Microbes In human welfare

- Microbes are the major components of biological systems on this earth.

- Microbes are present everywhere that is in soil, water, air, inside the body of plants and animals, inside thermal vents, deep in the soil, under the layers of snow several meters thick and in highly acidic environment.

- Microbes are diverse such as protozoa, bacteria, fungi and microscopic plants. Viruses, viroids and prions that are proteinacious infectious agents.

- Microbes like bacteria and fungi can be grown on nutritive media to form colonies which can be seen with naked eyes. (useful in scientific studies on micro-organism)

- Microbes cause a large number of diseases in human beings, animals and plants but all microbes are not harmful several microbes are useful to man in diverse ways. (Various microbes used in household products, industries and also in ~~sew~~ sewage treatment).

MICROBES IN HOUSEHOLD PRODUCTS

- **Curd**

- Milk is converted to curd by micro-organisms such as lactobacillus and others commonly called lactic acid bacteria (LAB) which grow in milk and convert it to curd.

- During growth of bacteria, the LAB produce acids the coagulate and partially digest milk proteins.

- A small amount of curd added to the fresh milk as inoculum or starter which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing Vitamin B_{12}.

- In our stomach, the LAB play very beneficial role in checking disease causing microbes.

- **Dough**

- The dough, which is used for making food such as dosa and idli is also fermented by bacteria.

- The puffed-up appearance of dough is due to the production of CO_2.

- The dough, which is used for making bread is fermented using baker's yeast (Saccharomyces cerevisiae)
- A number of traditional drinks and foods are also made by fermentation by the microbes.

- **Toddy**
  - is a traditional drink of some parts of southern India is made by fermenting Sap from palms trees, Coconut etc.
  - → Microbes are also used to ferment fish, Soyabean, bamboo shoots etc to make food.

- **Cheese**
  - Formed by partial degradation of milk by different microorganism.
  - Different Varieties of cheese are known by their characteristic texture, flavour and taste, the specificity come from the microbes used.
  - The large holes in 'Swiss Cheese' are due to production of a large amount of CO_2

by a bacterium named Propioni bacterium shermanii.

- The Roquefort cheese are ripened by growing a specific fungi ~~on them~~, (Penicillium roque-fortii) on them, which gives them a particular flavour.

- MICROBES IN INDUSTRIAL PRODUCTS

- Production on an industrial scale, requires growing microbes in very large vessels called fermenter or bioreactors.
- Beverages, antibiotics, enzymes are some of the industrial products produced by microbes.

Fermented Beverages

- Microbes are used for the production of beverages like - wine, beer, whiskey, brandy or rum
- Malted cereals and fruit juices are fermented by S. Cerevisiae to produce ethnol.
- Saccharomyces Cerevisial is used for the production of fermented beverages.

- Wine and beer are produced without distillation (filtered, pasteurised and bottled).

- Whiskey, brandy and rum are produced by distillation of the fermented broth.

- Beer has an alcoholic content of 3-6%.

- Wines has an alcoholic content of 9-12%.

Antibiotics - Waksman - 1942

- Antibiotics are the chemicals substances which are produced by some microbes and can kill or stop the growth of other microbes.

- Alexandar Flemming discovered Penicillin obtained from Penicillium notatum which was the first antibiotic to be discovered.

- A. Fleming while working on Staphylococci bacteria observed a mould growing in one of his unwashed culture plates around which Staphylococci could not grow and he found out that it was due to a chemical produced by Penicillium notatum.

- Antibiotics are used against the deadly diseases like - Plague, Whooping Cough, leprosy, Malaria etc.

- Production of antibiotics has become widespread by efforts of Ernest chain and Howard Florey on chemotherapeutic effectiveness of penicillin during 1939-41.

- Penicillin was used in treating American Soldiers wound in World War - II.

- Chain & Florey were awarded the Nobel Prize in 1945 for discovery of potential use of penicillin as antibiotic

- Some other antibiotics were also purified after successful discovery of penicillin.
  e.g fumagillin from Aspergillus fumigatus.

Judicious use of Antibiotics

- Excess antibiotic use is a well-documented risk factor for infection or colonisation with resistant pathogens.

- unnecessary antibiotics use for viral illness is common and has led to increasing rates of antibiotic resistance among Streptococcus pneumonia and other community acquired pathogens.

- antibiotic overuse include lack of education, patient's expectations, Past experience and economic incentives.

Chemicals, Enzymes and other Bioactive Molecules.

Microbes are being used for Commercial and industrial production of certain chemicals like – alcohols, organic acids, enzymes and other bioactive molecules.

MICROBES IN SEWAGE TREATMENT

– Municipal waste-water which contains large amounts of organic matter is called Sewage

– Before disposal, hence, sewage is treatment in Sewage treatment plants (STPs) by the ~~hetero~~ heterotrophic microbes to make less polluting.

Sewage treatment is carried out in two ways

- Primary or Physical Treatment.
- Secondary or biological Treatment.

