Food spoilage means the original nutritional value texture, flavor of the food are damaged, the food become harmful to people and unsuitable to eat.

Food spoilage

characteristic

Food spoilage can be the result of

- insect damage
- physical Injury
- Enzymatic degradation
- Microbial activity.

Main source of food spoilage :

Physical Changes :

- Aw, temperature, mechanical effects.
- Caused by the inappropriate transport, handing and storage.

Biological factors:

- Microbiological
- Bacteria, yeasts, moulds (most common)

Microbiological :

- Rodents, insects, birds parasites.
- Chemical, biochemical factors.
- Non-microbial or enzymes change usually involving oxygen.
- activity of endogenous tissue enzyme.

Effects of food spoilage :

- Change in nutritional value.
- Decomposition of proteins, carbohydrates, vitamins.

Changes in organoleptic features:

Colour, flavour, taste, unpleasant odors,

Unwholesome effects:

Biogenic amines, toxins

Metabolites of microorganisms

Pathogen microbes.

Spoilage signs:

odors:

- Breakdown of proteins.

eg. "rotten egg" smell.

Stickiness:

Primarily due to surface accumulation of microbial cells and also be a manifestation of tissue degeneration.

Discoloration:

Mould on bread, blue and green mould on citrus fruit and cheese.

Souring:

Production of acid.

eg. Sour milk from production of lactic acid.

Gas formation:

Meat becomes spongy

Swollen or bubbling packages and cans.

Two types of spoilage:

Microbial spoilage

Non microbial

Based on rate of spoilage

Highly perishable

Meat, fish, poultry eggs, milk, most fruits.

Semi perishable.

Potatoes, some apple varieties, nutmeat's

Stable or non. perishable

Sugar, flour, dry beans.

a. Physical spoilage:

moisture loss or gain.

b. Chemical spoilage.

Oxidation of fat.

Browing of fruit and vegetables

c- Microbial spoilage:

Growth of microorganisms.

Enzyme production.

Microbial spoilage of food:

Bacteria, yeasts, and moulds are the major causes of food spoilage. They produce various enzymes that decompose the various constituents of food.

Moulds are the major causes of spoilage of foods with reduced water activity.

Eg. dry cereals and cereal produce.

Bacteria spoil foods with relatively high water activity such as milk and products.

Source of microorganisms in food:

The primary source of microorganisms in food include.

1. Soil and water
2. plant and plant products
3. Food utensils.
4. Intestinal tract of man and animals.
5. Food handles
6. Animal hides and skins
7. Air and dust.

Spoilage of cereals:

Moisture content above 12 to 13 percent may cause spoilage of cereals.

Little moisture causes mould growth and high moisture may cause growth of yeast and bacteria.

Microbial content, physical damage

Some factors:

Spoilage of milk:

An excellent medium.

Souring

Caused by streptococcus lactis, enterococci

Gas production.

Caused by coliform, clostridium, yeasts, proteolysis.

Causes bitter taste, caused by bacillus.

Micrococcus

Change in colour and taste.

Spoilage of meat:

Raw meat is subject to spoilage by its own.

enzymes and microbial action.

Excessive autolysis can cause souring.

Factors involving spoilage include.

The greater gut load of animal.

Spoilage of fish:

Spoiled by autolysis, oxidation or bacterial activity.

Under aerobic conditions change in colour of meat pigments.

Red, olour, green, brown or grey.

Off odours and off tastes.

Spoilage of eggs:

Cracks, leaks, stained or dirty spots on exterior and blood clots, bloodiness, translucent spots, in the interior are all sign of spoilage.

Pseudimonas, certain coliform bacteria, proteus spp.

Acromonas, serratia sporotrichum all causes rots in eggs.

Spoilage of vegetables:

Vegetables are a good substrate for yeasts, moulds or bacteria.

It is estimated that 20% of all harvested fruits and vegetables for humans are lost to spoilage by these microorganisms.

Mould Spoilage:

a. In vegtables where bacterial growth is not favoured, moulds are the principal spoilage agents.

b. Most mould must invade plant through a surface wound such as a bruise or crack.

