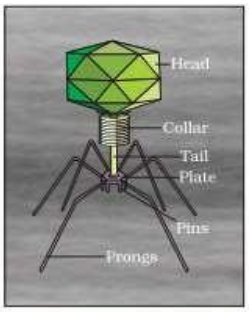
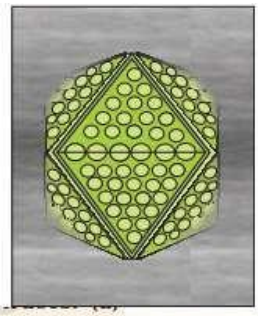
CHAPTER-10

MICROBES IN HUMAN WELFARE

- 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–sites such as deep inside the geysers (thermal vents) where the temperature may be as **high as 100^{0}C**, deep in the soil, under the layers of snow several metres thick, and in highly acidic environments.
- Microbes are diverse–protozoa, bacteria, fungi and microscopic plant viruses, viroids and also prions that are proteinacious infectious agents



A bacteriophage;


Adenovirus which causes respiratory infections;

Microbes like bacteria and many fungi can be grown on nutritive media to form colonies (Figure 10.3), that can be seen with the naked eyes.

1. Microbes in Household products

- **LACTIC ACID BACTERIA (LAB)**

- Micro-organisms such as **Lactobacillus** and others commonly called **Lactic acid bacteria (LAB**) grow in milk and convert it into **curd**.
- During the growth, LAB produces acids that coagulate and partially digest the milk proteins. A small amount of curd added to the fresh milk as **inoculums** or **starter** contains millions of LAB, which at suitable temperature multiply and convert milk into curd.

- LAB improves nutritional quality by increasing **vitamin B_{12} (Cyanocobalamine**).
- In our stomach LAB check the disease causing microbes.

- ✓ The **dough**, which is used for making dosa and idli is also fermented by bacteria. The puffed-up appearance of dough is due to the production of **carbon dioxide (Fermentation results in the formation**
- ✓ The dough, which is used for making bread, is fermented using **baker's yeast-*Saccharomyces cervisiae***
- ✓ 'Toddy', a traditional drink of some parts of southern India is made by **fermenting sap from palms.**
- ✓ Various microbes are also used to ferment fish, soyabean and bamboo shoots to make food.
- ✓ Large holes in **'swiss cheese'** are due to production of a large amount of **CO_2** by a bacterium ***Propionibacterium sharmanii.***
- ✓ The **'Roquefort cheese'** are ripened by growing a specific **fungi** on them, which gives them a particular flavor

2. Microbes in Industrial products

Even in industry, microbes are used to synthesise a number of products valuable to human beings. **Beverages and antibiotics are some examples**.

Fermentors; are large vessels used for growing microbes in very large scale in Industries.


Fermentors

(a) Fermented Beverages

- ✓ Microbes (Yeast) are used for the production of beverages like wine, beer, whisky, brandy

or rum. For this purpose ***Saccharomyces cervisiae*** **is used (Brewer's yeast)**

- ✓ This yeast is used for fermenting malted cereals and fruit juices to produce **ethanol**
- ✓ Depending upon **the type of 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 of fermented broth**
- ✓ **Whisky ,Brandy and Rum are produced by distillation of fermented broth**

Qn. Find the Odd one and write the reason for selection ?

Wine, Whisky ,Brandy , Rum

Ans:

(b) Antibiotics

- ✓ Discovery of antibiotics is regarded as the one of the **most significant discoveries of the 20th** century
- ✓ **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 'pro life' and not against.**
- ✓ Antibiotics are the chemical substances, which are produced by the some microbes and can kill or retard the growth of other (Disease causing) microbes.
- ✓ **Pencillin** was the first antibiotic to be discovered. **Alaxander Fleming** discovered Pencillin**. (Un expected discoveries**/ chance discovery **are called Serendipity)**. Pencillin is produced by a mould called **Pencillium notatum**
- ✓ Alexander Fleming while working on Staphylococci bacteria, once 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***
- ✓ **Full potential effective antibiotic** (Pencillin) was established by **Ernest Chain and Howard Florey**
- ✓ This antibiotic was extensively used to treat American soldiers wounded in World war II. **Felmming, Chain, and Florey were awarded Nobel Prize in 1945, for this discovery**.
- ❖ Antibiotics are now widely used against deadly diseases **like Plaque, whooping cough** (kali khansi)**, diphtheriaa** (gal ghotu)**, and leprosy** (kusht rog) ,which used to kill millions all over the globe.

