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Species

A Review on Unicellular green Algae – Chlamydomonas

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ABSTRACT

It is unicellular green algae found in standing water of ponds, pools and ditches. Each cell is biflagellate spherical in shape. Cell wall is thin anterior end of chlamydomonas is papillate. At anterior end at right angles of the flagella are two contractile vacuoles. They help in excretion and respiration of the plant. Towards this end on one lateral side is an eye spot or stigma which is reddish or brownish red in colour due to a pigment harmatochrone. This eye spot is sensitive to light. Each cell has a basin shaped or up shaped chloroplast on posterior regions. There is single pyrenoid towards the base of chloroplast. Starch is formed around the pyrenoid. Nucleus lies in the centre of cell.In nutrition cells of chlamydomonas are autotrophic due to the presence of chloroplasts water and inorganic salts are absorbed over whole surface of the cell.

1. INTRODUCTION

Chlamydomonas is the name given to a genus of microscopic, unicellular green plants (algae) which live in fresh water. Typically their single-cell body is approximately spherical, about 0.02 mm across, with a cell wall surrounding the cytoplasm and a central nucleus. Two filaments of cytoplasm, flagella, (sing. flagellum), extend from one end, and their whip-like lashings pull the chlamydomonas through the water and rotate it at the same time. A single, cup-shaped chloroplast occupies the greater part of the cell. In this chloroplast is a protein region called a pyrenoid, which is involved in starch production and is often surrounded by starch granules. A region of cytoplasm near the origin of the flagella is sensitive to light, and associated with this is a red pigment spot whose shadow when cast on the sensitive area is thought to cause turning movements of the chlamydomonas and so bring it into the region where the intensity of the light is most suitable for it.In this anterior region are seen two spherical vacuoles which swell and collapse alternately. These contractile vacuoles are concerned with the expulsion of excess water absorbed by osmosis.

1.2. Nutrition

Chlamydomonas makes its food in the same way as green plants, but without the elaborate system of roots, stem and leaves of the higher plants. It is surrounded by water containing dissolved carbon dioxide and salts so that in the light, with the aid of its chloroplast, it can build up starch by photosynthesis. From this carbohydrate, with additional elements, it can synthesize all the other materials necessary for its existence.

1.3. Gaseous exchange

No special breathing organs are present; the oxygen needed for respiration diffuses in from the water through the entire surface of the cell. Similarly, carbon dioxide diffuses in during photosynthesis. In favourable conditions the chlamydomonas individuals will continue to grow and then, at a certain size, reproduce by cell division. The flagella are withdrawn, the cytoplasm shrinks slightly within the cell wall, the nucleus and then the cytoplasm divide once, twice, or occasionally three times, to give two, four or eight separate units of cytoplasm each with a nucleus and chloroplast. Each of these units forms a new cell wall and a pair of flagella. The parent cell wall bursts open and releases the daughter individuals. This fission may occur once a day, so that great numbers of Chlamydomonas may appear very rapidly, when they usually make the water look green. Sexual reproduction, of a kind, occurs. Division as described above takes place but produces up to sixteen new individuals which do not develop cell walls. On release from the parental cell they swim about and may meet other individuals and fuse in pairs to form a zygote. The zygote eventually rounds off, withdraws the flagella, and secretes a thick wall round the cytotoplasm so forming a zygospore which sinks to the bottom of the pond. In this form it may be resistant to extremes of temperature and survive even the drying up of the pond. As a zygospore, too, it may be distributed in dust or mud, and so reach new situations. The cytoplasm in the zygospore will divide, usually into four units, which are released as new chlamydomonas individuals.

2. MICROSCOPIC EXAMINATION AND MEASUREMENT OF FLAGELLA

Motile *Chlamydomonas* can be induced to shed their flagella or flagella can be removed mechanically. Provided the cells themselves and the basal bodies on which flagella are constructed are not damaged, they re-grow flagella following such amputation. By using agents with very specific known actions to interfere with cellular processes, we can learn how cells initiate flagella growth, control the rate of growth, and establish a terminal length. Such information can then be extended to microtubule systems in more complex organisms. A means of measuring flagellar growth is necessary. Since fairly uniform cultures can be prepared, one way of assessing growth is to take samples at specific time intervals, to preserve the cells in the exact condition they were at the time sampled, and to measure the length of their flagella using a light microscope. To stop the cells from continuing to grow flagella during the measurement (scoring) process, samples of cells should be killed and "fixed." Effective fixatives preserve structures at the microscopic level by cross-linking proteins, allowing one to make observations at a fairly leisurely pace. Unfortunately, flagella become brittle and begin breaking off a few minutes after fixing cells, thus observations on flagella must be made rather promptly.

