

## 8. Useful and Harmful Microbes



- Useful micro-organisms : *Lactobacilli, Rhizobium, Yeast*
- Harmful micro-organisms : *Clostridium* and others.



### Can you recall.

1. What is meant by microbes? What are their characteristics?
2. How did you observe microbes?

You are familiar with different types of microbes which are all around us but cannot be seen with our eyes. In what way are they related to our everyday life?

### Useful micro-organisms



#### Try this



8.1 Lactobacilli

#### Lactobacilli

Smear a drop of fresh buttermilk on a glass slide. Stain it with methylene blue and put a coverslip over it.

Observe the smear under the 10X objective of a compound microscope and then with the more powerful 60X objective.

Did you notice the blue rod-shaped organisms moving around? They are lactobacilli, a kind of bacteria. They are minute and rectangular in shape. Lactobacilli are anaerobic bacteria i.e. they can produce energy without the use of oxygen.



### Can you tell?

How is yoghurt made from milk? What exactly happens in this process?

The lactobacilli convert lactose, the sugar in the milk, into lactic acid. This process is called fermentation. As a result, the pH of milk decreases causing **coagulation** of milk proteins. Thus, milk proteins are separated from other constituents of milk. This is what happens when milk changes into yoghurt. Yoghurt has a specific sour taste due to lactic acid. The low pH destroys harmful microbes present in the milk.



#### Use your brain power !

1. Why do doctors advise you to have yoghurt or buttermilk if you have indigestion or abdominal discomfort?
2. Sometimes, yoghurt becomes bitter and froths up. Why does this happen?
3. Which different milk products are obtained at home by fermentation of the cream from the milk?



#### Do you know?

What is meant by 'probiotic' yoghurt and other foodstuffs that are popular nowadays?

Useful microbes like lactobacilli are added to these eatables. Such eatables are healthy because they kill the harmful bacteria like clostridium in the alimentary canal and help to improve our immunity.

### Uses of Lactobacilli :

1. Various milk products like yoghurt, buttermilk, *ghee*, *cheese*, *shrikhand*, etc. can be obtained by fermentation of milk.
2. Lactobacilli fermentation is useful for large scale production of cider, cocoa, pickles of vegetables, etc.
3. Lactobacilli and some other useful microbes taken together are used to treat abdominal discomfort.
4. Leavened fodder offered to domestic cattle like cows and buffalos, is fodder fermented with the help of lactobacilli.
5. The lactobacilli fermentation process is used to make wine and some types of bread.



### Research

1. How many different industries depend upon the lactobacilli bacteria?
2. Which types of cottage industries and factories can be started in areas with abundant milk production?

### Rhizobium : Symbiotic bacteria

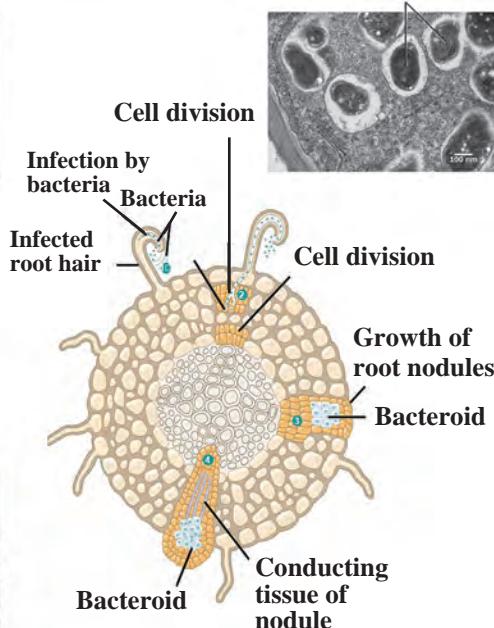


### Let's try this

Take a plantlet of fenugreek, groundnut or any other bean and sterilize it with a 3 to 5 % solution of hydrogen peroxide.