Fruits:

Like vegetables, fruits are nutrient rich substrates but the pH of fruits does not favor bacterial growth. As a result yeasts and moulds are more important that bacteria in the spoilage of fruits.

Fermented products:

Beer:

Spoilage in package beer is often due to growth of the yeast Saccharomyces dioslaticus which grows on dextrins that brewer yeast cannot utilize.

In either case, spoilage by yeast results in the development of turbidities, off flavors and odours.

Wines:

Candida valida is the most important spoilage yeast in wine.

This reduces the acidity of the wine and adversely affect wine flavour.

Food poisoning:

When someone gets sick from eating food or drink that has gone bad or is contaminated.

There are two kids of food poisoning by toxic agent or by communicable agent.

Food preservation is the process of treating and handling food to stop or slowdown food spoilage, loss of quality, edibility or nutritional value and thus allow for longer food storage.

Preservation usually involves preventing the growth of bacteria, fungi.

The food treated that way will go bad later that if it had not been treated that way, for thousands of years, humans have used methods of preserving food, so that they can store food to eat later.

Advantages :

Food preservation prevents the food from being spoiled by the action of enzyme and microorganism.

Food preservation increases the safe storage period of food stuff.

It increase the availability of out of season food stuffs.

It increase the availability of various food stuff even of distance and not easily approachable places. In other maker the methods of food preservation.

Industrial methods

Drying
Cooling
freezing
Boiling
Heating
Salting
Sugaring
Smoking
pickling
Lye
canning
Jellying
Burial.

Industrial modern methods.

Pasteurization
vacuum packing
Artificial food additives
Ray irradiation
Pulsed electric field electroporation
Modified atmosphere
Northermal plasma
High pressure food preservation
bio preservation
Hurdle technology.

Drying:

Food is one of the oldest and easiest methods of food preservation.

Dehydration is the process of removing water or moisture from a food product. Removing moisture from foods makes them.

Dehydrated foods are ideal for backpacking, hiking and camping because they weigh much less than their non-dried counterparts and do not require refrigeration. Drying food is also a way of preserving seasonal food for later use.

dehydration preserves foods:

Foods can be spoiled by food microorganisms, or through enzymatic reactions within the food. Bacteria, yeast and molds must have a sufficient amount of moisture around them to grow and cause spoilage. Reducing the moisture content of food prevents the growth of these spoilage causing micro organisms and slows down enzymatic reactions that take place within food.

The combination of these events helps to prevents spoilage in dried food.

Pasteurization:

To increase milk safety for the consumer by destroying diseases causing microorganisms that may be present in milk.

To increase keeping the quality of milk products by destroying spoilage microorganisms and enzymes that contribute to the reduced quality and shelf life of milk.

Canning:

Canning is the process of applying heat to food that sealed in a jar in order to destroy any microorganisms. During the canning process air is driven from the jar and a vacuum is formed as the jar cools and seals.

General methods of classification of bacteria, Fungi, Virus, algae.

Microorganisms or microbes are organism invisible to noted eye - and are visible under a microscope. There is a great diversity among these organisms.

Based on their unique features, they are divided into certain groups. They include viruses, bacteria, algae, fungi and protozoa. The classification of microorganisms is called microbial taxonomy.

The microorganisms are classified in the following ways.

Based on plants or animals
Based on cellularity
Based on the type of nuclear materials.

Are Five kingdom concepts
Eight kingdom concept
Three domain system.

1. Classification of microbes based on plants or animals:

Aristotle classified the living organisms in the two kingdoms namely plantae and animalia. kingdom plantae is includes algae, fungi, bacteria and other plants. kingdom animals includes all animal including protozoa.

2. Classification based on cellularity:

Based on cellularity, microbes are classified into three categories, They are

1. Non-cellular 2. Unicellular 3. Multicellular.

Non-cellular microbes have no cells- eg. viruses, they are living chemicals.

Unicellular microbes have single cells. eg protozoa, Bacteria, Some algae and some fungi.

Multicellular microbes have many cells eg; Fungi, Algae, etc.

3. Classification Based on the nature of nuclear materials.

Microbes are classified into 2 groups based on the nature of nucleus, they are.

