TOPIC: INTRODUCTION TO PROTOZOA:NUTRITION AND REPRODUCTION IN PARAMOECIUM

LECTURE NO:04

B.SC PART 1

ZOOLOGY(HONS.)-PAPER I-GROUP A

CHAPTER 2

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Nutrition:

Paramecium feeds in the holozoic manner like Amoeba. The food is mostly bacteria found in floating water. It has been estimated that about 2 to 5 million bacteria (Bacillus coli) are devoured in 25 hours by a single Paramecium *P. Bursaria* can live holophytically for long periods due to the presence of symbiotic zoo chlorella algae.

Food is ingested by cytostone situated at the bottom of buccal cavity. Constant lashing movements of cilia direct the food particles towards buccal cavity. Only selected food particle are passed on inside the buccal cavity. Beating of cilica of buccal cavity derives food in to cytopharynx through cytostaome. The food is collected at the bottom of cytopharynx, in the form of a food vacuole. Another food vacuole may be formed within 2 to 4 minutes.

Digestion: Each food vacuole consists of particles surrounded by a thin film of water. Food vacuole in circulated

around the body along a definite path by a streaming movement of endoplasm known as cyclosis. Food vacuoles move particularly, than forward and aborally and again posterior & orally up to cytopyge. Digestion & assimilation of food takes place during cyclosis. Digestive enzymes are secreted by the

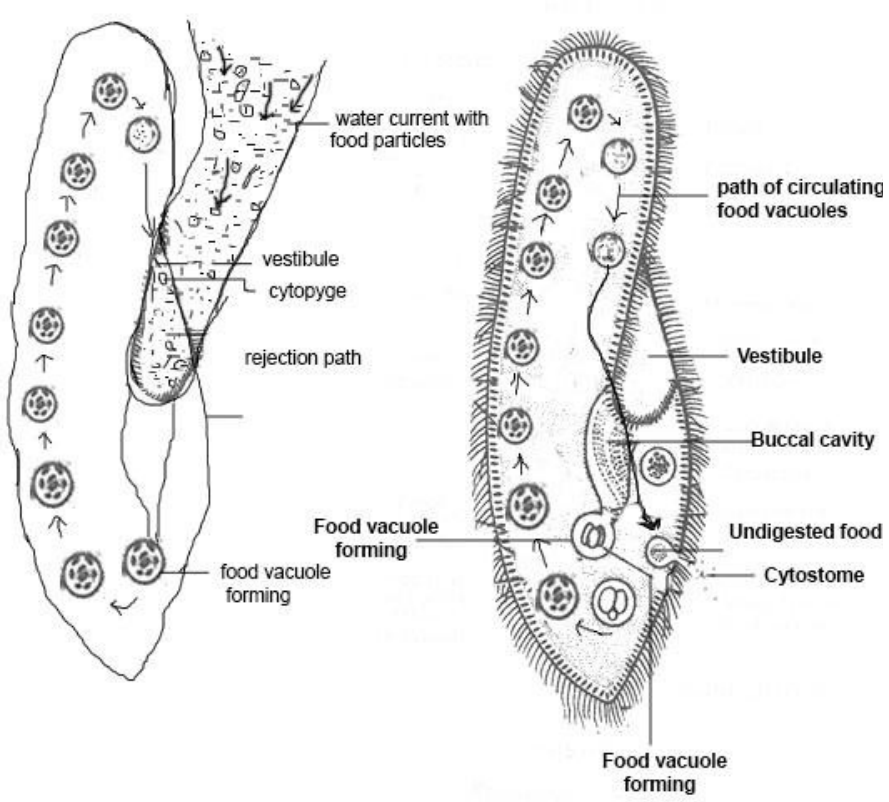

Fig.11 Paramecium showing cyclosis and path of food vacuoles in endoplasm

Lysosomes in to the food vacuoles. She contests of a food vacuole first become acidic but gradually become alkaline. Products of digestion (glycogen & fat) are diffused in to the surrounding cytoplasm.

Egestion: The vacuole gradually becomes smaller as absorption of digested food proceeds. The undigested residual matter is eliminated through cytopyge or anal spot.

