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Paper-1

Dr. Mirza Imteyaz Baig

Osmoregulation in Protozoa

The contractile vacuoles are usually large, colourless, pulsatile fluid-filled organelles found in majority of protozoans. These vacuoles are nearly always found in freshwater Flagellata, Sarcodina and Ciliata. The contractile vacuoles are also found in some marine ciliates but these are not at all found in parasitic protozoans.

The contractile vacuoles are found in their simplest form in Sarcodina like Amoeba. In this case, these are usually spherical vesicles or sometimes irregular and bounded by a limiting membrane. These vacuoles are found surrounded by a circlet of mitochondria which provide energy for their pulsating activity.

In Flagellate like Euglena, the contractile vacuole is somewhat complicated and surrounded by a large number of accessory contractile vacuoles. In Ciliata like Paramecium, the contractile vacuoles are much complicated and found surrounded by 5 to 12 radiating canals or feeding canals which collect water from the various parts of the body.

The number of radiating canals varies in different ciliates. The radiating canals discharge their contents in the main contractile vacuole, thus, serving as feeders.

The position of contractile vacuole is not definite in Sarcodina and, therefore, can be found anywhere in the endoplasm. In Flagellata, e.g., Euglena the contractile vacuole is found situated near the anterior end at the side of reservoir. In Ciliata like Paramecium, the contractile vacuoles are usually two in number, situated one at each end of the body.

The number of contractile vacuoles varies in the different groups of Protozoa but its number remains constant, in the same species. However, it is single in Amoeba, single in Euglena, two in Paramecium but these are many in Radiolaria and Heliozoa.

Contractile vacuole is an empty space filled with fluid. Electron microscopic studies have revealed that its limiting membrane is lipoprotein in nature, like that of the plasma membrane.

The mode of working of contractile vacuole includes two steps, the diastole and the systole. The diastole is the phase of enlargement of the contractile vacuole to its maximum size and systole is the phase of its contraction to expel its contents.

A contractile vacuole is usually formed by the fusion of a large number of very small droplets in the area where contractile vacuole is to be formed (Amoeba) or around the mitochondria contractile vacuole (Euglena).

The systole occurs by the sudden burst of the contractile vacuole in Sarcodina but in Flagellata like Euglena, it empties in reservoir and so is the case with other forms. As referred, the energy required for the working of contractile vacuole is furnished by the mitochondria surrounding the vacuole.

However, the exact mechanism of working of contractile vacuole is not yet understood, even then the following theories have been put forth to explain its working:

1. Osmotic theory:

This theory explains that the water from the surrounding cytoplasm enters into the contractile vacuole by osmosis.

2. Filtration theory:

This theory explains that the water from the cytoplasm is forced into the contractile vacuole through its membrane due Fig- to internal hydrostatic pressure. Kitching has, however, contradicted this theory.

3. Secretion theory:

This theory states that the water is actively secreted into the vacuole during diastole through the vacuole wall. This theory, too, is not widely accepted.

(v) Function and Significance:

Contractile vacuole performs the function of osmoregulation by removing excess of water content from the body. In addition to its water regulatory function, the contractile vacuole is also believed to be excretory in function.

It has been observed that the water from the surrounding media continuously enters in the body of freshwater protozoans, therefore, water content of the protoplasm increases, i.e., there is an increase in the internal hydrostatic pressure.

This increased water content or hydrostatic pressure of the protoplasm inhibits the normal functioning of the body and if it continues to increase then a time may come when the body of the individual may burst.

Thus, the contractile vacuole helps in removing the excess water content of the protoplasm, i.e., it helps in maintaining the internal hydrostatic pressure.

Actually, the body fluid is hypertonic to the surrounding medium in freshwater forms. In case of marine and parasitic protozoans the surrounding media is nearly isotonic and, therefore, no excess water enters in the body. Hence, contractile vacuole is usually absent in these forms.