1. Prokaryotes 2. Eukaryotes.

1. Prokaryotes:

The organism which do not contains nucleus, are called prokaryotes. The nuclear materials remain scattered in the cytoplasm. There is no nuclear membrane. The nuclear material not surrounded by a nuclear membrane is called a prokaryotic cell.

In prokaryotes cells, the ribosomes is 70S. The chromosome is circular in shape. cell organelles like mitochondria, Golgi complex, lysosomes, endoplasmic reticulum and centrioles are absent Eg. bacteria.

2. Eukaryotes:

The organisms which contain a true nucleus are called Eukaryotes. The nuclear materials also surrounded by a nuclear membrane. The cell containing a nucleaus is called eukaryotic cell.

In eukaryotic cell the ribosome is 80S. The chromosome is not circular in shape. cell organelles like mitochondria, Golgi complex, lysosome, endoplasmic reticulum, and centrioles are present. Eg. protozoa, algae, fungi and all animals.

4. Five kingdom Concept:

Whittaker (1969) Proposed a 5-kingdom concept for the classification of microbes. This classification is mainly based on mode of nutrition and cellular organisms. According to this concept the microbes are classified into five kingdom namely,

1. Monera
2. Protista
3. Fungi
4. Plantae
5. Animalia.

1. Monera:

Kingdom monera includes prokaryotes which lack ingestive mode of nutrition, eg. Bacteria, Cyanobacteria, etc.,

2. Protista:

The kingdom protista includes unicellular microbes such as unicellular, algae and unicellular fungi. The exhibit three types of nutritions namely autotrophic, halozoic and heterotrophic.

3. Fungi:

Kingdom fungi includes eukaryotic fungi, they show absorptive nutrition all filamentous structure.

4. Plantae:

Kingdom plantae includes eukaryotes, multicellular plants, They show photosynthetic mode of nutrition.

5. Animalia:

Kingdom, animalia includes eukaryotic, multicellular animals. They show ingestive mode of nutrition.

5) Eight Kingdom Concept:

The eight kingdom concept was proposed by cavalier Smith in 1987. This system of vids the microbes into two empires having eight kingdom. Here. It is called eight kingdom system of classification.

This system includes two empires. namely bacteria, and Eukaryota

The empire bacteria is divided into two kingdom.

1. Eubacteria:

It includes all true bacteria.

2. Archaebacteria:

It includes all filamentous bacteria.

The empire Eukaryota include all eukaryotic organisms. It is divided six kingdoms.

1) Archezoa:

Its include microscopic animals feeding on archaobacteria.

2) Protozoa:

It includes unicellular animals.

3) chromista:

It includes photosynthetic organisms having chromoplants in the lumen of endoplasmic reticulum. It includes diatoms, Cryptomads, and brown algae.

4. Plantae:

It includes all photosynthetic plants and algae.

5. Fungi:

It includes eukaryotic multicellular organisms having absorptive mode of nutrition.

6. Animelia:

It includes multicellular animals having ingestive mode of nutrition.

6. Three domain system:

The three domain system of microbial classification was proposed by Woese, Kandler and wheeles in 1990. It is based on the comparative analysis of ribosomal RNA's in various organisms. It is a phylogenetic system.

This system unicellular or filamentous in its three domains. They are eukaryotic.

1. Bacteria:

It includes unicellular or filamentous prokaryotes. They have diacylglycoyl diester and eukaryotic type rRNA in the cells.

2. Archeae:

This domin includes organisms having is pyronoid glycerol diester in the cell membrane and archae bacterial rRNA in cells.

It is divided into the following groups:

3. Eukaryotes:

This domain includes organism having glycerol saftly acydiester, in the cell membrane and eukaryotic tRNA in the cells.

Its includes the following groups:

Entamoeba

Slime molds

Fungi

Diatomoods

ciliates

Flagella

Trichomonads.