(c). Microbes for the production of acids and Alcohol

Some microbes are used for the commercial and industrial production of certain chemicals like **organic acids, alcohol and enzymes**

Aspergillus niger(Fungus)---------	Citric acid
Acetobacter aceti(Bacteria)-------	Acetic acid
Clostridium butylicum (Bacteria)---	Butyric acid
Lactobacillus (Bacteria) ----------	Lactic acid
Saccharomyces cervisiae----------	Ethanol

(d) Microbes for the production of Enzymes

- **Lipase** are used in Detergent formulations for removing oily stains in laundry
- Bottled fruit juices bought from market are clearer as compared to those made at home. This is because the bottled juices are clarified by the use of **Pectinase and Protease**

(e) Microbes used as Bioactive molecule

- Bioactive molecules are substance that can be acted on a living organism or an extract from a living organism. It can be extracted from micro organism.

- A bioactive molecule is a naturally occurring chemical compound found in living organisms that can have a significant effect on biological processes, either positive or negative
- **Streptokinase**

  It is produced by the bacterium Streptococcus and modified by genetic engineering is used as **a 'CLOT BUSTER'** for **removing clots from blood vessels** of patients who have undergone myocardial infarction leading to heart attack
- **Cyclosporin A**

  Trichoderma polysporum (fungus) produces **Cyclosporin A** . It is used as a **immunosuppressive** agent in organ transplantation
- **Statin**

  Monascus purpureus (Yeast) Produce **Statins**. It is used as **blood cholesterol lowering agent**. Statin act on enzyme responsible for synthesis of cholesterol. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

Microbe	Bioactive molecule	Function
Streptococcus (Bacteria)	Streptokinase	It is used as a 'CLOT BUSTER' for removing clots from blood vessels of patients
Trichoderma polysporum (fungus)	Cyclosporin A	immunosuppressive agent in organ transplantation
Monascus purpureus (Yeast)	Statins.	blood cholesterol lowering agent

3. Microbes in Sewage Treatment

- Municipal waste-water is called **Sewage**.
- A major component of this water is human excreta. It also contains large amounts of organic matter and microbes.
- Many of which are pathogenic. Before disposal of this sewage water into natural waterbodies like river and Streams, they undergo treatment in **sewage treatment plants (STPs)**.
- Treatment of waste water is done by the **heterotrophic microbes** naturally present in the sewage.
- Sewage treatment consists of two stages.

a) Primary treatment

It include the 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 grits (soil and small pebbles) are removed by sedimentation.
- All the solids that settle form the **primary sludge**. The supernatant forms the **Effluent**.
- The Effluent from primary settling tank is taken for secondary treatment.

b) Secondary treatment/Biological treatment

- The primary Effluent is passed into Large aeration tank, 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 structure).
- While growing, these microbes consume the major part of the organic matter in the Effluent. This reduces **BOD(Biochemical oxygen Demand-It is the amount of oxygen that would be consumed if all the organic matter in one liter of water were oxidized by**

bacteria) of the Effluent. Here Sewage water is treated till **the BOD is reduced.**

- **The BOD test measures the rate of uptake of oxygen by the microorganism in a sample of water.Thus indirectly it is a measure of organic matter present in the water.**
- **The greater the BOD of waste water** Once the BOD of sewage is reduced , the Effluent is then passed to a **settling tank** where bacterial 'Flocs' are allowed to sediment. This Sediment is called **Activated Sludge**.
- A small part of activated Sludge is pumped back to aeration tank to serve as **inoculum**.
- The remaining major part of the sludge is pumped into large tanks called **Anerobic sludge digesters.** Here, other kinds of bacteria (Eg:Methanobacterium), which grow anerobically, 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 sued as source of energy as it is inflammable.**
- Then **the effluent from secondary treatment is generally released into natural water bodies like rivers and streams.**

❖ **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 STPs so that only treated sewages may may be discharged in the rivers.

