CHARACTERISTICS AND LIFE CYCLE OF PARAMECIUM

DR POONAM KUMARI
DEPT OF ZOOLOGY
(BSC PART I PAPER I)

1. Habit and Habitat

Paramecium has a worldwide distribution and is a free-living organism. It usually lives in the stagnant water of pools, lakes, ditches, ponds, freshwater and slow flowing water that is rich in decaying organic matter.

2. Movement and Feeding

Its outer body is covered by the tiny hair-like structures called cilia. These cilia are in constant motion and help it move with a speed that is four times its body's length per second. Just as the organism moves forward, rotating around its own axis, this further helps it to push the food into the gullet. By reversing the motion of cilia, paramecium can move in the reverse direction as well.

Through a process known as phagocytosis, the food is pushed into the gullet through cilia which further goes into the food vacuoles.

The food is digested with the help of certain enzymes and hydrochloric acid. Once the digestion is completed the rest of the food content is quickly emptied into cytoproct also known as the pellicles.

The water absorbed from the surroundings through osmosis is continuously expelled from the body with the help of the contractile vacuoles present on either end of the cell. P. bursaria is one of the species which forms a symbiotic relationship with photosynthetic algae.

In this case, the paramecium provides a safe habitat for the algae to grow and live in its own cytoplasm, however, in return the paramecium might use this algae as a source of nutrition in case there is a scarcity of food in the surroundings.

Paramecium also feeds on other microorganisms like yeasts and bacteria. To gather the food it makes use of its cilia, making quick movements with cilia to draw the water along with its prey organisms inside the mouth opening through its oral groove.

The food further passes into the gullet through the mouth. Once there is enough food accumulated a vacuole is formed inside the cytoplasm, circulating through the

cell with enzymes entering the vacuole through the cytoplasm to digest the food material.

Once the digestion is completed the vacuole starts to shrink and the digested nutrients enter into the cytoplasm. Once the vacuole reaches the anal pore with all of its digested nutrients it ruptures and expels all of its waste material into the environment.

3. Symbiosis

Symbiosis refers to the mutual relationship between two organisms to benefit from each other. Some species of paramecium including P. bursaria and P. chlorelligerum form a symbiotic relationship with green algae from which they not only take food and nutrients when needed but also some protection from certain predators like Didinium nasutum.

There has been a lot of endosymbioses reported between the green algae and paramecium with an example being that of the bacteria named Kappa particles giving paramecium the power to kill other paramecium strains which lack this bacteria.

4. Reproduction

Just like all the other ciliates, paramecium also consists of one or more diploid micronuclei and a polypoid macronucleus hence containing a dual nuclear apparatus.

The function of the micronucleus is to maintain the genetic stability and making sure that the desirable genes are passed to the next generation. It is also called the germline or generative nucleus.

The macronucleus plays a role in non-reproductive cell functions including the expression of genes needed for the everyday functioning of the cell.

Asexual Reproduction in paramecium is by binary fission. The mature cell divides into two cells and each grows rapidly and develops into a new organism. Under favourable conditions, Paramecium multiplies rapidly up to three times a day. Binary fission divides a cell transversely and followed by mitotic division in the micronucleus. Macronucleus divides amitotically. The gullet also divides into two halves.

Although the favoured mode of reproduction in Paramecium is mostly asexual, they reproduce sexually too, when there is a scarcity of food.

Sexual reproduction in Paramecium is by various methods.

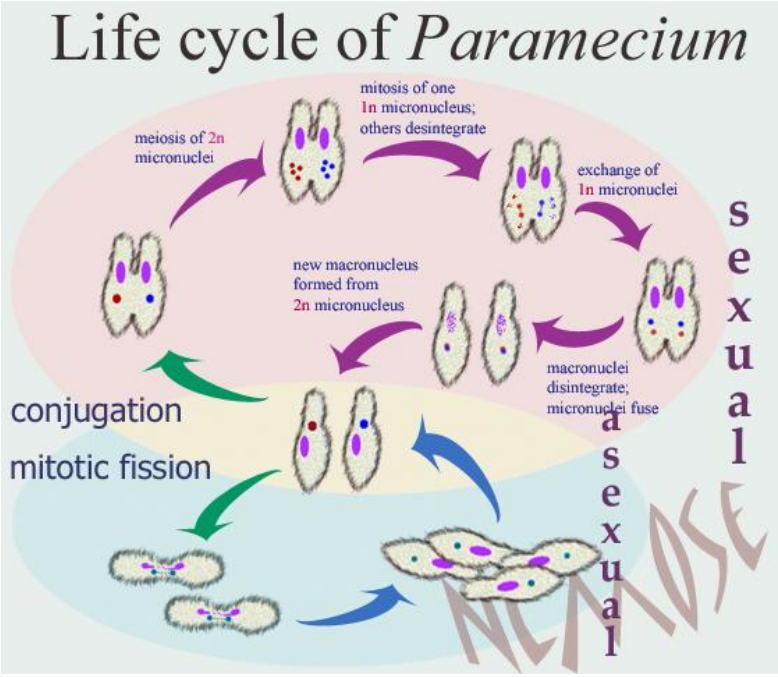
In conjugation, two complementary paramecia (syngen) come together and there is a transfer of genetic material. An individual has to multiply asexually 50 times before reproducing by conjugation.

In the process of conjugation, the conjugation bridge is formed and united paramecia are known as conjugants. Macronuclei of both the cells disappear. The micronucleus of each conjugant forms 4 haploid nuclei by meiosis. Three of the nuclei degenerate. The haploid nuclei of each conjugant then fuse together to form diploid micronuclei and cross-fertilization takes place. The conjugants separate to form exconjugants. They are identical, but different from the earlier cells. Each exconjugate undergoes further division and forms 4 daughter Paramecia. Micronuclei form a new macronucleus.

Paramecium also shows autogamy i.e. self-fertilization. A new macronucleus is produced, which increases their vitality and rejuvenates them.

Cytogamy is less frequent. In cytogamy, two paramecia come in contact but there is no nuclear exchange. Paramecium rejuvenates and a new macronucleus is formed.

A Paramecia undergoes ageing and dies after 100-200 cycles of fission if they do not undergo conjugation. The macronucleus is responsible for clonal ageing. It is due to the DNA damage.



5. Aging

There is a gradual loss of energy as a result of clonal aging during the mitotic cell division in the asexual fission phase of growth of paramecium.

P. tetraurelia is a well-studied species and it has been known that the cell expires right after 200 fissions if the cell relies only on the asexual line of cloning instead of conjugation and autogamy.

There is an increase in the DNA damage during clonal aging specifically the DNA damage in the macronucleus hence causing aging in P. tetraurelia. As per the DNA damage theory of aging the whole process of aging in single-celled protists is the same as that of the multicellular eukaryotes.

6. Genome

Strong evidence for the three whole-genome duplications has been provided after the genome of species P. tetraurelia has been sequenced. In some of the ciliates including Stylonychia and Paramecium UAA and UAG are designated as sense codons while UGA as a stop codon.