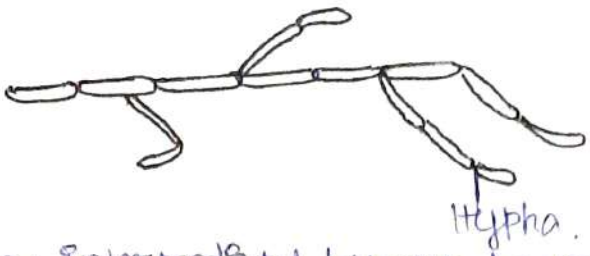
7. Gram negative facultative anaerobic rods.
8. Gram pos negative anaerobic bacteria.
9. Gram negativ anaerobic bacteria.
10. Gram negative Cocci and coccobacilli.
11. Gram negative anaerobic cocci.
12. Gram negative chemolithotrophic bacteria.
13. Methane producing bacteria.
14. Gram positive cocci
15. Endospore forming rods and cocci.
16. Gram positive asporogenous rod shaped bacteria.
17. Actomycetes.
18. Rickettsias.
19. Mycoplasma.

Though there are 19 Foats. Most of bacteria of biological value fall under the following groups.

1. Actinomycets
2. Mycoplasma
3. Rickatsias
4. Archaebacteria
5. Cyanobacteria
6. Eubacteria.

1. Actinomycets:

Actinomycetes is a group of filamentous bacteria, Actins = rays, fungus, they fungus like bacteria.



Hypha.

They are intermediated between bacteria and fungi eg Actinomyces, Streptomyces, Nocardia, Corynebacterium, Mycobacterium etc.

The actinomycetes are filamentous bacteria.

They are prokaryotic.

The body is formed of a network of branching filaments of mycelia.

Each filament is called hypha.

They are Gram positive

They are non-motile

They are non-consulated.

The cell wall is formed of rumaric acid.

Most of wall is formed of them free living in the soil.

They may be aerobic or non-aerobic.

They are chemoorgandrophs, organisms depending on organic components for their energy sources.

They are non-photosynthetic.

Actinomycites is an intermediate link between bacteria and fungi.

Similarities with bacteria:

Prokaryotic.

cell wall contains muramic acid

Susceptable to antibacterial antibiotics

Similarities with fungus:

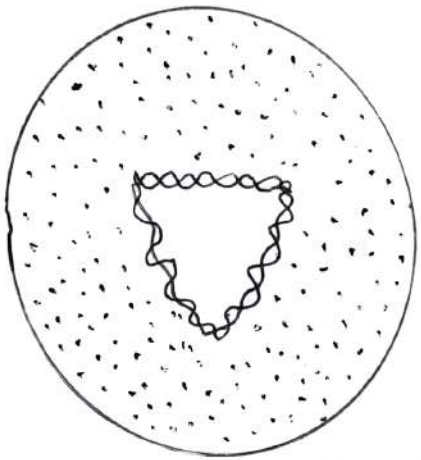
Filamentous mycellium with hyphae.

2. Mycoplasma:

Mycoplasma are prokaryotes without cell wall and are placed in the class mollicuta.

They are plemorphic and occur in any shape.

They are Gram negative.



They reproduce by fragmentation, binary fission and budding.

They are non sporing.

They grow well in a medium enriched with human or horse serum and yeast extract.

The common mycoplasma are given below.

1. Mycoplasma pneumonia. It causes mycoplasmal pneumonia.
2. Mycoplasma hominis } They cause genital infection.
3. M. urealyticum
4. Ureaplasma urealyticum. It causes urethritis.
5. Spiroplasma.

3. Rickettsias :

Rickettsias are a group of Gram negative intracellular parasitic. They are plasmorphic and are rod shaped be coccoid. They are intermedia between bacteria and viruses the following are the common species.

Rickettsia prowazekii : It causes typhus fever.

Rickettsia rickettsii : It causes rocky mountain spotted fever.

R. orientalis : It causes scrub typhus

R. burnetii : It causes Q. fever.

4. Archaebacterial:

Archaebacterial is a group of unique bacteria, they are intermediate between prokaryotes and eukaryotes, They form a missing link.

They cell wall lacks peptidoglycan. They inhibit missing link. Such as salty lakes and volcanic springs.

They are those groups of archaebacteria. namely halophiles thermo acidophiles and methanogens.