Rhizobium



8.2 Root nodules of soyabean plant

Afterwards, keep it in a 70% solution of ethyl alcohol for 4 to 5 minutes. Clean the roots with sterile water and take thin sections of the root nodules. Select good section and place it in a solution of safranin for 2 to 3 minutes. Place the stained section on a glass slide, cover it with a coverslip and observe it under the compound microscope. The pinkish rod-shaped organisms are the rhizobium bacteria.

Note that we had to search for the root nodules of leguminous plants to obtain these bacteria. Are the rhizobium bacilli useful to these plants or harmful?

### Role and importance of rhizobium

Rhizobia living in root nodules supply nitrates, nitrites and amino acids to that plant and in exchange get energy in the form of carbohydrates from it. Such a mutually beneficial relationship is called symbiosis.

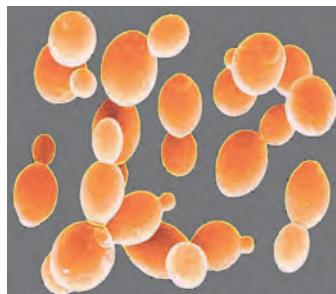
Rhizobia produce nitrogenous compounds from atmospheric nitrogen. However, for this process of nitrogen fixation, they need leguminous plants like beans, sweet pea, soyabean, etc. as 'host'. Beans and pulses are rich in proteins due to the nitrogenous compounds made available by rhizobia.

After harvesting a leguminous crop, the left over roots and other plant parts are deliberately dumped in farm soil to maintain its bacterial population. The use of rhizobium has helped to reduce the use of chemical fertilizers and thereby their adverse effects. It has also helped to reduce expenses on fertilizers and thus works to the benefit of farmers.

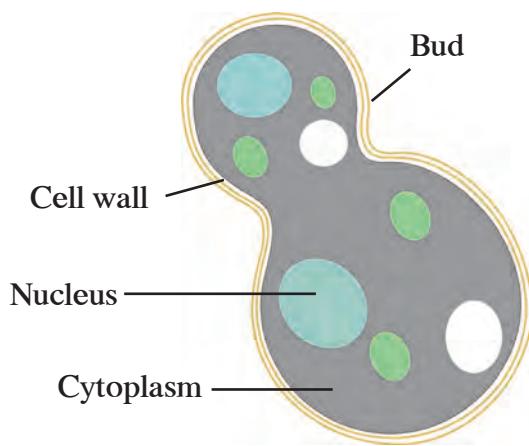
### Yeast



#### Let's try this



Fungus cells



8.3 Yeast cells

In the above experiment, yeast grows and multiplies very quickly due to the carbon compounds in the sugar solution. In the process of obtaining nutrition, yeast cells convert the carbohydrates in that solution into alcohol and carbon dioxide. This process called fermentation.

#### How is bread made ?

Find out how to use the solution prepared in the above experiment, to make bread. Follow the recipe and make the bread. Find out and note down the reasons why the dough rises and makes the bread spongy.

Nowadays, seeds are coated with rhizobial solution or powder before sowing. After sowing, rhizobia enter the plantlets. This is called 'rhizobial inoculation'. This experiment has helped in the supply of nitrogen to cereal and other crops, besides leguminous crops.

**Activity :** Bring 'active dry yeast' from the market. Mix a spoonful of yeast, two spoonfuls sugar with a sufficient quantity of lukewarm water in a bottle. Fix a colourless, transparent balloon on the mouth of that bottle.

What changes do you observe after 10 minutes? Mix limewater with the gas accumulated in the balloon. Collect that limewater in a beaker and observe it. What do you notice?

Take a drop of the solution from the bottle on a glass slide, put a cover-slip over it and observe it under the compound microscope. Store the solution in the bottle carefully.

Do you see the colourless, oval cells of yeast on the slide? Some of those cells may have small round bodies attached to them. These are new daughter cells of yeast in the process of formation.

This method of asexual reproduction is called '**budding**'. Yeast is a heterotrophic fungal microbe that grows on carbon compounds.

Yeast is a unicellular fungus with 1500 different species in existence. The yeast cell is a eukaryotic type of cell.