Difference between primary treatment and secondary treatment

Primary treatment	Secondary treatment
It is a physical process	It is a biological process
It remove both grits and large piece of Organic matter	It remove small sized organic matter
It doesnot requires aeration	It requires aeration
It involve filtration and sedimentation	It involve microbial digestion of organic matter

4 Microbes in production of Bio Gas

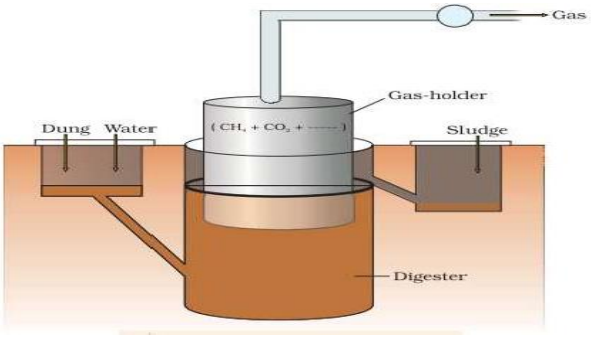
Biogas is a mixture of gas (Mainly **Methane**) produced by the microbial activity. Certain bacteria, which grow **anerobically** on cellulosic material, produce large amount of methane along with CO_2 and H_2. These bacteria is collectively called **Methanogens**
(Eg; Methanobacterium).

Methanogens are found in **Anerobic sludge digester** (In sewage treatment), in the **Rumen of cattle**. In the Rumen, these bacteria help in the breakdown of cellulose and play important role in nutrition of cattle. Thus, the excreta (dung) of cattle , commonly called **Gobar**, is rich in these bacteria. So **Dung can be used in for generation of Biogas, commonly called Gobar gas.**

BIOGAS PLANT

The technology of Biogas production was developed in India due to the efforts of **Indian Agricultural Research Institute (IARI)** and Khadi and **Village Industries Commission (KVIC).**

The Biogas plant consist of a concrete tank of **10-15 feet deep** in which bio-waste are collected and a slurry of dung is fed. A floating cover is placed over the slurry, which keeps on rising as the gas is produced in the tank due to the microbial activity. The biogas plant has an outlet, which is connected to a pipe to supply biogas to nearby house. The spent slurry is removed through another outlet and may be used as fertilizer . Cattle dung is available in large quantities in rural areas where cattle are used for a variety of purposes. Biogas produced thus produced is used for cooking and lighting.



5. Microbes as Biological control of pests and diseases:

- It refers to the use of biological methods for controlling plant diseases and pests.
- Biocontrol can be simply defined as the control of the growth of an insect or pest by using a biological agent or living organism. This process is also referred to as biological control
- Ie: It is a method of controlling pests that relies on **natural predation** rather than **introduced chemicals.**
- So Biocontrol measures **greatly reduce our dependence on toxic chemicals and pesticides**.

  Eg: (1)-The beetle with red and black marking-)-Ladybird and dragonflies are useful to get rid of **aphids and mosquitoes** respectively

  Eg:(2)-Introduction of ***Bacillus thuringiensis*** (Bt) is used to control **butterfly catterpiller** is **an example for microbial Biocontrol**. These are available in sachet as dried spores which are mixed with water and sprayed onto vulnerable plants such as Brassicas and fruit trees, where these are eaten by insect larvae. The bacterial disease will kill the caterpillars but leave the other insects unharmed.

