Revision Notes

Class 12 Biology

Chapter 8- Microbes in Human Welfare

Microbes are beneficial as well as detrimental to the welfare of human beings. Microbes are utilized in many ways for human beings as explained below-

Microbes in vaccination and antibiotics/microbes in industrial products

The different products that are useful for humans are synthesized by microbes. The most common product obtained from microbes is beverages and antibiotics. For large-scale production and use of microbes in industries, The special vessels are referred to as fermenters for the use of microbes on large scale in industries.

Fig.1. Fermenters

Fermented beverages are as old as civilization and are used in wine, whisky, brandy, etc. Saccharomyces cerevisiae commonly known as brewer's yeast is the most common microbe used for fermentation. It has been used for fermenting malt-based cereals and fruit juices to produce ethanol. Different alcoholic drinks are produced based on the type of fermentation and raw material used. The drinks produced by distillation of the fermented broth are Whisky, brandy, and rum whereas wine and beer are produced through distillation.

Antibiotics are chemical substances produced using microbes against any disease-causing microbe. Penicillin, the first antibiotic discovered was obtained from mold is referred to as Penicillium notatum. For the treatment of different diseases like Whooping cough, leprosy, diphtheria, plague, etc antibiotics are required.

Antibiotic	Source	Organisms affected
1. Bacitracin	*Bacillus subtilis*	Gram positive bacteria.
2. Gramicidin	*Bacillus brevis*	Gram positive bacteria.
3. Neomycin	*Streptomyces fradiae*	TB bacteria and many gram positive and gram negative bacteria.
4. Chloromycetin	*S. venezuelae*	Typhoid causing bacteria.
5. Streptomycin	*S. griseus*	Bacteria causing TB, meningitis and bacillary dysentery.

Fig.2. Some antibiotics produced by different bacteria

For the production of certain chemicals like alcohols, enzymes, organic acids, etc, microbes are used. For example, Acetobacter aceti is used to produce acetic acid, Aspergillus niger is used to produce citric acid and Lactobacillus is used to produce lactic acid. Lipase enzymes can also be prepared using microbes. Streptokinase is produced by the bacterium Streptococcus which is very useful in removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack, thus acting as a 'clot buster'. An immunosuppressive agent known as cyclosporin A is obtained from the fungus known as Trichoderma polysporum is used during organ transplant.

Microbes in household products

A bacterium found in curd is Lactobacillus. To convert milk into curd, it is required. Lactic acid is produced from this bacterium that partially digests milk protein and thus coagulates it to form curd. For the process of formation of curd, a small inoculum of curd is required in milk. The curd is rich in Vitamin B12.

Fermentation is the process of the formation of alcohol from sugar. For this process, no oxygen is required. So, it is an anaerobic process. Louis Pasteur discovered the process of fermentation. The dough used in the making of food items like idli, dosa, etc. is also formed by the action of bacteria. Bacteria are particularly responsible for the fermentation of the dough to form the final batter. The puffing of dough is due to the production of carbon dioxide. The bread is also formed by fermentation. The fermentation of dough is done by a yeast known as Saccharomyces cerevisiae. By this same process of fermentation, many drinks are required.

Cheese is produced by a fermenting bacteria called Propionibacterium sharmanii. For the preparation of Swiss cheese, this bacterium is required. The 'Roquefort cheese' is ripened by growing a selected fungus on them, which provides them a specific flavor. Different sorts of cheese are known based on their texture, taste, and flavor. These are the characteristics that are based on the different types of microbes used.

Microbes in Sewage treatment

The human excreta is a major component of this wastewater. This municipal wastewater is also called sewage. Large amounts of organic matter and microbes are present inside it. To minimize the pollution, the excreta should be treated before release. To treat the sewage, heterotrophic bacteria which are naturally present in wastewater are required. It takes place in two stages-

(i) primary treatment

(ii) secondary treatment.

