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Paramecium : A Prominent Aquatic Protist in Freshwater Lakes of Aurangabad

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Abstract:

Paramecium is a genus of organisms within the kingdom Protista, which represents single cell organisms and some multicellular algae. While the organisms in the more familiar plant and animal kingdoms are composed of many cells that work together to fulfill the animal or plant's biological functions, single celled organisms like the paramecium must do everything required for life take in nutrition, eliminate waste, produce energy, and reproduce within the confines of a single cell. As such, the single cell of a paramecium has many functions. *Parameciu*mcan move, digest food, and reproduce. They belong to the kingdom of Protista, which is a group of similar living micro-organisms. In the present study brief morphological and taxonomic position of Paramecium a free living ciliate (Protist)has been cited.

Key words: Protist

Materials and Methods

The water samples were collected from different water bodies of Aurangabad (M.S.) Observations on ciliates were done after their movements were slowed down with methyl cellulose.

Introduction:

Protozoa (proto=first, zoa=animals) are the oldest known group of heterotrophic life-that consume and transforms complex food particles into energy. Although protozoans are only made up of a single cell these organisms manage to perform all the basic tasks of life.

Ciliates have:

- at least one small, diploid (2n) micronucleus. It contains the entire genome but is not active in gene transcription.

- a large, polyploid macronucleus that contains the active genes that run the cell.

The paramecium is an oval, slipper shaped micro-organism, rounded at the front/top and pointed at the back/bottom. The pellicle is stiff but elastic membrane that gives the paramecium a definite shape but allows some small changes. Covering the pellicle are many tiny hairs, called cilia. On the side beginning near the front end and continuing half way down is the oral groove. The rear opening is called the anal pore.They are about .02 inches long (.5mm). They are also famous for their predator-prey relationship with *Didinium*. *Paramecium* are known for their avoidance behavior. If an encounters a negative stimulus, it is capable of rotating up to 360 degrees to find an escape route. *Didinium* are heterotrophic organisms. They only have one type of prey; the much larger ciliate *Paramecium*. When a *Didinium* finds a *Paramecium,* it ejects poison darts (trichocysts) and attachment lines. The *Didinium* then proceeds to engulf its prey. Although *Paramecium* are larger than they are, *Didinium* are voracious eaters and will be ready to hunt for another meal after only a few hours. The contractile vacuole and the radiating canals are also found on the outside of a paramecium. Inside the paramecium is cytoplasm, trichocysts, the gullet, food vacuoles, the macronucleus, and the micronucleus.

Taxonomic Position:

Super Kingdom Eukaryotae
Kingdom Animalia (Protista - Protozoa)
Phylum Ciliophora
Class Ciliatea
Subclass Rhabdophorina
Order Hymenostomatida
Suborder Peniculina
Family Parameciidae
Genus Paramecium
Species aurelia, bursaria, caudatum

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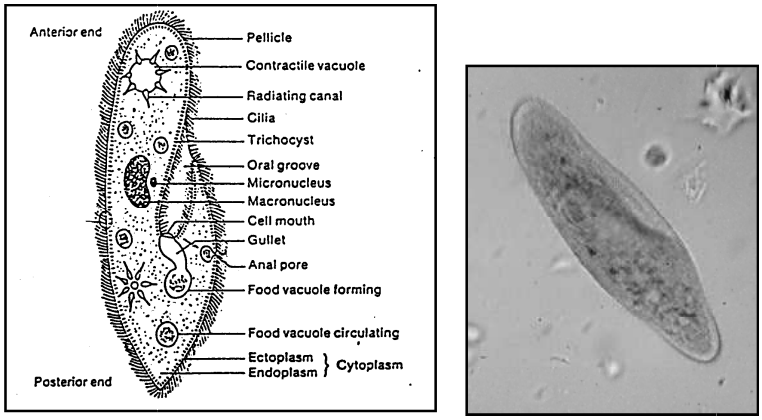

Figure 1 a- Paramecium: at a glance b. Stained

Pellicle - a membrane covering that protects the paramecium like skin

Cilia - hair like appendages that help the paramecium move food into the oral groove

Oral Groove - collects and directs food into the cell mouth

Cell Mouth - opening for food

Anal Pore - disposes of waste

Contractile Vacuole - contracts and forces extra water out of the cell

Radiating Canals - paths to the contractile vacuole

Cytoplasm - intercellular fluid needed to contain vital cell parts

Trichocyst - used for defense

Gullet - forms food vacuoles

Food Vacuole - storage pocket for food

Macronucleus - larger nucleus which performs normal cell functions

Micronucleus - smaller nucleus which is responsible for cell division.

The paramecium, genus of protozoa of the phylum Ciliophora, is often called slipper animalcules because of their slipper-like shape. Paramecia are unicellular organisms usually less than 0.25 mm (0.01 in) in length and covered with minute hair-like projections called cilia. Cilia are used in locomotion and during feeding. When moving through the water, paramecia follow a

spiral path while rotating on the long axis. When a paramecium encounters an obstacle, it exhibits the so-called avoidance reaction: It backs away at an angle and starts off in a new direction. Paramecia feed mostly on bacteria, which are driven into the gullet by the cilia. Two contractile vacuoles regulate osmotic pressure and also serve as excretory structures. A paramecium has a large nucleus called a macronucleus, without which it cannot survive, and one or two small nuclei called micronuclei, without which it cannot reproduce sexually. Reproduction is usually asexual by transverse binary fission, occasionally sexual by conjugation, and rarely by endomixis, a process involving total nuclear reorganization of individual organisms. Macronuclear DNA in *Paramecium* has a very high gene density. The macronucleus can contain up to 800 copies of each gene. Paramecia abound in freshwater ponds throughout the world; one species lives in marine waters. They are easily cultivated in the laboratory by allowing vegetable matter to stand in water for a few days. The common species Paramecium caudatum is widely used in research. The nuclei of Paramecium, the micronucleus and the macronucleus, differ in both structure and function. The diploid micronucleus, which is present in two copies in the *P. tetraurelia*species, represents the germ line and is completely silent in terms of transcription. This is the nucleus which undergoes meiosis and fertilization during sexual events (conjugation between competent cells or autogamy in a single cell).

