

## NUTRITION IN PROTOZOA

**Q. 3. Write an essay on the modes of nutrition in Protozoa studied by you.**  
(Bundelkhand 1988; Bhopal 93; Kanpur 91; Lucknow 97)

**Describe the various modes of nutrition found in Protozoa.**  
(Agra 1988; Lucknow 91, 94; Kanpur 96)

**Nutrition** (*L. nutrimentum*, nourishment) is the process of ingestion, digestion, assimilation and egestion of food to release energy needed for various vital activities. The methods of obtaining nourishment in Protozoa are variable and are as follows :

1. Holozoic or Zootrophic—animal like
2. Holophytic or Autotrophic—plant like
3. Saprozoic or Saprophytic
4. Parasitic
5. Mixotrophic
6. Coprozoic

### 1. Holozoic Nutrition (in Amoeba and Paramecium)

Majority of free-living protozoa feed in holozoic or animal-like manner. These utilize ready made solid food in the form of micro-organisms, bacteria,

yeast, algae, protozoans and small metazoans. *Amoeba* and *Paramecium* are good examples of this type. The holozoic mode of nutrition involves three steps :

- (a) Food capture or ingestion
- (b) Digestion and assimilation
- (c) Egestion.

**1. Ingestion**—The holozoic mode of nutrition needs specialized organelles for food-capture and food-ingestion. The locomotory organs usually serve this purpose.

**A. Ingestion in Amoeba**—In *Amoeba* (Rhizopoda) mouth and the specialized organs for food-catching are wanting. The food is ingested at any point of the cell body, and the pseudopodia act as food-catching organs. The ingestion might be facilitated by any of the following methods :

- (a) **Circumvallation**—The process is employed by *Amoeba* in catching of actively moving prey. Coming in contact with food organism, *Amoeba* throws out pseudopodia forming a food cup. The food cup embraces and encloses the food organism and changes into the food vacuole.
- (b) **Circumfluence**—*Amoeba* rolls over the immotile prey and its protoplasm flows over and engulfs it by completing the food cup. Axopodia and reticulopodia of Helizoans and Radiolarians also utilize this method.

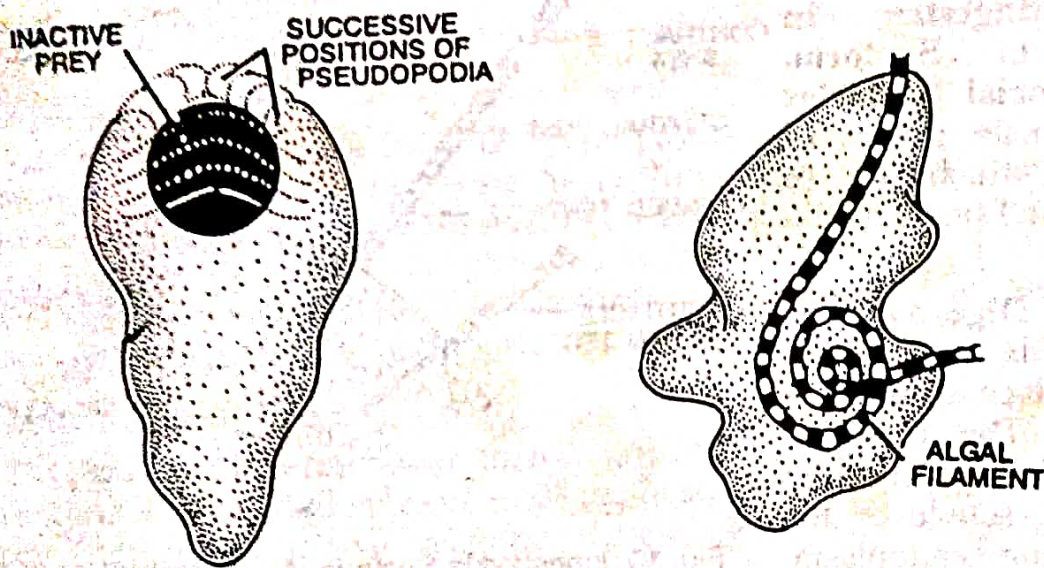


Fig. 9. Ingestion in *Amoeba*. A—Circumfluence, B—Import.

- (c) **Invagination**—Firstly, the prey is killed and held near the body surface by the adhesive secretion of pseudopodia, the ectoplasm invaginates at the point of contact and encloses the prey into a food vacuole.
- (d) **Import**—The filamentous food-like algal filaments are drawn into the body passively with least movement.

**B. Ingestion in Mastigophora**—In Mastigophora the ingestion occurs at a definite region which is specialised for this purpose. It may be mouth opening or cytostome leading into the endoplasm through tubular **cytopharynx** (*Euglena*). The lashing movement of flagellum brings the food particles towards the cytostome, but in some mastigophores (Hypermastigida) food can be ingested by pseudopodia.