## Do you know?

Often, alcohol is produced along with sugar in sugar factories. Molasses is produced from sugarcane juice. It is rich in carbohydrates. Molasses is fermented with the help of the yeast called *Saccharomyces*. In this process, ethanol ( $C_2H_5OH$ ) alcohol is produced as a primary product and ester and other alcohols as secondary products.

Spirit and other alcohols can be obtained from ethanol. Ethanol is also a smokeless and high quality fuel. Besides molasses, maize, barley, and other grains are also used for industrial production of ethanol.

Glucose and fructose, the sugars present in grape juice, are also fermented with the help of yeast to produce the alcohol which is used for making wines.



## Use your brain power !

- Recently, it has been made compulsory in India and some other countries to mix 10% ethanol with fuels like petrol and diesel. What is the reason for this?
- Why are wineries located near Nashik in Maharashtra?
- Chapattis made from wheat only swell up but bread becomes spongy, soft and easy to digest. Why is it so?

### Bio-remediation

A yeast, *Yarrowia lipolytica* is used to absorb the toxins released during the production of palm oil and the heavy metals and minerals released in some other industrial processes. *Saccharomyces cerevisiae* is used for absorption of a pollutant, arsenic.

Oil spills in oceans are cleaned with the help of *Alcanivorax* bacteria.

## Antibiotics

Carbon compounds obtained from some bacteria and fungi for destroying or preventing the growth of harmful micro-organisms are called 'antibiotics'. Antibiotics, a discovery of the 20<sup>th</sup> century, have brought about a revolution in the field of medicine. Even a disease like tuberculosis has been almost completely eradicated from some countries.

Antibiotics mainly act against bacteria. Some antibiotics can destroy protozoa. Some antibiotics are useful against a wide variety of bacteria. They are called **broad-spectrum antibiotics**. Examples are ampicillin, amoxicillin, tetracycline, etc. When the pathogen cannot be identified even though the symptoms of disease are visible, broad spectrum antibiotics are used.

Whenever a pathogenic micro-organism is definitely known, then **narrow-spectrum antibiotics** are used. Examples are penicillin, gentamycin, erythromycin, etc.

### Institutes at work

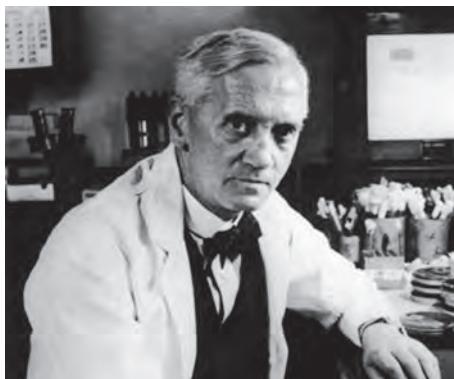
**The National Institute of Virology, established in 1952 in Pune, undertakes research related to diseases like measles, jaundice, fever and diseases of the lungs, with support from the World Health Organization.**

## Penicillin

Penicillin is a group of antibiotics obtained from a fungus, *Penicillium*, and is used for controlling the infections caused by bacteria like Staphylococci, Clostridia, Streptococci, etc. Medicines containing penicillin are useful to treat certain bacterial infections of the ear, nose, throat and skin as well as diseases like pneumonia and scarlet fever.

### Caution

- \* Antibiotics should be taken only when prescribed by a doctor.
- \* Don't purchase any antibiotic from medical stores without a prescription from a doctor.
- \* Don't consume antibiotics on your own to treat common diseases like a throat infection, common cold or influenza.
- \* Even if you feel well before completing of the prescribed course of the antibiotic you must continue and complete it.
- \* Don't suggest to others the antibiotics which were useful to you.



Dr Alexander Fleming

### Introduction to scientists

Alexander Fleming, a professor of microbiology at St Mary's Hospital had cultured varieties of bacteria and fungi in Petri dishes in his laboratory.

On 3 September 1928, while observing staphylococci cultures, he made an interesting observation in one Petri dish. In that Petri dish, fungal colonies had grown but the area around those colonies was clean and clear. i.e. bacteria had actually been destroyed. After further studies, he confirmed that the fungus growing there was *Penicillium* and its secretion had destroyed the bacterial colonies.