The macronucleus, which is highly polyploid (about 1000n), represents the somatic line and is the site of transcription. Both the macronucleus and the micronucleus are derived from copies of the zygotic nucleus. The programmed development of the macronucleus includes DNA amplification by a factor of about 250, precise elimination of short internal sequences called IES and imprecise elimination of regions which are rich in transposons and repeated sequences and are probably heterochromatic. This event causes fragmentation of chromosomes. The extremities created in this way are repaired by the addition of telomeres.

The paramecium swims by beating the cilia. The paramecium moves by spiraling through the water on an invisible axis. For the paramecium to move backward, the cilia simply beat forward on an angle. If the paramecium runs into a solid object the cilia change direction and beat forward, causing the paramecium to go backward. The paramecium turns slightly and goes

forward again. If it runs into the solid object again it will repeat this process until it can get past the object.

Paramecium feed on microorganisms like bacteria, algae, and yeasts. The paramecium uses its cilia to sweep the food along with some water into the cell mouth after it falls into the oral groove. While paramecia have no stomachs, they do tuck food into small structures called vacuoles, which contain digestive enzymes. Here, digestion takes place.The food goes through the cell mouth into the gullet. When there is enough food in it so that it has reached a certain size it breaks away and forms a food vacuole. The food vacuole travels through the cell, through the back end first. As it moves along enzymes from the cytoplasm enter the vacuole and digest it. The digested food then goes into the cytoplasm and the vacuole gets smaller and smaller. When the vacuole reaches the anal pore the remaining undigested waste is removed. *Paramecium* may eject trichocyst when they detect food, in order to better capture their prey. These trichocyts are filled with protiens. Trichocysts can also be used as a method of self-defense. *Paramecium* are heterotrophs. Their common form of prey is bacteria. A single organism has the ability to eat 5,000 bacteria a day. They are also known to feed on yeasts, algae, and small protozoa. *Paramecium* capture their prey through phagocytosis. P*aramecium bursaria* is capable of farming certain algae within its own cytoplasm! It receives some of the products of the alga's photosynthesis in return for providing a home for the algal symbiont,*Chlorella*. In this photo, the green symbionts are seen through *Paramecium*'s clear cell membrane. In a dish lit from one side, *P. bursaria* gathers toward light, while its colorless relatives tend to be found in the opposite side. This is a good relationship for the algae; safely contained within the larger organism they are not as likely to be eaten. However, if there are no other food sources available, P. bursaria will digest its algal symbionts for a source of nutrition. Paramecium is also capable of *regulated exocytosis* of secretory vesicules (trichocysts) in response to external stimulation, like that which occurs in animals during the secretion of hormones or neuromediators. This regulated secretion implies a membrane fusion stage triggered by a transmembrane signaling cascade. In Paramecium it functions as a defense against predators, but is not essential under culture conditions in the laboratory. Consequently, Paramecium provides one of the rare models

in which regulated secretion, and especially the last stage of membrane fusion during exocytosis, can be dissected using a genetic approach.

Parameciums live in aquatic environments, usually in stagnant, warm water. The species Paramecium bursaria forms symbiotic relationships with green algae. The algae live in its cytoplasm. Algal photosynthesis provides a food source for Paramecium. Some species form relationships with bacteria. For example, *Paramecium caudatum* hosts Holosporaobtusa in its macronucleus. This bacteria is specific to the macronucleus of Paramecium caudatum; they cannot grow outside of this organism. This species acquires heat-shock resistance when infected with Holosporaobtusa, which contributes to ciliary motion. *Paramecium* are also well known as prey for Didinium.

Paramecia play a role in the carbon cycle because the bacteria they eat are often found on decaying plants. Paramecium will eat the decaying plant matter in addition to the bacteria, further aiding decomposition.

Paramecia can be used as model organisms in research. Currently, they are being used a great deal in genetics research. For example, recent research involves inactivating Paramecium genes for studying functional analysis by homology-dependent gene silencing. They can also be used to study membrane excitability and the duplication of basal bodies. More than 50 years of classical genetics experiments have led to the accumulation of almost 200 Mendelian mutations of Paramecium, affecting very diverse cellular processes (i.e. morphogenesis, regulated secretion, cell cycle, antigenic variation, sex determination and expression of the mating type, and rearrangements of the genome). Indeed, Paramecium is very well-suited to genetic analysis because of its two modes of sexual reproduction, autogamy and conjugation. Autogamy is a process of self-fertilization which renders the genome of the zygote completely homozygous in one generation. The stored strains are therefore just as easy to manipulate as haploid organisms. Conjugation is a process of reciprocal fertilization which produces two new zygotic nuclei which are identical in the two partners, which makes it possible to identify the traits with Mendelian heredity very easily, and to distinguish traits which are maternally inherited. The genes identified by mutation can be cloned by functional complementation.

Acknowledgement

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