

Chapter – 2: Microorganisms

- Food items – left in open – rot (spoil) – unfit for use
- Eating such food – harmful for health
- Not advisable – drinking water without purification
- Rotten food and impure water – contain germs – micro-organism – cannot be seen with naked eye – only with microscope
- Microbes – cause disease – BUT – some are good and useful

Where are microorganisms found?

- Present everywhere – air, ice-cold water, marine water, deserts, polar regions, food, and even our bodies
- Survive any conditions – harsh or soft – some – volcanic eruptions
- Unfavourable conditions – develop hard outer covering – **cyst**
- Remain inactive inside cyst – until conditions – temperature and humidity – favourable

Classification

- Five major groups –
 - Bacteria (bacterium) –
 - Simple, single-celled organisms
 - Found in air, water, soil, bodies of other organisms
 - 3 shapes – bacillus (rod), cocci (spherical), spirilla (spiral)
 - Some – autotrophic – produce own food – most – heterotrophic – saprotrophic (dead and decaying) or parasitic (other organisms)
 - Algae (alga) –
 - Autotrophic organism – plant bodies
 - Found abundantly (extra) in – aquatic habitats – **grasses of water**
 - Single-celled – Chlamydomonas – OR – multi-cellular – Spirogyra, Laminaria
 - Survive extreme climatic condition
 - Grow in water bodies – ponds, lakes, moist soil, rocks, barks of trees
 - Chlamydomonas –
 - Unicellular
 - Cup-shaped chloroplast
 - Locomotion (movement) – flagella
 - Single pyrenoid body – storing starch
 - Spirogyra –
 - Multicellular
 - Ribbon-shaped chloroplast
 - No locomotion
 - Many pyrenoid bodies – storing starch
 - Fungi (fungus) –
 - Group of plant-like organisms – heterotrophic
 - Grow on moist bread, leather, cotton, paper – specially in damp, warm, dark places

- Unicellular – yeast – OR – multi-cellular – Rhizopus, Agaricus, Penicillin, Aspergillus
- Protozoa (protozoan) –
 - Unicellular – animal-like characteristics
 - Amoeba, paramecium, giardia
 - Most – heterotrophic
 - Some live in fresh or salt water – some live in soil – some live as parasite
 - Structure – locomotory – move place to place
 - Amoeba – **pseudopodia** – paramecium – **cilia**
- Viruses (virus) –
 - Smallest microbes
 - Seen – only with help of electron microscope – magnify upto 2,00,000 times

Viruses – living or not?

- Both characters
- Cannot reproduce by themselves – lack the cell organelles – non-living object – outside host cell
- Enter host cell – start multiplying – often kill host
- Biological puzzle

Useful microorganisms

- Useful – many ways –
 - Field of agriculture –
 - Bacteria (**rhizobium**) and **blue-green algae** – fix nitrogen atmosphere to soil – increase fertility – nitrogen fixers
 - Rhizobium found in soil and root nodules – leguminous plants – peas, beans
 - Various bacteria – maintain nitrogen cycle
 - Some microbes – form humus – decompose organic matter – used as manure
 - Commercial use –
 - **Lactobacillus** – helps in making curd – curd added to warm milk, bacteria in curd – multiply and convert milk to curd
 - Help in preparation – cheese, pickles and many other things
 - Yeast – baking and brewery industries – bread, alcohol, wine
 - Yeast – breaks down glucose – bread, fruit juices – ethyl alcohol, CO₂ – absence of O₂ – **fermentation**
 - Dhoklas, idlis – soft and fluffy – CO₂ from fermentation
 - Medicinal use –
 - Antibiotics –
 - Medicines – kill harmful microbes
 - Bacteria and fungi – used to make medicines
 - Penicillin – created from fungus – **Penicillium notatum** – kill Staphylococcus – causes cold
 - Other examples – streptomycin, tetracycline, erythromycin
 - Mixed with feed – livestock and poultry – control microbial infection
 - Control plant diseases

- Always use as prescribed by doctors – may kill effective bacteria – can make drug less effective
- Vaccines –
 - Made from microbes
 - Protect against diseases – typhoid, TB, hepatitis, measles, polio, small pox
 - Dead or weak microbe – introduced to our body – immune system produce antibodies
 - Antibodies – remain in body forever – fight microbes
 - This process – vaccination
 - Insulin – hormone – control blood sugar – can be obtained from bacteria
 - Bacteria and yeast – synthesis – tablets for vitamin B complex
- Cleaning the environment –
 - Bacteria and fungi – decompose dead and decaying organic matter
 - Release nutrient – back to soil- maintain nitrogen cycle
 - Some bacteria – pseudomonas – decompose sewage water – clean water
 - Algae – autotrophic – release O₂ into water
- Other uses –
 - Some bacteria – leather industry for **tanning, rotting** jute fibres
 - Some bacteria, protozoa – ruminants' digestive system – digest cellulose
 - Anaerobic breakdown – animal and plant waste – bacteria – produce methane (CH₄) – used as fuel