Reproduction in Paramecium

Paramecium multiplies very quickly by transverse binary fission. But this is interrupted at intervals by the so called sexual process conjugation. Several types of nuclear reorganizations such as endomixis, hemimixis, auto gamy and cytogamy have also been reported.

1- Binary fission:

During favorable conditions paramecium multiplies by transverse binary fission.

The animal stops feeding and the micronucleus divide into two by an elongated type of mitosis.

The two daughter micronuclei move apart toward the opposite end.

Mean while the macronucleus elongates and gets constricted into two amitiotically.

A transverse constriction appears in the middle of body, which deepens gradually dividing it into two equal valves.

The oral groove of the parent is retained by one half and the mouth and cytopharynx by other. These later on regenerated the essential parts.

The contractile vacuole in each half also divides. These now separated and start their free existence.

The entire process is completed within half to two hour (Fig.12).

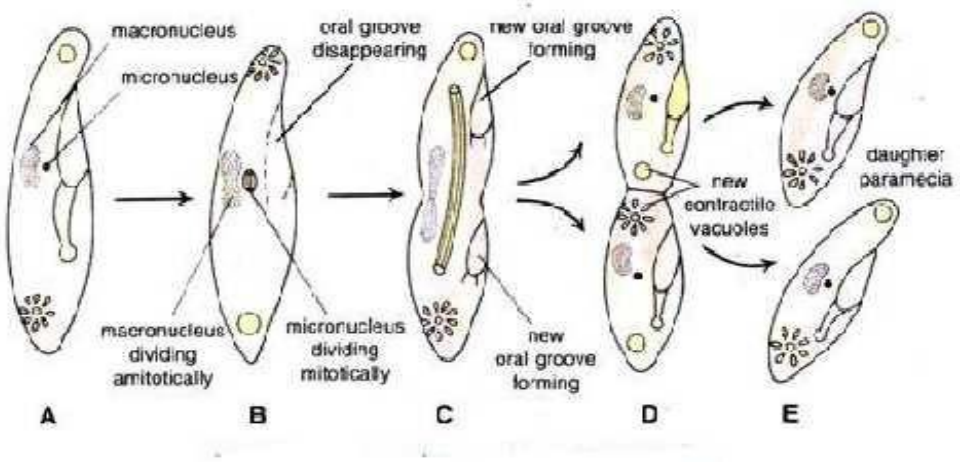

Fig.12 Paramecium: Stage showing Binary Fission

2-Conjugation:

Conjugation is a temporary process and completed in following steps-

Macronucleus Changes-Soon after pairing the macronucleus degenerates into fragment and is absorbed in the cytoplasm micronucleus Changes:-

Simultaneously the micronucleus undergoes two pre-gametic divisions, of which first is reduction division.

