

**Encystment in protozoa :-** Many protozoa undergo encystment.

The cysts have the following function:

- 1 protection against unfavorable environment eg. *Entamoeba histolytica*.
- 2 Nuclear division which is followed by multiplication at the time of encystment eg. *E. histolytica*.
- 3 They may function in attachment eg. Ciliates of certain fish.
- 4 Serve as means of transmission from one end to another eg. *E. histolytic* and *Giardia intestinalis*.

**Factors contribute towards cyst formation :-**

Nutrient deficiency, desiccation, increase concentration of dissolved salts in the medium, changes in temp, low P<sup>H</sup>, decreased O<sub>2</sub> supply, accumulation of waste products in the medium, crowding phenomenon etc. But the conditions for encystment are not uniform for all the protozoa .

**Enzymes :** Microorganisms liberate enzymes that breakdown the tissue of the host into soluble material, which they can utilize. The enzyme are protease, amylase, lipase etc or oxidase, dehydrogenase etc.

**Differences between protozoa and protophyta :**

<b>Protozoa</b>	<b>Protophyta</b>
Posses a well defined nucleus.	Nuclear material is scattered through out the cytoplasm as granules, which are somewhat difficult to detect.
Bounded by a delicate non-rigid membrane called periplast.	Bounded by a most rigid wall made of cellulose
The way of nutrition is holozoic ie. they require ready made food material.	The way of nutrition is holophytic ie most of them have green pigment chlorophyll carried is pigment cells called chromatophores
Asexual reproduction is usually by binary fission is longitudinal axis (except <i>B. coli</i> .)	Asexual reproduction by transverse binary fission

### Differences between bacteria and protozoa :

Bacteria	Protozoa
Prokaryotic cells	Eukaryotic cells.
Have no distinct nucleus, disperse nuclear material.	Have distinct nucleus.
No nuclear membrane to separate nuclear apparatuses from surrounding cell.	Have distinct double layer nuclear membrane.
Absent (indistinct nuclear).	Highly developed & consists of ER, golgibody, mitochondria, lysosome & Other subcellular organellae.
Bacterial disease progress at a first speed (except Tuberculosis)	Runs a protracted course.

### *Economic Importance of Protozoa :*

- 1) A majority of protozoa are free living of which the large sized protozoa play an important role is the control of bacteria in water having dead organic matter. Thus they play a vital role is **sanitary microbiology**.
- 2) Ciliates normally found in the stomach of ruminants and in the caecum & colon of equines, form an essential part of an environment in which the **metabolic activities of the host**, the bacteria and the protozoa are all linked.
- 3) Parasitic protozoa **causes disease in domestic animals and human being**. Some of the protozoa disease appears with severity resulting in mortality. But sub acute & chronic form may lead to poor growth, loss of body weight. Reduced milk, egg & wool production.

### **The damage caused by protozoa to the host depends upon certain factors :-**

- a) The ability of the parasite to multiply inside the host.
- b) The rate of infection of the host.
- c) The virulency of the parasite.
- d) The situation of the parasite inside the host's body.
- e) The nature of the damage inflicted by the parasite.
- f) The nature of the host's reaction to it.

## **Harmful nature (pathogenesis) of protozoa infection :**

- 1) **Mechanical obstruction :** Protozoa are too small to cause mechanical obstruction however, occasional clumping of the organisms may lead to blocking the capillaries of visceral organs including brain & spleen ie. *Plasmodium falciparum*, *Babesia* sp. & trypanosomes.
- 2) **Hematological changes :** All blood protozoa cause a variety of changes in the normal blood picture.
  - a. **Anemia** due to destruction of RBC & dyshaemopoiesis as in case of *Trypanosoma congolense*.
  - b. **Hypoglycaemia** due to consumption of a large amount of blood sugar (*T. evansi*).
  - c. Exhaustion of glycogen reserve in the body due to liver dysfunction, increase in lactic acid which interfere with respiration.
  - d. Piroplasm destroys the RBC causing **haemolytic anaemia**.
  - e. **Leucopenia** arising due to prevention of the normal development of granulocytes (*Leishmania donovani*).
  - f. **Jaundice** as a result of occlusion of the bile ducts caused by parenchymatous degeneration in piroplasmosis.
  - g. Fall in total RBC count, PCV & Hb, increase in WBC count in theileriosis & others.
  - h. Biochemical changes in proteins, enzymes & minerals in blood serum.
- 3) **Interfere with digestion of food :**