The pigmentation and motion of living *Chlamydomonas* allow them to be spotted in a bright field microscope. At low power in bright field one simply focuses on the moving green objects, then moves up in magnification. They move so fast, though, that with higher magnifications it is necessary to find a cell that is stuck to a surface. Both living and fixed Chlamydomonas are much easier to find and observe if contrast is enhanced using phase contrast or dark field microscopy. Nonmotile cells settle to the bottom of a culture tube, so the tube should be agitated before sampling fixed cells. One small drop of culture should be sufficient for preparation of a wet mount, with or without vaseline. A recommended procedure is to set up the microscope for low magnification (e.g., 100 xs) in phase contrast or dark field mode, whichever is available. Focus on the edge of an air bubble or visible piece of debris that is definitely between slide and coverslip. It is essential at this point to be aware of what a 10 micrometer diameter object looks like at 100x (quite small). Cells will appear as out of focus circles, ghostly in appearance. As with any specimen, the image becomes smaller and color more intense as it comes into focus. With one or more cells centered in a field at 100x, the magnification should be increased to high dry mode (e.g., 400x) in either dark field or phase contrast. Cells can be distinguished by their size, shape, color, and presence of organelles. Flagella, if present, can then be measured using a calibrated ocular micrometer scale.

3. REPRODUCTION

It takes place either by asexual or sexual method.

3.1. Asexual reproduction

3.1.1. by Zoospore formation

This type of reproduction occurs in favourable conditions. Active cells of organism comes to rest, the flagella re withdrawn, and the ell contents divide into four, eight or sixteen parts, which become zoospore. These daughter individuals develop their individual cell wall and flagella. The parent cell wall is lost and the new individuals attain independent existence. They grow and develop into new chlamydomonas.

3.1.2. Palmella stage

Under favourable conditions the pond becomes dry. Zoospores remain enclosed within the parent cell wall, it grows in size and divides and large number of zoospores without flagella may be found in clusters inside an envelope of mucilage. This aggregation of cells is called palmella stage. On approach of favourable condition cell change to motile condition.

3.2. Sexual Reproduction

It takes place by fusion of gametes and is isogamous. Inchlamydomonas sexual reproduction is variable from isogamy to anisogamy and oogamy. Some species are monoecious and others are diocious. In clamydomonas media and C debaryana the sexual reproduction is isogamous. In this case contents of cell divide to form 2 to 64 biflagellate gametes (like zoospores). Gametes may be naked or may have a cell wall. These are identical in shape and size and are called isogametes. They unite in pairs from their anterior end and form quadric-flagellate zygospore. It then loses cilia and becomes rounded. In chlamydomonas braumi sexual reproduction is of amisogamous type. One cell divides twice to form four big biflagellate gametes (female gametes) and other cells divide 3 to 4 times to form 8 or 16 small biflagellate gametes (male gametes). In this way gametes of different sizes are formed one big and one small gamete unit together which result in the formation of zygospore. In chlamydomonas coccifera and Coogamum the sexual reproduction is of oogamous type. In male cell produces 16 or 32 small biflagellate male gamete and the female are produced singly non motile female gamete. Male and female gamete fuse together to form zygote.

3.2.1. Germination of Zygote

Zoospore of zygote is formed by fusion of gametes. When favourable conditions come, the zygote nucleus which is diploid (2n) divides by meiotic (reduction) division and then divides mitotically to form four zoospores which are biflagellate and contain haploid nucleus. They come out by the burting of zygote wall and develop into new individuals.

4. CONCLUSION

The most widely used laboratory species is Chlamydomonas reinhardtii, which can grow on a simple medium of inorganic salts, using light to provide energy. They can also grow in total darkness if an alternative carbon source, such as acetate, is provided. When deprived of nitrogenous compounds, haploid cells of opposite mating types (usually referred to as "plus" and "minus" usually fuse to form a diploid zygospore which forms a hard outer wall that protects it from adverse environmental conditions. When conditions improve (or when the scientist restores nitrogenous compunds to the culture medium and provides light and water), the diploid zygote undergoes meiosis and releases four haploid cells which then resume the vegetative life cycle.

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