The common examples are:

1. Halococcus
2. Halobacterium
3. Sulfolobus
4. Thermoplasma
5. Thermoproteus.

5. Cyanobacteria:

Cyanobacteria are blue green algae or blue green bacteria. They form a connecting link between bacteria and green plants. They are prokaryote.

They may exists as single cells or as colonies or as chains of cells. They are Gram negative bacteria. This group includes microscopic as well as macroscopic forms.

They contain chlorophylls and they are photo-autotroph. The chlorophyll is located in thylakoids they are photosynthetic.

They are not toxic to man. The cytoplasm contains phycobilins and carboxysomes.

They have heterocysts - cell specialised for N_2 fixation and akinete cells specialised for spore formation.

Anabena	Nostoc	Rhizomidium
Microcystis	Chlorococcus	Calothrix.

6. Eubacteria:

Eubacteria are true bacteria. They are prokaryotic unicellular microscopic organism. They are found everywhere. They are spherical or rod shaped or spiral like or filamentous or pleomorphic.

The cell wall contains peptidoglycan. The ribosomes is 70s the nuclear membrane is absent.

They have flagellum, pili and capsule. They are gram positive or Gram negative.

The common examples are,

Bacillus	Streptococcus	E. coli
Vibrio	Diplococcus	Clostridium.

Classification of viruses.

Viruses are living molecules infecting bacteria, plant cells and animal cells. Viruses classification in three ways, They are,

1. Based on the hosts in which that infect.
2. LHT system.
3. Cassens and Kings system.

1. Classification based on their hosts:

Holmes grouped viruses under the order virales. The order virala is divided three sub-orders, namely phginae, phytophaeinae and zoophaginae.

i) Phaginae:

The viruses infecting bacterial cells are phaginae. They are commonly called bacteriophages or simply phages or bacterial viruses.

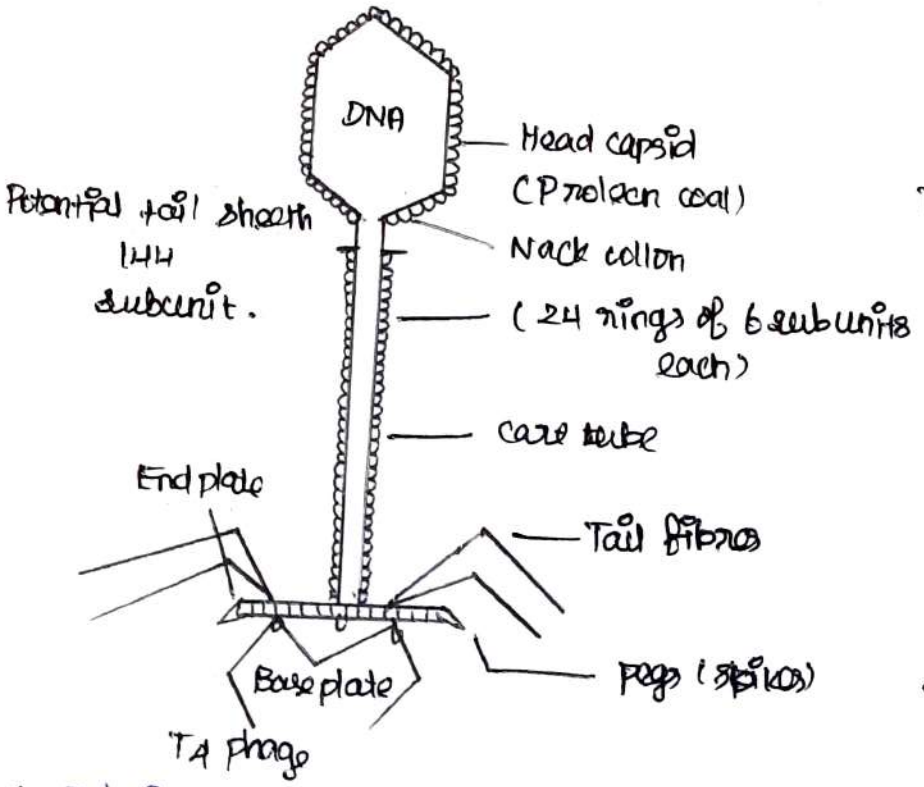
Bacteriophage means bacteria eating agent.