*Giardia lamblia* is responsible for mechanical interference of fat absorption from the intestine by the layer of parasites adhering to its wall which leads to the deficiency of fat soluble vitamins.

Coccidial recovery results in replacement of functional epithelium by connective tissue, which hamper the intestinal digestion & keeps the individual unthrifty.

*Trichomoniasis* of the upper digestive tract result in yellow caseous lesions on oral mucosa which extend to oesophagus, crop, even trachea. Bird avoids feeding due to painful lesions.
- 4) **Destruction of host cells :** All intra cellular protozoa are responsible for the destruction of a large number of cells of various organs and tissues of the host.

Destruction of RBC by haemoprotozoan. Destruction of epithelial cells of the G.I. tract by coccidia and other intestinal protozoa. Coccidia causes rupture of cells and blood vessels. Malaria causes rupture of RBC. *E. Histolytic* - use RBC as foods.

- 5) **Host reaction** : Parasitic protozoa may cause various host reactions. Such as inflammation, hypertrophy, hyperplasia, increase peristalsis (in amoebosis), enlarged lymph glands (theileriosis), Swelling of the spleen & liver and hyperaemia in kidney (in trypanosome infection), tumors like lesion in the bile duct (in *Eimeria stiedae* infection) & others.

*Entamoeba histolytica* – increase peristalsis & increase discharge of mucus and other excretion which form an important part of the syndromes of dysentery.

***In Trypanosoma infection in chronic cases enlargement of lymph glands, swelling of spleen, liver and hyperanemia of kidney occurs.***

*Plasmodium* infection – Splenomegaly due to exoerythrocytic infection.

*Eimeria stiedae* – Tumour like lesions in the bile duct due to hypertrophy of the affected parts.

- 6) **Toxin production:** Necrosis and lysis of the tissue may be due to various toxic substances and proteolytic enzymes having cytolytic effect. (In case of *Entamoeba histolytic* & *B. coli* infection). Trypanosomes elaborate toxins, which result in production of antibodies, the ablastins. *Plasmodium* sp in addition to destroying directly the erythrocytes may also cause hemolysis of the uninfected RBC.
- 7) **Secondary infection:** Some of the protozoa play a havoc in conjunction with bacteria eg. *Entamoeba histolytica* must be helped by anaerobic bacteria to onset the infection. Coccidian infection may be complicated by bacterial infection.
- 8) **Autoimmunity:** The immune response of the host against some intracellular parasite protozoa (*Theileria* and *Babesia* sp.) causes severe destruction of infected cell as well as non-infected normal blood cells.

## Mode of transmissions of protozoan parasites :

### **Direct :-**

1. Ingestion of contaminated feed & drinks – oocyst, cyst etc. of *Giardia*, *Entamoeba* & *B.coli*
2. Ingestion of infected meat containing the stages of the parasites. - *Trypanosoma* & *Sarcocystis*.
3. Through (genital route) – coitus - *Tritrichomonas* & *Trypanosoma equiperdum*
4. Congenital route – *Toxoplasma gondii*
5. Through crop milk - *Trichomonas gallinae*

### **Indirect :-**

A) Through vector

- (i) Mechanical transmission : Intermittent feeding habit of vector – Trypanosomes
- (ii) Biological transmission : *Leishmania*, Malaria

*Theileria* –Transtadial (stage to stage)

*Babesia* –Transovarian

*Histomonas* - Through the eggs of Helminthe, *Heterakis gallinarum*

*Hepatozoon*, *Sarcocystis* & *Toxoplasma* - Ingestion of infected I/H etc.