**C. Ingestion in Ciliates**—In Ciliata the food catching organelles are highly specialized and a definite cytostome is present. In raptorial forms the food passage is supported by a cirlet of trichites forming the pharyngeal basket. In *Paramecium* and *Vorticella*, oral groove or peristome directs the food into the cytopharynx. Both these structures are provided with special ciliary or undulating membranes for creating water currents to sweep the food into the cytopharynx.

**D. Ingestion in Suctoria**—In Suctoria, the suctorial tentacles are the main organs of ingestion, which paralyse the prey and suck its fluid contents.

**2. Digestion**—The digestion is intracellular. It takes place inside food vacuole. The digestive enzymes are poured into the food vacuole by the surrounding endoplasm. The contents of the food vacuole are first acidic and then alkaline. Trypsin, pepsin, amylase are recorded from the digestive secretion of protozoa and the starch, protein, cellulose are digested. A few forms can digest fat as well.

**3. Assimilation**—The digested food is absorbed by the cell cytoplasm by diffusion. The food vacuoles constantly move about in the cytoplasm to supply the digested food to every part of the cell body. The movement of food vacuoles pursues a definite path, the cyclosis, as in *Paramecium* but no definite route is followed in *Amoeba*.

**4. Egestion**—In naked forms like *Amoeba* the ingestible residue is left behind at any point from the body by the advancing animal. In *Paramecium* and other flagellates and ciliates, which possess a definite body covering or pellicle, a definite anal spot or cytopyge occurs for egestion. It may be a temporary opening

SUCTORIAL TENTACLES WITH FUNNEL ENDS

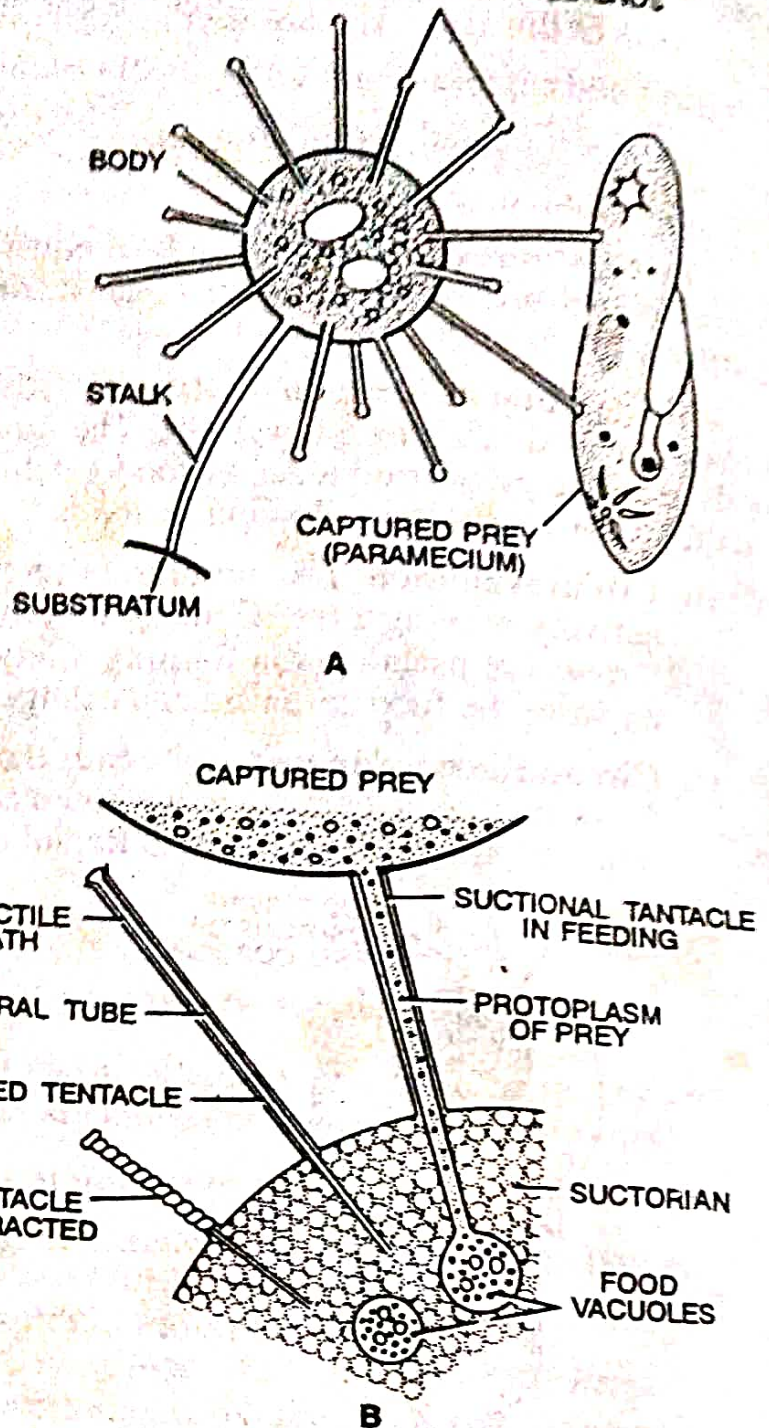


Fig. 10. Ingestion in Suctoria. A—*Podophyra* feeding on *Paramecium*; B—Suctorial tentacles sucking food from prey.