  Eg: (3)-Using genetic engineering skills, scientist introduced *B.thuringiensis* toxin gene into plants. Such plants are resistant to attack by insect pests. **Eg:Bt-Cotton**

  Eg: (4)-Trichoderma (Free living fungi present in the root ecosystem) used in the treatment of plant diseases.

  Eg(5) Baculoviruses (Genus : Nucleopolyhedrovirus) are viruses that attack the insects and other arthropods. These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. The virus has no harmful effect on plants and animals such as Mammals, Birds, Fishes or even on non-target insects.

  These viruses play a vital role for conserving the beneficial insects **in Integrated pest management (IPM) programme.**

8. Microbes as Biofertilisers

- The thoughtless use of **chemical fertilizers** has contributed much to the environment pollution.
- The realization of this problem problem compelled us **to switch to the Organic farming** –to use of Biofertilisers.
- **Biofertilisers are organism that enriches the nutrient quality of the soil.**
- **The main sources of Biofertilisers are Bacteria, Fungi and Cyanobacteria.**
- Currently, in our country, a number of biofertilisers are available commercially in the market and farmers use these regularly in their fields to replenish soil nutrients and to reduce dependence on chemical fertilisers.
- **Eg: (1)-**The roots of Leguminous plants contains **Rhizobium**, it fix atmospheric nitrogen into organic forms which is used by the plant as nutrient
- **Eg: (2)-Azospirillum and azobacter** (Both are free living bacteria in the soil) are able to fix atmospheric Nitrogen
- **Eg: (3)-**Certain Fungi such as **Mycorrhizae** forms symbiotic association with plants.Many member so of the genus **Glomus** forms Mycorrhiza. The fungal symbiont helps the plant **to absorb phosphrous** from the soil. This association also resist to **root borne pathogens**, **tolerance to salininty and drought**. This association also **accelerate the growth and development** of the plant
- **Eg: (4)-Cyanobacteria (Eg; Anabaena, Nostoc, Oscilaatoria**) are **autotrophic microbes** widely distributed in aquatic and terrestrial environments. Many of which can **fix atmospheric nitrogen**. In paddy fields, **cyanobacteria serve as biofertiliser**. Blue green

algae also add organic matter to the soil and increase its fertility.

Difference between Biofertiliser and Chemical fertilizer

Biofertilisers	Chemical fertilizers
They are microbes	They are chemicals
They do not cause pollution	They cause pollution
They are cheap	They are costlier
They improve soil structure and Functions	They destroy soil structure and function

OGY Academy
Outstanding Guidance for Youth

MICROBES IN HUMAN WELFARE

1. Match the following :
(HSE-MARCH-2024).(2)

A	B
Clostridium butylicum	Acetic acid
Aspergillus niger	Lactic acid
Acetobacter aceti	Butyric acid
Lactobacillus	Citric acid

2. Microbe known as both Baker's yeast as well as Brewer's yeast is _____
(HSE-JUNE-2023).(1)
3. Complete the table using appropriate terms (HSE-JUNE-2023).(2)

Microbe	Bacterium/Fungus	Product
Aspergillus niger	_____A_____	Citric acid
_____B_____	Bacterium	Acetic acid
Clostridium butylicum	_____C_____	Butyric acid
Lactobacillus	Bacterium	_____D_____

4. Which microbe is called baker's yeast ?
(A) Propionibacterium sharmanii
(B) Lacto bacillus
(C)Saccharomyces cerevisiae
(D) Aspergillus niger (HSE-March 2023)(1)
5. Two bioactive molecules are given :
(i) Cyclosporin-A
(ii) Streptokinase
(A) Name the microbe which produces these bioactive molecules.
(B) Write its use. (HSE-March 2023)(2)
6. Who discovered the first antibiotic Penicillin ? (HSE-July 2022)(1)
7. Write the use of following microbial product : (HSE-July 2022)(2)
(a) Pectinase and Protease
(b) Streptokinase
8. The first antibiotic discovered was _____. (HSE-March 2022)(1)
9. Match the following :(HSE-March 2022)(2)