1. Primary Treatment

- These treatment step basically physical removal of large and small particles.
- Initially, floating debris is removed by sequential filtration and then grit are removed by sedimentation in settling tanks
- Iron or Aluminium Sulphate is added in certain places for flocculation.
- All solids that settle from the primary sludge, and the supernatant forms the effluent
  ↓
  traps lots of microbes and debris
- The effluent from the primary settling tank is taken for secondary treatment.

2. Secondary Treatment

- The primary effluent is passed into large aeration tanks where it is constantly agitated which allows vigorous growth of useful aerobic microbes into flocs
- Flocs are the masses of bacteria associated with fungal filaments to form mesh like structure

- While growing the microbes significantly reduce the BOD (biochemical oxygen demand) which is the amount of oxygen required to oxidize total organic matter in the effluent.

- The BOD Test measures the rate of uptake of oxygen by micro-organisms, the greater the BOD of waste, water more is its polluting potential.

- The effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment and the sediment is called activated sludge.

- A small part of the activated sludge is pumped back into the aeration tank to serves as the inoculum.

- The remaining major part of the sludg is pumped into larg tanks called anaerobic sludge digesters where other kinds of bacteria grow anaerobically which digest the bacteria and the fungi in the sludge.

- During digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and CO_2 which form biogas.

- The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

RIVER ACTION PLAN

- each country producing several million Gallons of ~~Data~~ waste water everyday.
- Sewage treatment plants not increased.
- Due to which untreated sewage is being discharged into river causing pollution & water borne disease.
- The Ministry of Environment & Forest under the National Rivers Conservation Authority had it initiated Ganga Action Plan, Yamuna Action plan, Gomti Action plan etc. to save major river of our country from Pollution.
- Plan Purposed to build large no. of Sewage treatment plant.

★ States involved in Ganga action Plans are.. U.K, UP, Bihar, West Bengal and Jharkhand.

MICROBES IN THE PRODUCTION OF BIOGAS

- Biogas is a mixture of gases (containing major content is methane) produced by the anaerobic microbial activity.
- Certain bacteria grow anaerobically on cellulosic material produce large amount of methane along with CO_2 and H_2 which are collectively called as **Methanogens**.
- One common methanogen is Methanobacterium.
- These bacteria are commonly found in the anaerobic sludge during sewage treatment and in the rumen of cattle to digest cellulose in the food of the cattle, thus the excreta of cattle, commonly called Gobar can be used for generation of biogas, commonly called Gobar Gas

Biogas Plant

- The biogas plant consists of a concrete tank (10-15 feet deep) in which bio-wastes 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 houses.

- The spent slurry is removed through another outlet and may be used as fertilizer

- Biogas thus produced can be used for cooking and lighting

- Biogas production technology was developed in India by (KVIC) Khadi & Village Industries Commission and (IARI)

MICROBES AS BIOFUELS

- Biofuels are fuels of biological origin, used for production of heat and other form of energy.

- energy derived from biofuels called bioenergy

- Biologically generated hydrogen, methane, ethanol, butanol and diesel are referred as biohydrogen, biomethane, bioethanol, biobutanol and biodiesel. All of these called biofuels.

MICROBES AS BIOCONTROL AGENTS

- Bio control refers to the use of biological methods for Controlling plant disease and Pests.

- Chemicals, insecticides and pesticides are extremely harmful to human beings and also these pollute our envisonment

- The use of bio control measure will greatly reduce our dependence on toxic chemicals and pesticides

* Bio Control agents are which are useful in Controlling plant diseases and pests are-

① - The ladybuid, a beetle with red and black markings and dragon flies are useful to get rid of aphids and mosquitoes respectively.

② - Bacteria (Bacillus thuringiensis Bt) used to get rid of butterfly caterpillars where dried spores of Bacillus thuringiensis are mixed with water and sprayed onto vulnerable plants such as brassicas and fruit trees and these are eaten by the

insect larvae and in the gut of the larvae, the toxin is released and the larvae get killed.

③ Trichoderma species are free-living fungi found in the root ecosystem these are effective as bio Control agents of several plant pathogens.

④ Baculoviruses are pathogens that attack insect and other arthropods and the majority of baculo viruses used as biological control agents are the genus Nucleopolyhedrovirus.

MICROBES AS BIOFERTILIZERS

- Biofertilizers are organisms that enrich the nutrient quality of the soil
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- The main sources of biofertilizers are bacteria, fungi and Cyanobacteria.

★ Some microbes used as biofertilizers are-

① Bacteria

- Rhizobium from root nodules in leguminous plants and fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient

- Free living bacteria like Azospirillum and Azotobacter fix atmospheric nitrogen hence, increases nitrogen content of the soil.

② Fungi

- Many member of the genus Glomus from Mycorrhiza which is the Symbiotic association of fungi with other plants.

- The fungal Symbiontic Symbiont in these associations absorbs phosphorus from soil and passes to the plants.

benefits

- Resistance to root-borne pathogens.
- Tolerance to salinity and drought
- Increase in plant growth and development

③ Cyanobacteria

- Cyanobacteria are autotrophic microbes which can fix atmospheric nitrogen, Anabaena, Nostoc, Oscillatoria.

ue green algae (BGA) also add Organic
atter to the Soil and increase its fer

till BGA are not very popularly use
(Blue Green Algae)