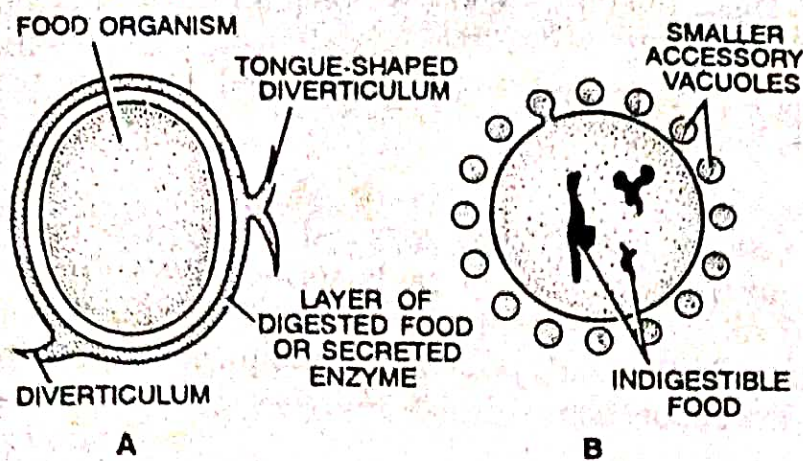


Fig. 11. A— Recently formed food vacuole; B— An old food vacuole.

visible only at the time of defaecation (*Paramecium*) or a permanent opening with a short rectal canal, the cytoproct (*Balantidium* and *Nyctotherus*).

## 2. Holophytic Nutrition (in *Euglena*)

Holophytic or plant-like nutrition is wide-spread among the chromatophore bearing flagellates (Phytomastigophorea), e.g. *Euglena*. They can synthesise carbohydrates from  $H_2O$  and  $CO_2$  in the presence of sunlight with the help of chlorophyll. During this process  $CO_2$  is decomposed into carbon and oxygen. The carbon is retained inside the body and in combination with other inorganic salts and water forms complex organic compounds such as proteins and carbohydrates.

## 3. Saprozoic Nutrition (in *Entamoeba* and *Euglena*)

Various parasitic and a few free-living protozoa which live in contact with organic solutions practice this mode of nutrition. They do not possess special organelles for ingestion but obtain their nourishment simply by diffusion through general body surface. Parasitic protozoa such as *Entamoeba histolytica* and *Balantidium coli* which although feed holozoically, also absorb dissolved organic compounds through general body surface.

## 4. Parasitic Nutrition

The parasitic protozoa obtain their nourishment partially or wholly from the digested and decomposed substances of the host, either in holozoic or saprozoic manner. They constitute two categories depending upon the nature of food and mode of feeding :

**1. Food robbers**—They feed upon the raw or digested foodstuffs of the host either holozoically or by diffusion but do not harm the host. They are usually commensals.

**2. Pathogenic**—They feed upon the living tissues of the host causing several dreadful diseases. They may obtain their food in holozoic manner in *Entamoeba histolytica* or saprozoically by absorbing liquid or assimilable food as in *Plasmodium* and *Trypanosoma*. Thus they exhibit two ways of food uptake :

(1) **By phagotrophy**—In this method, the parasites feed on host tissue by holozoic method. It is exhibited by *Nyctotherus* and *Balantidium*.

(2) **By osmotrophy**—In this method, parasitic protozoa feed saprozoically and obtain liquid food by diffusion as for example, *Trypanosoma* and *Entamoeba*. Osmotrophic individuals are of following two types :

- (i) **Coelozoic**—These obtain predigested food from the intestine of host as *Opalina* or *Entamoeba histolytica*.
- (ii) **Histozoic**—*Monocystis* and *Plasmodium* feed on host tissue and are described as histozoic.

#### 5. Pinocytosis

It is found in *Amoeba*, certain flagellates and ciliates. This involves ingestion of liquid food by invagination through body surface. Pinocystotic channels are formed at certain parts of the body surface. These enclose the fluid food from the surrounding medium. Lower ends of channels are pinched off as food vacuoles which circulate in the endoplasm.

#### 6. Other Types of Nutrition

- (i) **Coprozoic**—A few free living protozoa feed upon the faecal matter of other organisms.
- (ii) **Mixotrophic**—Certain protozoa feed by more than one methods at the same or different times. For example, *Euglena* and *Paranema* feed holophytically but obtain certain necessary substances by osmosis from their surroundings.