General Protozoology 1

Definition of Protozoa

- The organisms living on Earth
  - Monerea,
  - *Protista*,
  - Fungi,
  - Animalia and
  - Phyta are collected in the 5 kingdoms.
- the organisms of Monera kingdom is only prokaryote, while the other organisms are eukaryotes.

- Protozoa,
- Unicellular algae,
- Slime mold and
- Fungus are located in Protista kingdom.
- These are eukaryote microorganisms.

- Word origin of Protozoa,
- Proto (=first) and
- zoa(=animals),
- are derived from the words, and it refers to the meaning of a single-celled organism.

- Protozoa;
  - Subkingdom or phylum of microscopic unicellular organisms which range from plant-like form to types which feed and behave like animals.

- It is accepted that there are about 65.000 protozoan species in the world.
- Most are free-living, but some lead commensalistic, mutualistic, saprophytic or parasitic existence.
- The number of parasitic protozoa species is about 17.000.

- The sizes of protozoan species range from 1-300 μ m.
- Parasitic protozoan species are very small (0.5-20 μ m) and they are only recognized in the microscope.

- The branch of science that deals with these unicellular organisms is called Protozoology.
- The subjects of this scientific field can be summarized as the classification of protozoon species, body structures, life cycles and relationships with environment.
- It is a subdivision of zoology.
- The branches of science dealing with protozoans that survive parasitically in humans and animals are called medical and veterinary protozoology.

The importance of protozoans

- It is easier to see, observe and examine the mechanisms of life in the protozoa than other living organisms.
- In other words, they are the ideal organisms to make a definition and description of life in real sense.
- Depending on their relationship with host, parasitic protozoa have roles in determining the kinship grades of hosts with the same protozoan species.

The importance of protozoans

- The fossils belonging to some protozoan species (Foraminifera, Radiolaria, Heliozoa) that survive in the ocean and marine water are important in terms of forming underground riches.
- The information about the geological time periods of the site can be obtained by using these fossils.

The importance of protozoans

- Protozoa cause diseases in humans and animals, and some of these cause disease in both humans and animals.
- Therefore, they have an importance in human and veterinary medicine.
- The most common causes of human deaths are parasitic diseases after HIV and tuberculosis according to WHO.
- Parasitic diseases cause 2-3 million people and billions of animal deaths each year.

The importance of protozoa

- Protozoan diseases affect more than one billion people and several billion animals every year worldwide, especially in underdeveloped, tropical and subtropical countries.
- Thus, they cause important health problems and deaths in human and animals, as well as heavy economic losses.

The importance of protozoans

- Malaria and trypanosomiasis are important health problems in humans, and every year, millions of people are affected by these diseases and millions of people die.
- Additionally, leishmaniasis, giardiosis, amoebiosis, cryptosporidiosis and toxoplasmosis are among dangerous protozoan diseases of humans and widespread worldwide.

The importance of protozoans

- In animals, trypanosomiasis, coccidiosis, theileriosis, babesiosis and cryptosporidiosis cause deadly disease and heavy economical loses.
- Giardiosis, leishmaniasis, amebiosis, cryptosporidiosis, toxoplasmosis and babesiosis, which cause infection both in humans and animals, are diseases that have medical and veterinary importance.

The history of protozoa

- Since protozoa are usually too small to be seen by the eye, scientific history of these organisms begins with the discovery of the lens by Antonie van Leeuwenhoek (1632-1723).
- In this regard, Leeuwenhoek has first discovered a parasite protozoon *Eimeria stiedae* in a rabbit in 1674.

The history of protozoa

- In parallel with the technological developments, the definition, description and classification of the protozoon species have been continuously developed in about 4 centuries following the first protozoon discovery.
- More detailed information on the structural and functional structures of the protozoon species has been made and many new protozoon species have been reported at the same.
- All these developments have caused a constant change in classifications.

