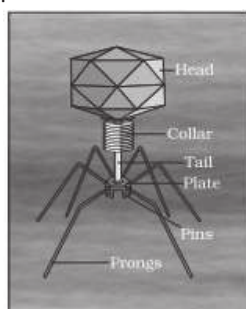


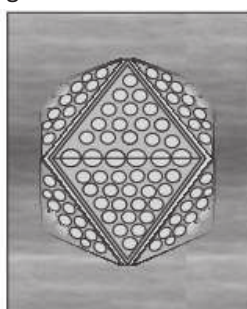
## CHAPTER-10

### 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°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 also improves nutritional quality by increasing **vitamin B<sub>12</sub> (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**
- ✓ The dough, which is used for making bread, is fermented using **baker's yeast- Saccharomyces cerevisiae**

- ✓ **Toddy** 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<sub>2</sub>** 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

**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 cerevisiae** 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**

#### (b) Antibiotics

- ✓ Discovery of antibiotics is regarded as the one of the **most significant discoveries of the 20<sup>th</sup> 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);

Navas cheemadan

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. **Alexander Fleming** discovered Pencillin. (**Unexpected discoveries/ chance discovery are called Serendipity**). Pencillin is produced by a mould called **Penicillium 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. **Fleming, Chain, and Florey were awarded Nobel Prize in 1945, for this discovery.**
- ❖ Antibiotics are now widely used against deadly diseases like **Plaque, whooping cough** (kalkhansi), **diphtheria** (gal ghotu), and **leprosy** (kusht rog)

### 3. Microbes for the production of acids

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

<i>Aspergillus niger</i> (Fungus)-----	Citric acid
<i>Acetobacter acetii</i> (Bacteria)-----	Acetic acid
<i>Clostridium butylicum</i> (Bacteria)---	Butyric acid
<i>Lactobacillus</i> (Bacteria) -----	Lactic acid
<i>Saccharomyces cerevisiae</i> -----	Ethanol

### 4. 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**

### 4. 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. Bio active molecules are secondary metabolites

- **Streptokinase** 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
- **Trichoderma polysporum** (fungus) produces **Cyclosporin A**. It is used as a **immunosuppressive agent** in organ transplantation
- **Monascus purpureus** (Yeast) Produce **Statins**. It is used as **blood cholesterol lowering agent**. Statin act on enzyme responsible for synthesis of cholesterol.

### 5. 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)**. 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. 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 used 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 sewage may be discharged in the rivers.



## **6. Microbes in production of Bio Gas**

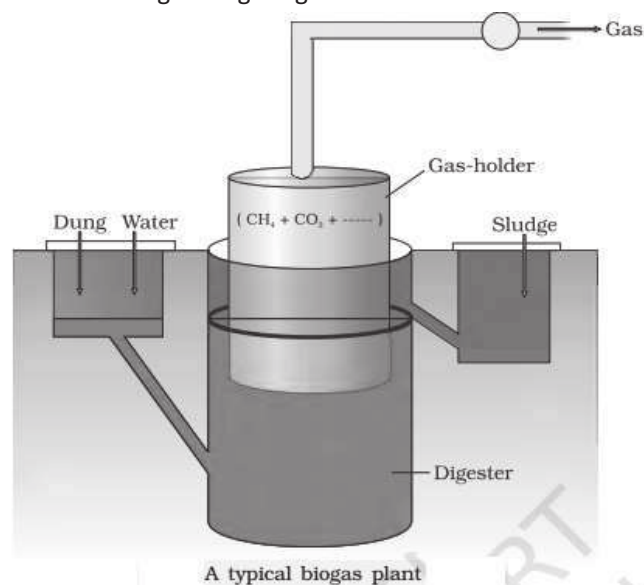
Biogas is a mixture of gas (Mainly **Methane**) produced by the microbial activity. Certain bacteria, which grow **anerobically** on cellulosic material, produce large amount of methane along with  $\text{CO}_2$  and  $\text{H}_2$ . These bacteria are collectively called **Methanogens (Eg: Methanobacterium)**.

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 an 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 consists 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. Biogas produced thus produced is used for cooking and lighting.



## 7. Microbes as Bio control agents

- **Biocontrol:** It refers to the use of **biological methods** for controlling plant diseases and pests. Biocontrol measures greatly reduce our dependence on toxic chemicals and pesticides.
- The organic farmer, therefore, works to create a system where the insects that are sometimes called pests are not eradicated, but instead are kept at manageable levels by a complex system of checks and balances within a living and vibrant ecosystem  
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 caterpillar** 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.
- Baculoviruses (Genus:Nucleopolyhedrovirus) are viruses that attack the insects and other arthropods. 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 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.**

- Eg: (1)-The roots of Leguminous plants contains **Rhizobium**, it fix atmospheric nitrogen into organic forms which is used by the plant as nutrient  
(2)-**Azospirillum and azobacter** (Both are free living bacteria in the soil) are able to fix atmospheric Nitrogen  
(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 phosphorous** from the soil. This association also resist to **root borne pathogens, tolerance to salinity and drought**. This association also **accelerate the growth and development** of the plant  
(4)-**Cyanobacteria** (Eg: **Anabaena, Nostoc, Oscillatoria**) 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.



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