(A)		(B)	
(i)	Trichoderma polysporum	(a)	Citric acid
(ii)	Monascus purpureus	(b)	Ethanol
(iii)	Saccharomyces cerevisiae	(c)	Cyclosporin A
(iv)	Aspergillus niger	(d)	Statin

10. (a) Expand the term AIDS. Mention the name of virus that causes AIDS.
(b) Name the widely used diagnostic test for AIDS.
(c) List out any four practices for the prevention of AIDS.
(HSE-March 2022)(5)
11. Name the free living fungus used as an effective biocontrol agent of several plant pathogen (HSE-August 2021)(1)
12. Biogas is a mixture of gases produced by the microbial activity and used as a fuel .Mention the name of bacteria used for production of biogas
(HSE-August 2021)(1)
13. Match the following(HSE-August 2021)(2)

A	B
1)Trichoderma polysporum	a)Streptokinase
2)Monascus purpureus	b)Ethanol
3)Streptococcus	c)Cyclosporin
4)Sacharomyces cervisiae	d)Statin

14. Organic pollutants in sewage water is measured as _____(HSE March-2021)(1)(a) GMO (b) MTP (c) BOD (d) HGP
15. Enzyme used in detergents for removing oily stains from laundry is _____.
(a) Lipase (b) Protease
(c) Amylase
(d) Pectinase (HSE March- 2021)(1)
16. Fill in the blanks to complete the table :

Micro-organism	Use of Micro-organism
(i) .....(a).....	Curding of Milk
(ii) *Bacillus thuringiensis*	.....(b).....
(iii) *Aspergillus niger*	.....(c).....
(iv) .....(d).....	Production of butyric acid

(HSE March- 2021)(2)

17. A free living nitrogen fixing bacteria in the soil. (HSE-July-2020)(1)
(a) Rhizobium (b) Azospirillum
(c) Nostoc(d) Anabaena

18. Match the following : (HSE-July-2020)(2)

(a) Acetic acid	(i)Trichoderma polysporum
(b) Citric acid	(ii) Acetobacter aceti
(c) Cyclosporine A	(iii) Lactobacillus
(d) Lactic acid	(iv) Aspergillus niger
	(v)Monascus purpureus

19. Microbe which help in the production of Biogas (HSE-March-2020)(1)
(a) Aspergillusniger
(b) TrichodermaPolysporum
(c) Saccharomyces cerevisiae
(d) Methanobacterium

20. Some examples of microbes in human welfare are given. Classify them under the headings given below.
[Egs : Rhizobium, Propionibacterium sharmanii, Azaspirillum, Lactic acid bacteria, Anabaena, Azotobacter, Aspergillus niger, Saccharomyces cerevisiae...] (HSE-March-2020)(2)

21. Match the following(HSE-June-2019)(2)

A	B
(a) Citric Acid	I. *Acetobactor aceti*
(b) Acetic acid	II. *Clostridium butylicum*
(c) Lactic acid	III. *Aspergillus niger*
(d) Butyric acid	IV. *Lacto bacillus*
	V. *Trycoderma polysporum*
	VI. *Saccharomyces cerevisiae*

22. Bio-fertilisers are organisms that enrich the nutrient quality of the soil. How these biofertilisers enrich the soil nutrients ? Give two examples
(HSE-June-2019)(2)

23. Microbes are useful to human beings in diverse ways. If so, name the following : (HSE-March-2019)(2)
(a) Microbe known as "Baker's Yeast".
(b) Lactic acid producing bacterium.
(c)Fungus which helps in theproduction of bio-active molecule –cyclosporine A.
(d) Symbiotic nitrogen fixing bacterium.