The history of protozoa

- The most important finding in the history development of the protozoans, especially in terms of systematic aspects, has been the discovery of the apical complex in the 1970s.
- Classification of protozoons has been reconstructed by introducing the apical complex in the electron microscope.
- Apicomplexa as a new ancestor, a now root, has been included in this classification.

The history of protozoa

- Molecular genetic methods (PCR, gen sequencing etc.) that have been widely used in the field of parasitology at the beginning of the 2000s revealed that the protozoans did not come from a single ancestor, and that they came from a total of 7 roots, of which the microspora is still controversial.

Structural characteristics of protozoa

- A protozoa has a certain shape; round, oval, lancet etc.
- However, some protozoa may change their body shape depending on the environment they are in.
- They may also exhibit different morphological structures (e.g., trophozoite, sporozoite, merozoite, kinet, ookinet or oocyst).
- The bodies of protozoans are usually symmetrical, but some species may be asymmetric.

Structure of an eukaryotic cell

1)Nucleolus
2)Nucleus
3)Ribosome
4)Vesicle
5)Granular endoplasmic reticulum
6)Golgi apparatus
7)Cytoskeleton
8)Agranular endoplasmic reticulum
9)Mitochondria
10)Vacuole
11)Cytoplasm
12)Lysosome
13)Centrioles

- The protozoon is a cell consisting of the nucleus, the cytoplasm, and the cell membrane that envelops the cytoplasm

Cell membrane

- The cell membrane forms the protozoon, separate it from the outside and protect it.
- At the same time it also provides a link to that environment.
- It conveys the reactions of the protozoon to the environment.
- In addition, many biological activities are carried our by this membrane.

Cell membrane

- The cell membrane is usually a two-fold phospholipid structure with the lipid surfaces facing each other.
- This membrane is called “pelicula”
- Most protozoa are covered by pelicula.
- There are 3 groups of proteins according to their functions in the cell membrane.
  - Channel proteins
  - Receptor proteins
  - Identity proteins

Cell membrane-related structures

- Surface coat
- Cyst wall
- Shells
- Apical complex

Surface coat

- This structure is located above the protozoon membrane
- and it has glycoprotein features varying thickness depending on the protozoa and developmental stages.

Surface coat

- The cell membrane surface coat can easily change identity because of the glycoprotein structure of the cell membrane and the polypeptide chains of amino acids have loosely attached and variable properties.
- This structure allows the hiding of the protozoa.

Cyst wall

- This structure is the wall of the developmental stages of some protozoa called cysts and oocysts.
- It has a durable structure.
- Some protozoan species cannot feed and breed adequately in the presence of reduced nutrients and degradation of the environment chemistry (pH).
- They may have lo leave their environment and keep their lives in a different environment.
- In this case, the protozoon transforms itself into a resistive form that can withstand the adverse difficult conditions of different environments. This is called “encystation”

Shells

- Free-living protozoa may have hard, silica, and calcareous shells to protect themselves from adverse conditions in the environment.
  - E.g. Foraminipherea

Apical complex

- This structure is found in parasitic protozoa in the sporozoea class (Apicomplexa), which contains many diseases agents in humans and animals.

Apical complex

- Members of this class develop in the cell.
- This organelles are used for cell finding, entering the cell and to adapt to the cell.
- Before entering the cell, the protozoon takes the form of a carrot with a pointed spine rounded back, and varying sizes.

Apical complex

- This form enters the target cell.
- The apical complex organelles that ended the mission often become resorbed.
- **Organelles**
  - **Conoid**
  - **Polar Ring**
  - **Rhoptri**
  - **Micronema**
  - **Subpellicular microtubulles**

Apical complexan organelles

- Conoid:
- It is a formation that develops as a conical-like protrusion at the head of the protozoon that takes the shape of a missile when going to the cell.
- This structure helps to enter the cell.

Apical complexan organelles

- **Polar Ring:**
- There are receptors that work in the selection of host, tissue and cells.