Thus, the first antibiotic - penicillin had been discovered accidentally and this formed the basis for attempts to find cures for incurable diseases.

Shouldn't we always be grateful to Alexander Fleming for discovering the life-saving antibiotics?

### Wonderful to know

Ants grow fungi in their termitarium (anthill) and obtain food from it. Some species of wasps and other insects lay their eggs in the fungal bodies growing on trees thus ensuring a food supply for their larvae.

### Harmful micro-organisms

#### Fungi



Can you tell?

1. Which changes do you notice in leather articles and gunny (jute) bags during the rainy season?
2. For how long afterwards can you use those articles?
3. Why do these articles not get spoilt during the summer or winter?

Microscopic spores of fungi are present in the air. If there is sufficient moisture, spores germinate on cotton fabric, gunny bags, leather, wooden items, etc. The fungal hyphae (fibres of the fungus) penetrate deep into the material to obtain nutrition and to reproduce. This causes the materials to wear and become weak. As a result, gunny bags, leather items like shoes, purses, belts, etc. on which fungi have grown do not last long. Wooden items also get spoilt.



### Think about it

Sometimes, you may notice a black powder or white discs floating on the pickle or *murabba*, when a jar is opened after a long time. What exactly is this? Why are such food items not good to eat?

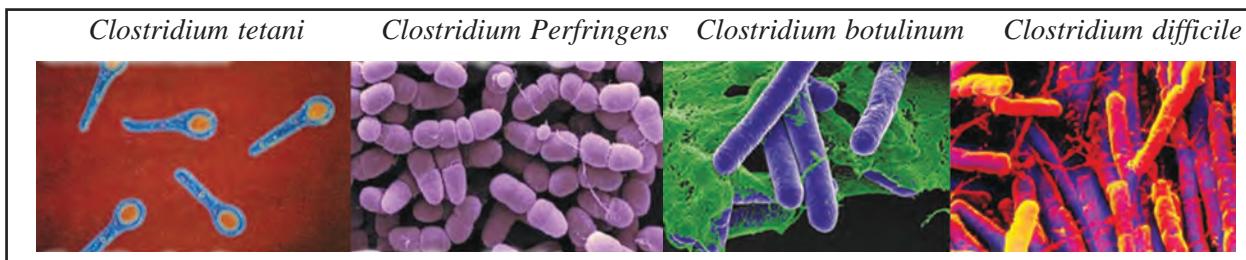
Various species of fungi grow on food items like pickles, *murabba*, jam, sauce, chutney, etc. They use the nutrients in these food items for growth and reproduction. During this activity, fungi release mycotoxins, certain poisonous chemicals, into the food and thus food becomes poisonous. Hence, the food on which fungi have grown cannot be eaten.

### *Clostridium*

Sometimes, cases of food poisoning occur during community feasts. How does the food become poisonous all of a sudden?

The bacteria which spoil cooked food are *Clostridium*. Out of about 100 different species of this bacterium, some are free living in the soil whereas some live in the alimentary canal of humans and other animals.

These bacteria are rod-shaped and produce bottle-shaped endospores in adverse conditions. One special characteristic of these bacteria is that they cannot withstand the normal oxygen level of the air because they grow in anaerobic conditions.



8.4 *Clostridium* species

### Other harmful micro-organisms

Do only the *Clostridium* bacteria cause illness?

Other kinds of micro-organisms like bacteria, viruses, protozoa and fungi are also responsible for different diseases that affect humans. You have learnt about viruses which are smaller than bacteria and can grow and reproduce only in living cells. Let us see how they are harmful to us.

### An Introduction to scientists

It was believed that meat gets spoiled due to some bacteria of the bacillus type but the exact type of bacillus was not known. Van Ermengem proved that the anaerobic bacterium *Clostridium botulinum*, is responsible for food poisoning.

Ida Bengston obtained higher education in biochemistry at Chicago University. She conducted important research on the toxin responsible for gas gangrene and the antitoxin useful for treating it. While she was doing research on the dreaded disease called typhus, she herself contracted the infection. But, she overcame it and continued her research. For this work, she was honoured with the 'Typhus Medal' in 1947.