24. In Sewage Treatment plant microbes play a significant role. Distinguish between primary and secondary treatment in sewage plant?
(HSE-June 2018)(2)

25. Complete the table with appropriate terms (HSE-March 2018)(2)

Organism	Scientific name	Bioactive Product
Fungus	A	Citric acid
B	Acetobacter aceti	Acetic acid
Fungus	Trichoderma polysporum	C
Yeast	D	Statin

26. Find the odd one out
a)Trichoderma polysporum
b)Clostidium butyliorm
c)Acetobacter aceti
d)Aspergillus niger

27. a)Name the yeast used for the commercial production of ethanol.
    b)Name the yeast used for the production of statins
    (HSE-model 2018)(2)

28. Complete the table by filling A,B,C and D using hints from the bracket
    (HSE-JUNE-2017)(2)

(Gobar gas, biological control, anabaena, *Sacharomyces cerviciae* ,*Prpionibacterium sharmanii*)

Methanogen- .....A.....
Bread making-.....B.....
Biofertilizer:.....C.....
Trichoderma:.....D.....

29. What are the advantages of biofertilizers over chemical fertilizers? Give an example for biofertilizer?
    (HSE-March-2017)(2)

30. Chose the correct answer from the bracket (HSE-June-2016) (1)
    Cyclosporin A is produced by.....

    (a) Aspergillus (b)Clostridium
    (c)Trichoderma (d)Acetobacter

31. Select a bio-control agent from the given microbe (HSE-June-2016)(1)
    a)Baculo virus b)Rhino virus
    c)Picorna virus d)Adeno virus

32. "BOD is commonly calculated as an index of water pollution"
    a) Do you agree with this statement? Why?
    b) Expand BOD? (HSE-March 2016)(2)

33. In our state waste management is a problem. Government promote and give subsidy to biogas plants. Comment the functioning of biogas plants with the help of microbe.
    (HSE-June 2014)(2)

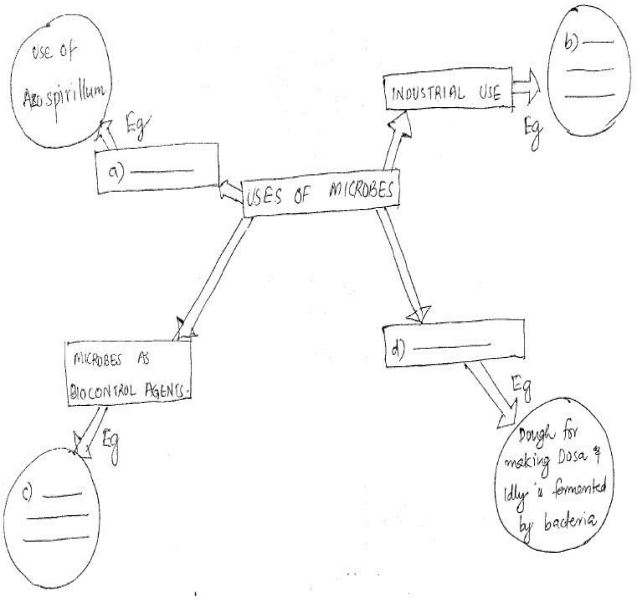
34. BOD of some water sample is given below (HSE-June 2015)(2)

A- Sample-1 200mg/L
B- Sample-2 80mg/L
C- Sample-3 300mg/L
D- Sample-4 25mg/L

    a) Which of above water sample is most polluted ?
    b) what is meant by flocs/ what is its role in sewage treatment ?

35. Microbes can also be used as a source of energy. Substantiate with example?
    (HSE-March 2015)(2)

36. Complete the illustration appropriately ? (HSE-MAY 2013)(2)



37. Some bioactive molecule, their sources and their medical importance are given in the table below. Fill up the missing part (HSE-March 2013)(2)

38. Match the following (HSE-june-2012)(2)

39. Rearrange the coloumn B & C with respect to A (HSE-March-2012)(2)

A	B	C
Monascus pupureus	Streptokinase	Antibiotic
Streptococcus	Statin	Immunosuppressant
Pencillium notatum	Cylosporin-A	Clot buster
Trichoderma polysporum	Pencillin	Cholesterol lowering agent