Fig.3. Sewage treatment steps

Primary treatment- It is the manual removal of small and large particles through filtration and sedimentation that begins the process of primary treatment. Firstly, sequential filtration removes debris. Then the soil and small pebbles are removed by sedimentation. leftover over known as effluent is taken for secondary treatment.

Secondary treatment- By doing continuous aeration, effluent is transferred through the aeration tanks. The vigorous growth of aerobic microbes is allowed by the method of aeration that helps in the aerobic breakdown of organic matter. The aerobic microbes form flocs. Flocs are an association of fungal filaments of masses of bacteria that are formed into mesh-like structures. This reduces the biological oxygen demand (BOD). Once the BOD

of the sewage is reduced, it is passed into a settling tank where the bacterial flocs are allowed to sediment. This sediment is known as activated sludge. In order to serve as inoculum, the small part of activated sludge is pump back into the aeration tank. The left part of the sludge is pumped into large tanks called anaerobic sludge digesters. During this process, different gases are produced such as carbon dioxide, methane, and hydrogen sulfide. Further, the wastes can be discharged into rivers, streams, etc. The Ganga Action Plan and Yamuna Action Plan are imitated by the Ministry of Environment and Forests to save these major rivers of our country from pollution. One of the major proposals discussed in these plans is to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

Microbes in gobar gas formation

Biogas is a mixture of different gases; methane percentage is the highest. Some bacteria, which grow anaerobically on cellulosic material, produce a large amount of methane along with CO2 and H2. These bacteria which produce methane as a result of anaerobic respiration are collectively called methanogens. is An example of methanogenic bacteria is Methanobacterium.

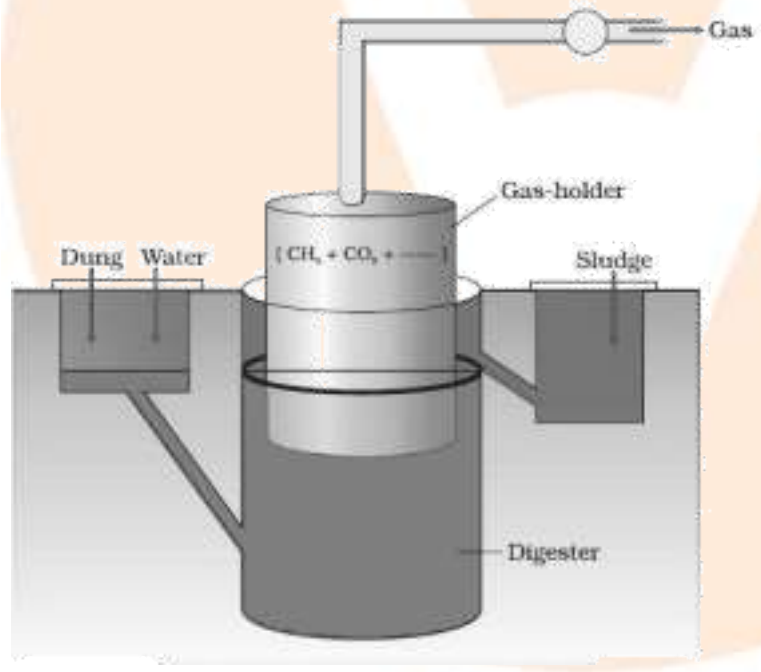

Fig.4. Gobar gas production

Microbes as biocontrol agents

Biocontrol is defined as the use of biological methods to control plant diseases and pests. Conventionally, pesticides and insecticides are being used for the control of diseases and pests. Hence, these chemicals are extremely toxic and harmful.

Biological control of pests and diseases.

A bacterium that is used as a biocontrol agent against insects/pests is Bacillus thuringiensis (Bt). An endotoxin is produced that paralyzes the gut of the insect/pest that consumes it. Bt cotton is an example of such plant-produced Trichoderma is a fungus used in controlling plant pathogens. The pathogens of insects and other arthropods are Baculoviruses. Most of the baculoviruses used as biocontrol agents belong to the genus Nucleopolyhedrovirus. These viruses are an ideal choice for narrow-spectrum actions such as for species-specific insecticidal purposes. It has been demonstrated that they have no negative impacts on other organisms like plants, mammals, birds, and fish, or even on non-target insects. Some microbes are also used as bio-fertilizers. Rhizobium is a gram-negative bacterium found as an endosymbiont in leguminous plants that helps in nitrogen fixation.