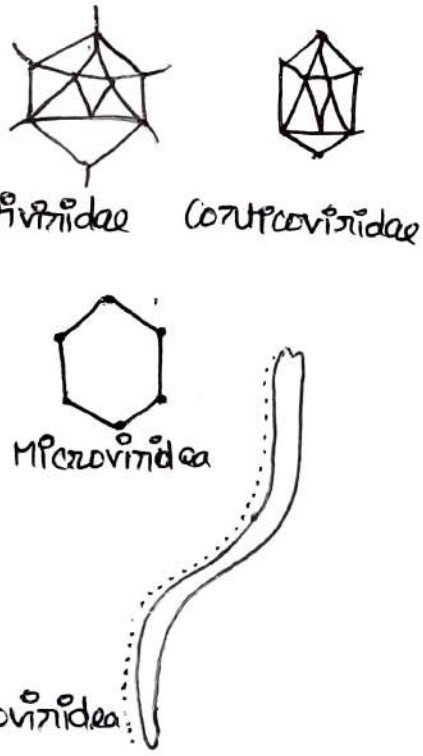
Bacteriophage are tadpole. like-or spherical or filamentous. They have a head and a tail only one phage. either DNA or RNA the DNA may be single standard (SS DNA) or double standed (ds DNA)

T2 bacteriophage,
T4 bacteriophage } even phages infecting E-coli.
T6 bacteriophage

mosaic virus. common mosaic virus.

3. Caulavirus group: cemation latent virus, Hop laten s virus, chicory, blotch virus, poplar mosaic virus,





4. Polyvirus group: Potato virus Y, Potato virus A, Bean common mosaic virus, Pepper mottle virus, Beet mosaic virusse, Bean yellow mosaic virusse.

5. Tobnavirus group: Tobacco mottle virus, Pea early browing.

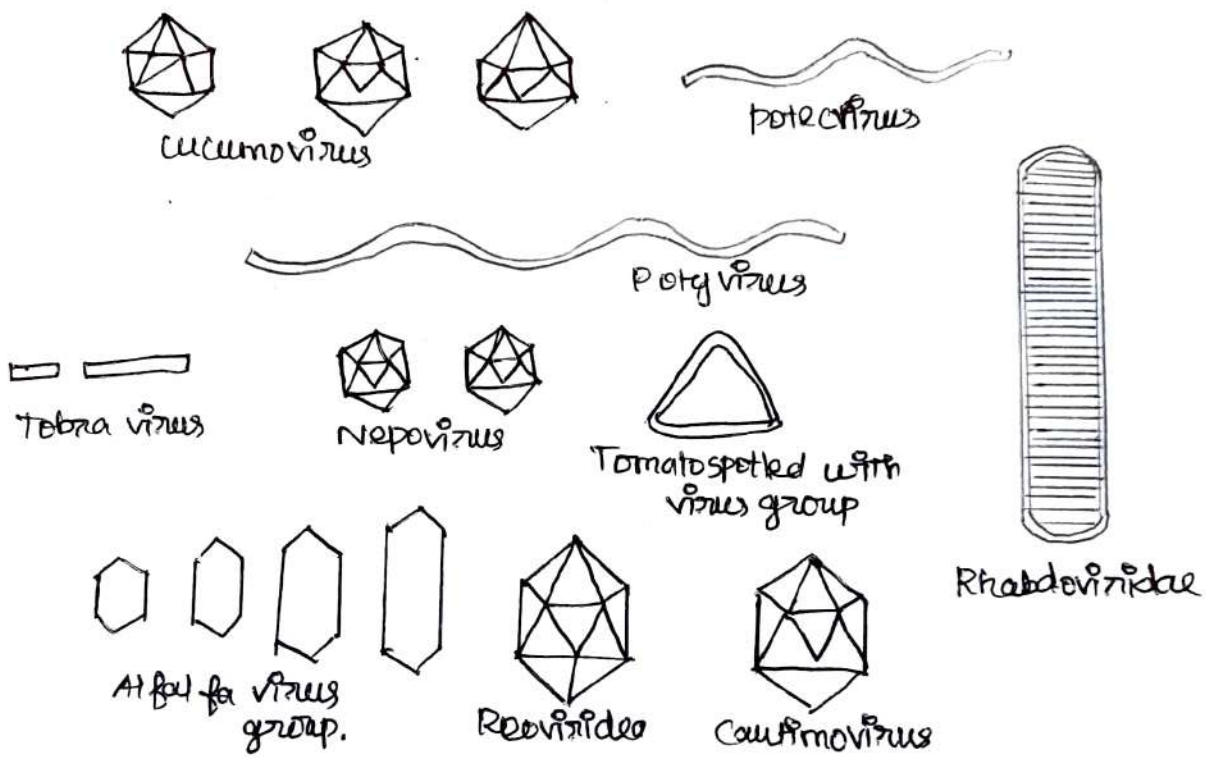
6. Barley stripe mosaic virus group, Boodey stripe mosaic virus (BSMV).