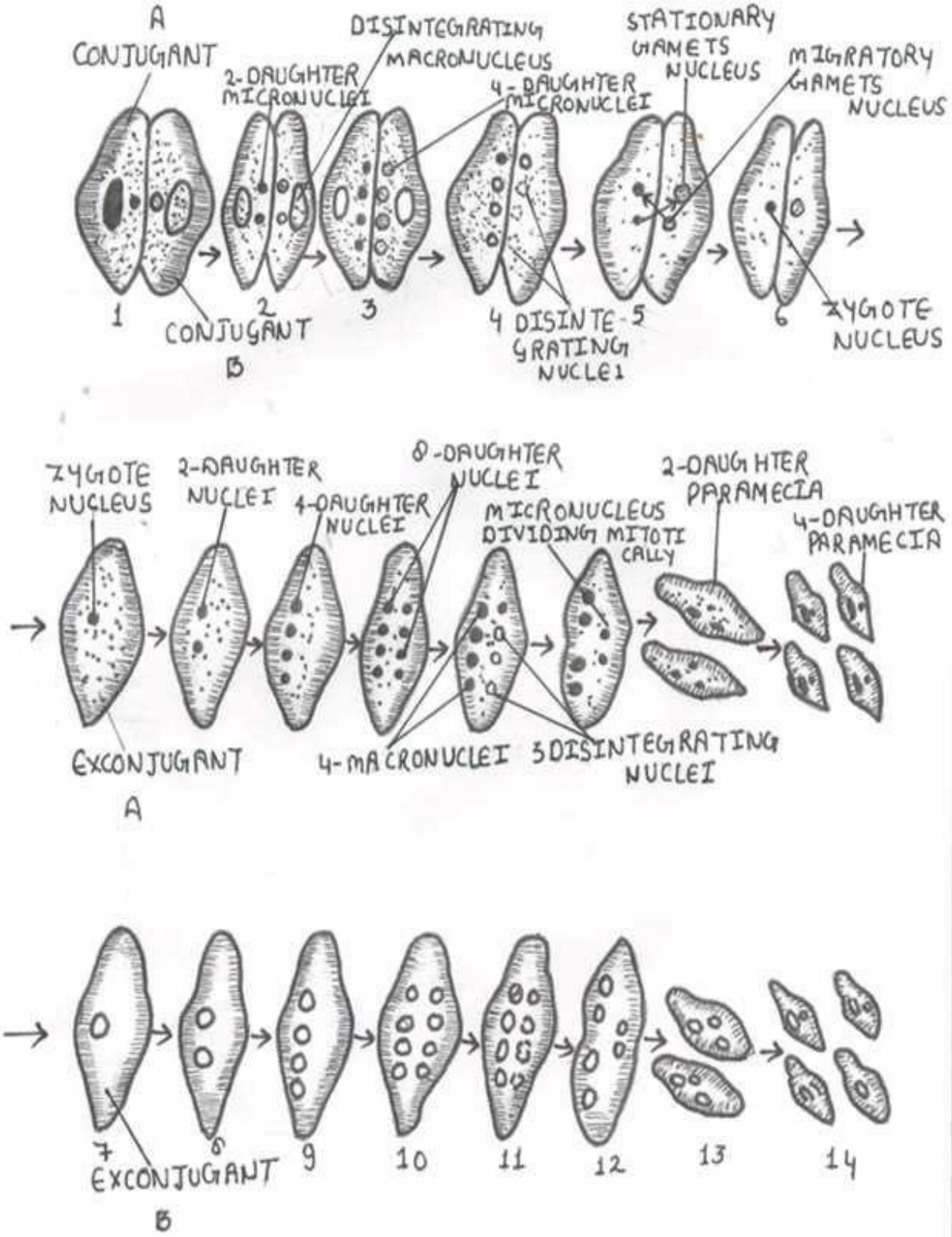

Fig. 13 Paramecium,stage in conjugation

- As a result four daughter micronuclei are formed each with haploid number of chromosome.
- Three of the four daughter micronuclei degenerate in each conjugant.
- The remaining micronucleus divides unequally producing a small active migratory male pronucleus and large and passive stationary pronucleus potentially female.

- The migratory male pronucleus of the two conjugant's are exchanged so that the male pronucleus of one passes into the other and fuses with the female pronucleus forming the zygote nucleus or synkaryon.
- The conjugant's now separate and is called exoconjugants.
- The synkaryon in each conjugant divides thrice and eight nuclei are formed.
- Four of them enlarge and from macronuclei, while the remaining four are known as micronuclei.
- Three of the four micronuclei disintegrate.
- The single micronucleus in each exoconjugants divide twice and each division is accompanied with the division of body.
- As a result four daughter paramecia are formed from each exoconjugants each with one micro and one macronucleus (Fig.13).

Significance of Conjugation:-

1-Rejuvenation- It has been found that individuals cannot continue to multiply indefinitely by asexual methods. After a definite number of asexual generations the rate of fission declines.

Nuclear reorganization: Old and decaying macronucleus is replaced by a new one during conjugation.

Heredity variations: The fusion of pronuclear facilitates exchanges of nuclear material.

Autogamy:-

It is found in *P.aurelia.* The process is similar to conjugation but found in a single individual. This is also called as self-conjugation. In P. Aurelia 2 micronuclei are meiosis to form 8 haploid daughter nuclei. 7 of them disintegrate nuclei. The macronucleus is absorbed in the cytoplasm. The 2-ganetic nuclei fuse to form homozygous diploid zygote nucleus or synkaryors. The zygote nucleus divides twice to form 4 nuclei 2 of which become macronuclei & 2 micronuclei. The call body & the micro nuclei divide to form 2 daughter individuals, each paramecium with a macronucleus & 2 micronuclei. Auto gamy was described by W.F. Diller (1936) in *P. Aurelia*.