Apical complexan organelles

- **Rhoptri:**
- This structure is in the form of a double sac and contains the enzymes.
- Thanks to this enzyme, a protozoa enters the cell unbreakable and contains to develop.
- This secretion inactivates the cell-related receptors and breaks the defense mechanisms of the cell.

Apical complexan organelles

- **Micronems** are muscular formations that act to move by sliding.
- **Subpellicular microtubulles** are a large number of support and evacuation organelles located under the pellicle.

Cytoplasm

- The cytoplasm has a homogeneous, granular, vacuolar, colloidal, jellylike and sticky structure.
- It is usually transparent, but it may be colored due to pigments in some protozoa.
- The cytoplasm consists of liquid and shaped organelles.

Cytoplasm

- The liquid part of the cytoplasm is called "hyaloplasm"
- The hyaloplasm contains water protein, vitamins, carbohydrates, fats, hormones and is a natural living environment.

Cytoplasm

- The two parts of the cytoplasm, ecto and endoplasm, are clearly visible in Sarcodina.
- **Ectoplasm** is a thin, transparent and immobile structure just below the cell membrane.
- protects from external influences by creating a crust outside the protozoon with the ectoplasmic secretion.
- It gives a certain shape to protozooon.
- Also, movement organelles are based on this structure.

Cytoplasm

- **Endoplasm** is more granular and active
- Feeding and reproductive functions are performed in the endoplasm.
- There are various cytoplasmic organelles other than the nucleus in the endoplasm.
  - Endoplasmic reticulum
  - Golgi apparatus
  - Lysosomes
  - Vacuoles
  - Mitochondria
  - Peroxisomes
  - Ribosomes
  - Supporting structure

Endoplasmic reticulum

- This organelle consists of channels that extend between the nucleus and the cell membrane.
- There are endoplasmic reticulum in two different functional structures.
- One of these is granulated endoplasmic reticulum that has ribosome, the other is agranular endoplasmic reticulum that has no ribosome.

Golgi apparatus

- It is made up of sacs.
- This structure, which is seen as a disc-shaped overlaid structure in the vicinity of the nucleus, is present in every protozoa except for Ciliata species.
- It plays important roles in the secretion of enzymes and the transport of these enzymes to lysosome.

Lysosomes

- are originated from the Golgi apparatus, and include digestive enzymes.
- It is the place where metabolism takes place.
- Normally, enzymes that are possessed are inactive.
- The enzymes are activated by the pH change that occurs after the food is taken.

Vacuole

- There are three different functional vacuoles, namely food, contractile and conchroment vacuole.

- **Food vacuole (Endosome)**
- A membrane-enclosed cell vacuole with a digestive function, containing material taken up in by the process of phagocytosis.
- There are two types.
  - Phagosome for large solid particles
  - Pinosome for liquid or small particles

- **Contractile vacuole**
- It is made to throw out excess eater that has been taken with osmosis and with food.
- These are usually encountered in free living protozoa

- **Conchroment vacuole**
- In some Cliata groups, there is a vacuum containing round or oval solid matter in the front 1/3 of the body.
- This vacuole has a complicated structure with a pellicular head, a permanent wall, conchroment granules and two fibril systems.
- Some researchers believe that this is a balance organelle.

- **Mitochondria**
- The mitochondria is made up of a couple of unit membrane
- The outer membrane is flat and the inner one is protruding.
- The outer membrane is thought to originate from the endoplasmic reticulum.
- The inner membrane entrances are called crista.
- It is known to have taken part in protein synthesis.
- Energy is obtained by oxidation in mitochondria.

- **Peroxisome**
- It originates from the endoplasmic reticulum in the cytoplasm.
- It is the formation of the sac structure in which the detrimental structures to the protozoa are detoxified.

- **Ribosomes**
- It is found freely in the cytoplasm.
- The proteins produced by them are used intracellularly.
- They are involved in rRNA synthesis.

- **Supporting structures**
- All eukaryotic cells contain protein strands that form the cytoskeleton within the cytoplasm.
- They provide the shape of the cell and remain in a certain position of intracellular.