B. ds RNA viruses:

Reovirus wound tumour virus (WTV). Rice dwarf virus (RDV). Raugh dwarf virus (NRDV), Rice black, streaked dwarf virus.

C. DS DNA viruses:

ds DNA virus group. cauliflower mosaic virus. Dahlia mosaic virus.



3. Zoophagaine:

The viruses that infect animal cells are called zoophaginae or animal viruses. They causes many disease in man and domestic animals. Eg. polio viruses. small pox virus, HIV causing (AIDS).

Animal viruses have been classified based on the relationship between the nucleic acid and mRNA accordingly, animal viruses are grouped into 6 classes which are listed below with examples.

1. ds DNA viruses: MRNA is synthesized on a ds DNA.

papevaviruses - Polyomavirus SV40.

Poxviruses - vaccinia virus.

2. SS DNA viruses: MRNA is synthesized on a SS DNA.

Parvon viruses - adeno associated virus (AAV).

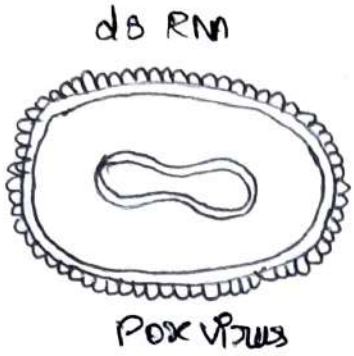
3. ds RNA viruses: MRNA is synthesized on a ds RNA.

Reoviruses - Reoviruses of humans,

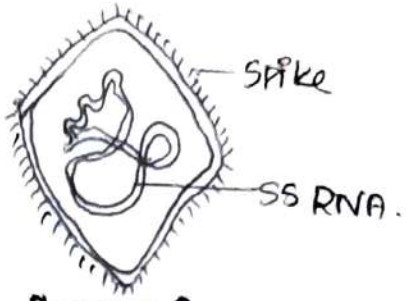
4. Positive strand RNA viruses: MRNA has the same polarity as RNA.

Picornaviruses - Poliovirus

Togaviruses - Dengue virus, yellow fever virus, semliki forest virus (SFV).



Pox virus



Mumps virus

II. The LHT system of classification:

Tosemincu (1962) classified viruses on the basis of the following characters:

a) Nucleic acid - DNA or RNA
b) Symmetry - helical, cubic, tailed.
c) presence of helical or absence of envelope
d) Diameter of helical capsid.
e) Number of capsomeres in cubic types.

III. Classification of cassense and kings:

Cassens and kings classified viruses on the basis of nucleic acid symmentry, presence or absence of envelope and site of assembly.

1. SS RNA viruses
2. ds DNA viruses
3. SS DNA viruses
4. ds RNA viruses.

Further they are subdivided as shown in the bellow diagram.

Classification of fungi.

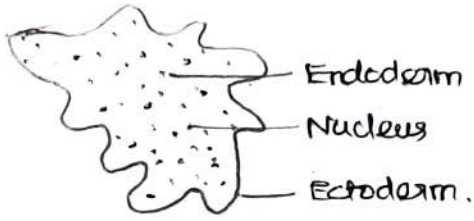
All fungi are placed in the division or phylum mycotia

There are two subdivision in fungi.