## The spread and prevention of disease

| Name of disease                                 | Pathogen | Mode of infection  | Preventive measures  |
|---|----------|--|--|
| AIDS  | Virus    | Through blood and semen of infected person and milk of mother suffering from AIDS. | Safe sexual contact, avoid reuse of needles and injections.                          |
| Hepatitis                                       | Virus    | Contaminated water and food.   | Clean and filtered water, proper storage of food.                                    |
| Influenza                                       | Virus    | Contact with infected person   | Personal hygiene and avoiding contact with infected person                           |
| Measles and Chicken pox                         | Virus    | Contact with infected person   | Vaccination, uncontaminated water, clean food  |
| Bird Flu ( $H_7N_9$ )<br>Swine Flu ( $H_1N_1$ ) | Virus    | Contact with infected birds and animals  | Personal hygiene, properly cooked meat.  |
| Dengue  | Virus    | Mosquito bite  | Cleanliness of surroundings preventing stagnation of water, mosquito control.        |
| Pneumonia                                       | Bacteria | Droplets spread in air by infected person  | Vaccination, avoiding contact with infected person                                   |
| Leprosy   | Bacteria | Long term contact with infected person   | Avoiding contact with infected persons and their belongings                          |
| Cholera   | Bacteria | Contaminated food and water.   | Clean food and water.  |
| Malaria   | Protozoa | Mosquito bite, uncleaned surroundings.   | Cleanliness of surroundings, preventing stagnation of water, controlling mosquitoes. |
| Dandruff, ringworm, scabies                     | Fungi    | Contact with infected person or his/her belongings like clothes.                   | Personal hygiene, avoiding contact with infected person                              |



### Use your brain power !



8.5 A lichen (*dagadphool*)- used as a condiment

1. Salt is applied on the inner surface of pickle jars and the pickle is covered with oil. Why is this done?
2. Which preservatives mixed with ready-to-eat foods to keep them from spoiling?
3. Find out the uses of fungi to plants and animals.
4. What is the structure of lichen, a condiment? Where else is it used?



### Collect information

Which plant and animal diseases are caused by micro-organisms and what are the measures to be taken against them?



## Exercises

1. Complete the statements using the proper option from those given below. Explain the statements.  
(mycotoxins, budding, rhizobium)
  - a. Yeast reproduces asexually by the ..... method.
  - b. Toxins of fungal origin are called .....
  - c. Leguminous plants can produce more proteins due to .....
2. Write the names of microbes found in following food materials.  
yoghurt, bread, root nodules of leguminous plants, idli, dosa, spoiled potato curry.
3. Identify the odd word out and say why it is the odd one?
  - a. Pneumonia, diphtheria, chicken pox, cholera.
  - b. Lactobacilli, rhizobia, yeast, clostridia.
  - c. Root rot, rust (*tambera*), rubella, mozaic.
4. Give scientific reasons.
  - a. Foam accumulates on a the surface of 'dal' kept for a long time in summer.
  - b. Why are naphthalene balls kept with clothes to be put away.
5. Write down the modes of infection and the preventive measures against fungal diseases.

## 6. Match the pairs.

| ‘A’ group             | ‘B’ group                    |
|-----------------------|------------------------------|
| 1. <i>Rhizobium</i>   | a. Food poisoning            |
| 2. <i>Clostridium</i> | b. Nitrogen fixation         |
| 3. <i>Penicillium</i> | c. Bakery products           |
| 4. Yeast              | d. Production of antibiotics |

## 7. Answer the following questions.

- a. Which vaccines are given to infants? Why?
- b. How is a vaccine produced?
- c. How do antibiotics cure disease?
- d. Are the antibiotics given to humans and animals the same? Why?
- e. Why is it necessary to safely store the pathogens of a disease against which vaccines are to be produced?

8. Answer the following questions in brief.

- a. What are 'broad spectrum antibiotics'?
- b. What is fermentation?
- c. Define 'Antibiotic'.

## Activity :

Collect information about generic medicines and discuss them in the class.