Harmful microorganisms

- Microbes – cause diseases – **pathogens or germs**
 - Diseases in humans –
 - 2 kinds –
 - Communicable –
 - Spread through modes of transmission
 - Caused by various pathogens
 - Polio, common cold, jaundice, chicken pox, TB
 - Non-communicable –
 - Do not spread through modes of transmission
 - Malfunctioning of organ, genetic disorder, hormone imbalance
 - Modes of transmission
 - Air –
 - Infected person – sneezes, coughs, spits
 - Healthy person – breathes infected air – gets infected
 - Mumps, measles, flu
 - Food or water –
 - Healthy person – consume contaminated (spoilt) food and water – gets infected
 - Cholera, typhoid, polio, jaundice
 - Direct contact –
 - Healthy person – share items with patients – gets infected
 - Common cold, TB, chicken pox, ringworm

- Insects –
 - Either through bite or transferring pathogens into food items
 - Insects – sits on dirt – pathogens stick to their bodies – sit on food – transfer germs to food – healthy person – consume food – gets infected – cholera
 - Female Anopheles mosquito – bites infected person – parasite transfers to mosquito – bites healthy person – parasite transfers to person – healthy person gets infected – Malaria
 - Parasite – completes entire life cycle inside mosquito - **vectors**
- Cuts and wounds –
 - Some pathogens – enter through wounds
- Some common diseases – modes of transmission – preventive measures
 - Tuberculosis – direct contact – vaccine, isolation
 - Cholera – food and water – vaccination, proper disposal of sewage, chlorination
 - Chicken pox – direct contact – vaccination, isolation, personal hygiene
 - Polio – food and water – vaccination, personal hygiene, proper disposal of waste
 - Malaria – insects – mosquito nets, insecticides, do not allow water to collect
 - Amoebiasis – food and water – personal hygiene, good sanitary habits, drink boiled water, avoid street food
 - Ringworm – direct contact – isolation
- Diseases in plants and animals – microorganism – mode of transmission
 - Plants –
 - Citrus canker – bacteria – air
 - Rust of wheat – fungi – air, seeds
 - Yellow vein mosaic – virus – insect
 - Animals –
 - Anthrax – bacteria – direct contact
 - Foot and mouth disease – virus – direct contact
- Food poisoning –
 - Microbes grow on food – produce toxic substance
 - Spoilt food – consumed – cause food poisoning – even death
 - Food spoils – kept at room temperature – fungal growth on bread
 - Summer – high temperatures – milk turns bad

Food preservation

- Imp. to be careful about quality
- Methods to preserve food –
 - Refrigeration –
 - Low temperatures – reduce rate of reproduction of microbes
 - Dehydration –
 - Dry under sun – may lose nutrients – fruits, cereals, pulses
 - Preservatives –

- Chemicals – sodium benzoate and sodium metabisulphate – added to food – control growth of microorganisms
- Used in jams, squashes
- Oil, vinegar – preserve vegetables, fish, pickles – do not allow bacteria to grow
- Salt, sugar – absorb moisture – salt – pickle, chips, meat – sugar – jams, jellies, squashes
- Freezing –
 - Frozen food – greater shelf life – without loss of nutrients
 - Low temperature – non-availability of water – control growth of microbes
- Smoking –
 - Meat products – preserved this way – drying up moisture
- Pasteurization –
 - 1st heat up – high temperatures – cool down immediately – temp. difference – kills bacteria
 - Milk – preserved this way
- Canning –
 - Heat up – high temperatures – seal in cans
 - Increases shelf life
 - Cans – swell – indicates damage
- Sterilization –
 - Ionizing radiations – destroy microbes – without affecting heat sensitive nutrients
- Microbial world – vast – different species – ranging from helpful microbes to deadly viruses
- Presence of microbes – examined

Nitrogen cycle

- Biogeochemical process – transformation of nitrogen and nitrogen compounds in nature
- Conversion of atmospheric nitrogen to nitrates and back
 - Nitrogen fixation –
 - Nitrogen gas in atmosphere to compounds of nitrogen
 - Biological –
 - Action of bacteria – rhizobium – roots of leguminous plants
 - Atmospheric –
 - Lightening – atmospheric nitrogen + oxygen = nitrogen oxides
 - Oxides mixed with rain water – comes back as nitrous and nitric acids
 - Minerals in soil – acids to nitrates
 - Industrial –
 - Fertilisers – ammonia, urea, ammonium nitrate
 - Assimilation –
 - Nitrates – absorbed by plants – converted to – amino acids, nucleic acids
 - Heterotrophic organisms – absorb nitrogen from food chain
 - Ammonification –
 - Plants, animals – die, excrete – organic nitrogen – converted to – ammonia by soil bacteria
 - Nitrification –

- Ammonia – converted to – nitrites – converted to – nitrates – action of nitrifying bacteria
- Denitrification –
 - Nitrates – converted back to – inert nitrogen gas – action of bacteria – anaerobic conditions