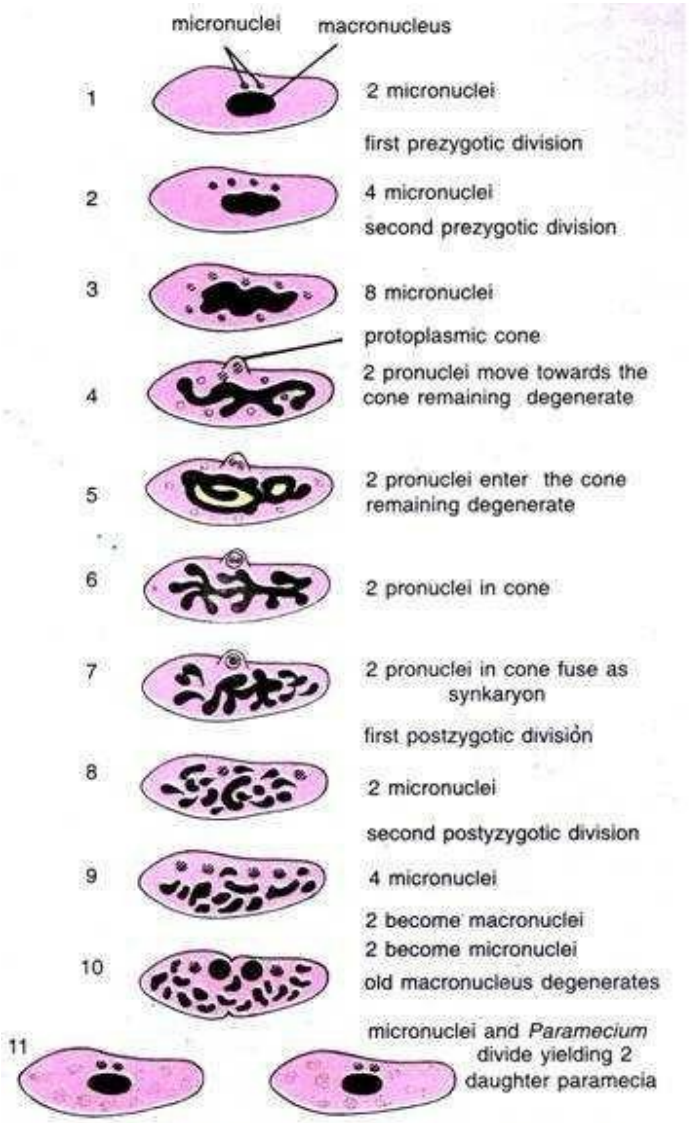

Fig.15 Diagramatic Representation of Autogamy

Cytogamy:

It is a sexual process without nuclear exchange thus called as cytogamy. The process resembles conjugation. Two small individuals temporarily fuse by their oral surfaces. The early nuclear divisions are similar to conjugation, but there is no nuclear

exchange between two individuals. But two haploid gamete nuclei in each individual fuse to form a synkaryon as in auto gamy. The process completed in about 12 to 13 hours. Cytogamy was reported by R. Wichterman in *P. Caudatum* (1940).

Endomixis - This is the periodic nuclear reorganization in ciliate protozoans. It is internal nuclear reorganization within a single individual taking place in the absence of conjugation. Erdmann & woodruff in 1914, first of all reported in the bimicronucleate species, *P. Aurelia* at regular intervals of about 30 days. The macronucleus disappears & degenerates. The micronuclei (2) divide twice mitotically forming 8 daughter nuclei of which 6 degenerate. At this stage Paramecium also divides, each daughter has one micronucleus. This micronucleus divides twice forming four micronucleus, two of which become microlei & two macronuclei, in each individual. The micronuclei again divide with the binary fission of Paramecium into two daughters, each getting one macronucleus & two micronuclei. Thus 4 daughters are produced from a single parent.