1. Myxomycotina and 2 Eumycotia.

Subdivision: Myxomycotina or true slime molds.

1. cell wall is absent.
2. The thallus is a multicellular mass of protoplasm called plasmodium.
3. It is free living.



4. It moves by amoeboid movement.
5. It feeds by ingestion of food.

This subdivision has a single class called myxomycetes.

Class myxomycetes: This class includes all free living slime mould or slime fungi. They are about 450 species. Some of the slime mold are beautifully coloured. They have been recorded from himalayas in India

Subdivision II Eumycotina or true fungi.

1. cell wall is present.

2. The thallus is a filamentous structure called mycelium. The unit of mycelium in hyphae.

3. They reproduce both sexually and asexually.

This subdivision include 8 classes.

Examples:

Aspergillus, Rhizopea, Agaricus, Puccinia, Fusarium etc.

Classification of algae.

Based on seven major divisions:

1. Nature and proportion of pigments.
2. Chemistry of reserve food products.
3. Morphology of flagella
4. Morphology of cells and thalli
5. Life history reproductive structure and methods of reproduction.
6. Food storage substance.
7. Cell wall composition.

Divided into 9 Phyla:

Phylum Rhodophycophyta
Phylum xanthophycophyta
Phylum Chrysophycophyta
Phylum phaeophycophyta
Phylum Bacillariophycophyta
Phylum Euglenophycophyta
Phylum chlorophycophyta
Phylum cryptophycophyta
Phylum pyrrophycophyta.

1) Phylum Rhodophycophyta:

Most are marine.

Smaller than brown algae and are often found at a depth of 200m.

Contain chlorophyll a and xeroxy d as well as phycobilins which are important in absorbing light that can penetrate deep into the water.

Have cells coated in carrageen which is used in cosmetics, gelatin, capsule and some cheeses.

Red algae gelidium from which agar is made.

2) Phylum Xanthophycophyta:

Yellow green algae.

Xanthophytes walls with cellulose and pectin.

Cellular storage product is chrysolaminarin.

Flagella unequal in length.

Asexual reproduction by cell division and fragment.

Vaucheria is a well known member of this division.

3) Phylum Chrysophycophyta:

Golden algae.

Predominately flagella some are amoeboid.

Chlorophyll a and c present.

Reserve food as chrysolaminarin and their frequent in composition of silica.

Characteristic odor due to masking of their chlorophyl by brown pigments.

Reproduction is commonly asexual but at time isogamous.

4) Phylum Phaeophycophyta:

1500 species of brown algae.

Mostly marine and include seaweed.

All are multicellular and algae.

Individual algae may grow to a length of 100m with a hold fast, stripe and blade.

Chlorophyll a and c present.

Used in cosmetics and most ice creams.

5) Phylum Bacillariophycophyta:

The diatoms:

Diatoms provide abundant food for aquatic animals.

Chlorophyll a and c present.

Shells of diatoms are called frustules.

Deposites of their shells from centuries of growth.

diatomite or diatomaceous earth.

6) Phylum Euglenophycophyta:

Unicellular and motile by means of flagella.

Chl. a and b present.

1000 species of euglenoids.

Have both plant like animal like characteristics.

Euglena cell with contractile vacuoles and fibrils.

7) Phylum Chlorophycophyta:

Green algae.

7000 diverse species.

Green algae contain one chloroplast per cell which contain pyrenoids.

Both green algae and land plants have chlorophill of a and b as well as carotenoids and store food as starch.

8) Phylum Cryptophycophyta:

Cryptomonads are biflagellate organism.

Cells are slipper shaped and flattened occur sigly.

Some with cellulose wall others naked.

They are 1 or 2 plastids with or without pyrenoids.

9) Phylum Pyrrophycophyta.

Flagella are inserted in the girdle and arranged with one encircling the cell and other trailing.

Many are covered only by plasmalemma and in some there is a wall made of cellulose.

Some have a series of cellulose plate with in plasmalemma formed the cal-plates.