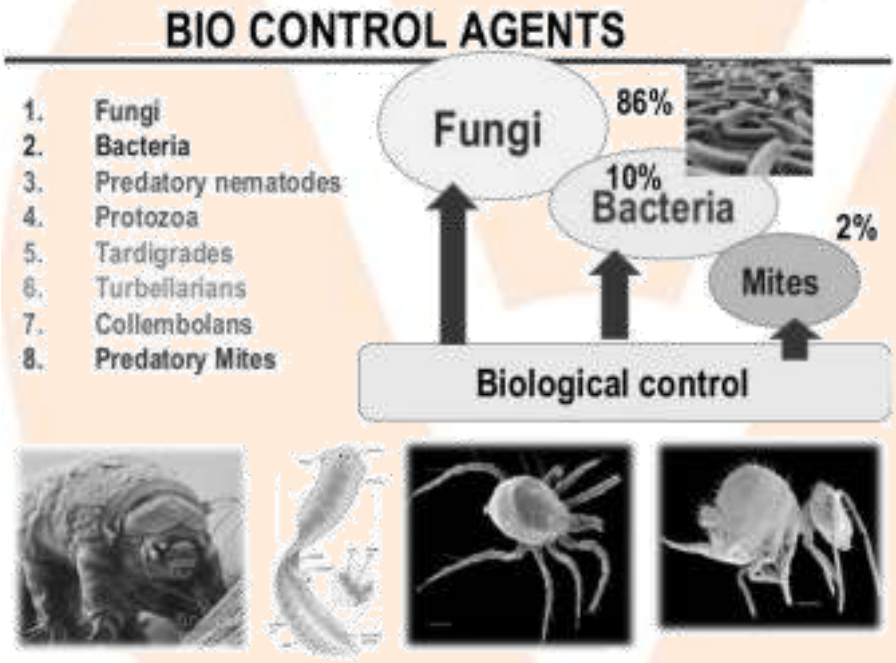

Fig.5. Different biocontrol agents

Microbes in the Human body

The colonization of different microbes in the human body is done in different parts of the body such as skin, gut, reproductive tract, etc. Gut Microflora is the most important microbes found in the human body.

The stomach microflora includes Streptococcus, Staphylococcus, etc. These bacteria are always ready to survive in the acidic conditions of the stomach.

The intestinal flora belongs to Enterobacteriaceae. This flora is required in the function of digestion and absorption. Thus, the efficiency of the process of

digestion is increased and also the utility of the gut.
Another microbe's colonization is being prevented by the microbes. Certain substances that are required for the digestion of the food are also secreted by them.
In recombinant DNA technology, viruses are used as a vector for the transmission of a required gene.

Microbes as biofertilizers

The excess use of chemicals and their harmful effect has forced the farmers to switch to organic farming. Organic farming uses biofertilizers. Biofertilizers are organisms that are required for the nutrient enrichment of the soil. Biofertilizers contain bacteria, fungi, and cyanobacteria. Rhizobium bacteria are found in leguminous plants like peas, beans, etc. In the process of absorption of nitrogen, this bacterium is required by the plants. The other bacteria fixing nitrogen are Azospirillum and Azotobacter. Fungi, when forming a symbiotic relationship with roots of higher plants, is known as mycorrhiza. The absorption of phosphorus is done by fungus from the soil and passes it to the plant. Cyanobacteria are autotrophic microbes. They are widely distributed in both aquatic and terrestrial environments. The fixing of atmospheric nitrogen can be done by them, e.g. Anabaena, Nostoc, Oscillatoria, etc. Therefore, an important biofertilizer, cyanobacteria are required especially in paddy fields. The organic matter is added to the soil by blue-green algae to increase its fertility.