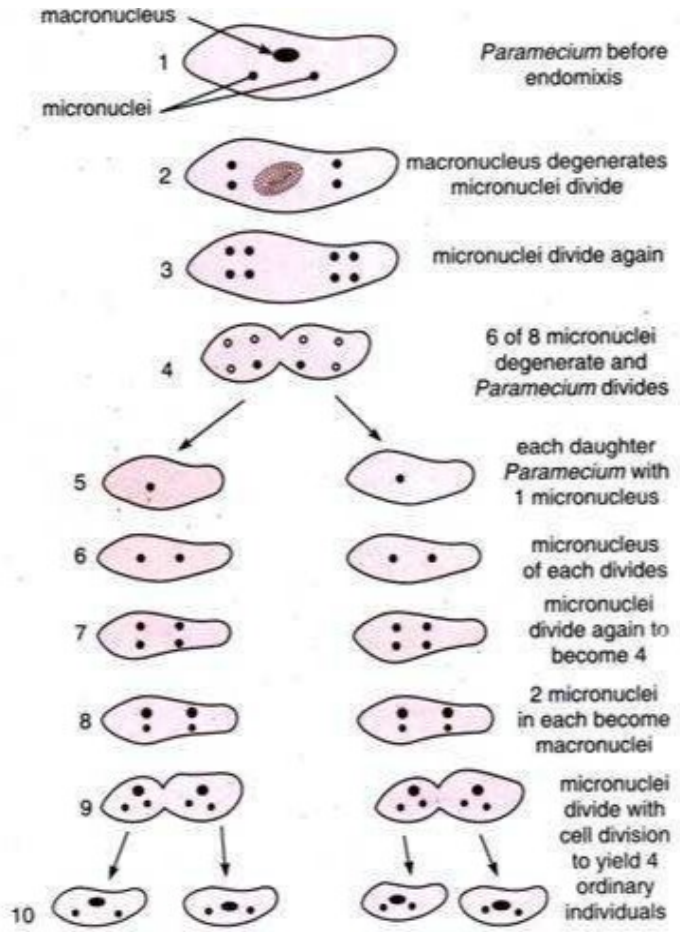

Fig.16 Stage of Endomixis in Paramecium

Summary

Protozoa means 'first animal' the simplest form of animal life. Protozoa are unicellular microorganisms that lack cell walls. It can grow in marine habitat or soil fresh water symbiotic parasites in other organisms. Protozoa depends on nutrition, temperature, pH, and some depends on sunlight. There are an estimated 30,000

protozoan species. They are aquatic (fresh and salt water) free living parasitic, symbiotic or commensally. They possess different types of locomotory organs. They may bear flagella (flagellates). Locomotory organs are absent in the parasitic forms. The osmotic concentration of cell body (Osmoregulation) is maintained by one or more contractile vacuoles. Asexual reproduction takes place by fission or budding. Sexual reproduction are occurring the fusion of gametes or conjugation **Eg. Free living**- *Euglena, Amoeba, Paramecium, Noctiluca, Elphidium* (Polystomella). **Parasitic**- *Monocystis, Entamoeba, Plasmodium, Trypanosome, Giardia* etc. Encystment occurs to tide over the unfavorable conditions and to help in the dispersal of race.

A phylum protozoon is a larger and varied group and poses a number of problems in its classification. The conventional scheme followed by Hyman (1940), Hickman (1961) and Storer (1965) etc. recognizes two subphyla on the basis of organs of locomotion and five classes.

Paramecium (Gr., Paramekos- oblong + Caudata-tail) is an elongated and sliper shaped animal.

Paramecium is a typical ciliate microscopic organism. It is ten species known in world. Ciliates

are characteristed by the presence of cilia as locomotor organelles. Paramecium is occurrence in

fresh water ponds, lakes, rivers and streams. Its size varies in different species being 120-250µ in

P.aruelia and 170-290µ in *P.caudatum.* Its body asymmetrical with flat oral and a convex aboral

or dorsal surface. The body is covered by a thin firm but elastic pellicle. **T**he entire body surface

is covered by a uniform covering of hair like protoplasmic processes, the cilia. In Paramecium,

there is a broad, shallow oral groove on the ventral surface. Paramecium process by three

following two methods

1 -Ciliary movement- 2-Body contortions-

Paramecium has two contractile vacuoles, one anterior and one posterior. The function of the contractile vacuoles is osmoregulation.

Paramecium reproduces asexually by transverse binary fission. Ordinarily Paramecium multiplies by binary fission for long periods of time, but at intervals this may be joining of two animals along their oral surfaces for sexual process of conjugation.