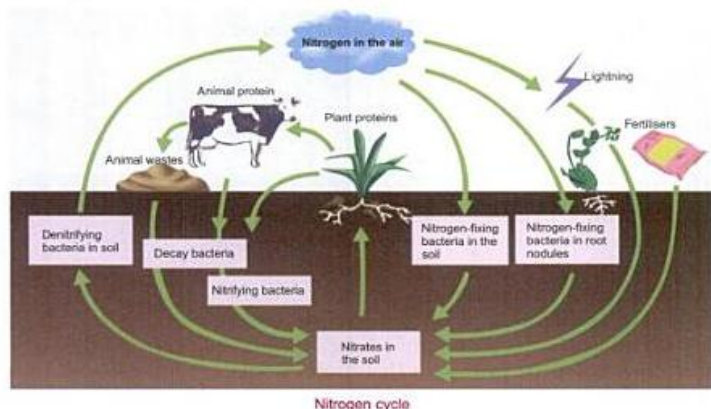
Pasteurisation

Milk is made germ free by pasteurisation. In this process milk is heated at 70°C for 15 seconds and is then suddenly chilled and stored, this prevents the growth of microbes. This process was discovered by **Louis Pasteur**.

Nitrogen Cycle

Nitrogen is the major component of air. Air consists of nearly 78 per cent of nitrogen. Plants and animals cannot use it as a gas. It has to be changed to nitrates before it can be used by plants. Plants can use the

nitrogen in the form of nitrates to make protein and animals get their nitrogen from plant proteins when they eat plant and plant products. But how is nitrogen gas changed into nitrates? We understand it by looking at the diagram (nitrogen cycle) as follows:



Decay bacteria

These bacteria break down dead remains and animal wastes releasing ammonium compounds into the soil. This process is called **ammonification**.

Nitrifying bacteria

These bacteria in the soil can change ammonia into nitrates. Ammonia is another chemical that contains nitrogen. It is present in animal waste and dead remains. This process is called **nitrification**.

Nitrogen-fixing bacteria

These bacteria (called *Azotobacter*) are found in the soil. They convert nitrogen from the air into nitrates. Plants take up the nitrates with their roots.

Nitrogen-fixing bacteria (*Rhizobium*) are also found in the roots of **leguminous plants** like peas, beans and clover. These bacteria make lumps on the roots called **root nodules**. They can change nitrogen into nitrates that the leguminous plants can use.

Lightning

The high temperature of lightning discharge causes some of the nitrogen and oxygen in the air to combine and form oxides of nitrogen. These oxides in the rain are washed into the soil as acids (weak), where they form nitrates.

When plants and animals die, bacteria and fungi present in the soil convert the nitrogenous wastes into nitrogenous compounds to be used by plants again. Some of it is converted into nitrogen gas by bacteria, which goes back to the atmosphere. Thus, the percentage of nitrogen in the atmosphere remains constant. The conversion of nitrates into nitrogen by the denitrifying bacteria is called **denitrification**.

KEY WORDS

Microorganisms	: the living organisms that we cannot see with naked eyes
Microscope	: a special device which we require to see microorganisms
Cyst	: hard outer covering of a cell
Habitat	: the natural home of an organism
Fermentation	: the breakdown of substance by microorganism
Protozoan	: a unicellular and microscopic organism, e.g., an amoeba
Virus	: an extremely small infectious agent that causes a variety of diseases in plants and animals, such as small pox, the common cold, and tobacco mosaic disease
Bacteria	: a large and diverse group of organisms, which in terms of numbers and variety of habitats, includes the most successful life forms
Diatom	: a unicellular algae as plankton and forming fossil deposits
Yeast	: a greyish-yellow fungus substance obtained especially from fermenting malt liquors and used as a fermenting agent, to raise bread, etc
Antibiotics	: medicines produced from microorganisms which kill microorganisms that cause diseases
Pathogen	: disease causing microbes

- **Microorganisms** are the organisms that cannot be seen with the naked eyes but can be seen only under the microscope. They can be classified into groups named bacteria, blue-green algae and diatoms, viruses, algae, fungi and protozoans.
- **Bacteria** are found everywhere. They may be rod-shaped, spherical, comma-shaped or spiral-shaped.
- **Bacterial** cell has a cell wall but has no chloroplast. It is chemosynthetic, saprophytic or parasitic in nature. They grow and multiply very fast by binary fission (a common method of reproduction). They are the most important decomposers and are also very useful in the manufacturing of medicines as **nitrogen** fixing bacteria. Some of them are harmful and cause diseases such as typhoid, pertussis, tuberculosis, cholera, diphtheria.