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B.Sc HONS Part-III Paper - VI
Topic :- Structure and function of Mitochondria
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Structure and function of Mitochondria.

Introductions :

The mitochondria are thread like or granular cytoplasmic organelles (Gr. mito = thread, Chordrion granule). They contain many enzymes and coenzymes which are responsible for energy metabolism. They are described as the power plants of cells.

History :

The mitochondria were first observed by FLEMMING and KOLLIKER in 1882. These organoids were first called bioblasts ALTMANN. Later the term mitochondria was introduced by BENDA in 1898.

Occurence :

Mitochondria are found both in plants and animal cells. But they are absent from prokaryotes.

Shape :

The mitochondria may be filamentous or granular in shape. The shape of mitochondria may change from one to another depending upon the physiological conditions of the cell. They may be rod shaped, club shaped, ring shaped, rounded or vesicular.

Size :

The size of mitochondria is highly variable. In most cells their length varies from 3 to 10 microns and their width from 0·2 to 1·0 micron. The smallest mitochondrion is seen in yeast where it measures about 1 micron. The largest mitochondria are found in the ocytes of amphiba, with the length of 20 + 50 micron.

Number :

The number is particularly related to the function state of the cell. If the metabolic activity in which the number of mitochondria is also high. A small number indicates cells of low metabolic activity. Thus they are found to be more abundant in liver and kideney cells. The giant Amoeba (chaoschaos) contains 50,000 mitochondria whereas egg of sea ucrhin contains 1,40,000 to 1,50,000.

Distribution :

In most cells, the mitochondria are distributed uniformly throughout the cytoplasm. But in some cases they are aggregated around the nucleus. In paramecium they are located just beneath the surface of cells. In the cells of kidney tubules, they occur in the folds of basal regions near plasma membrane. In neurons they are located in the transmitting region of impulse. During cell division, they are concentrated around the spindle. Generally they are concentrated in the region of higher activity.

Structure : The ultra structure of the mitochondria has been studied with help of electron microscope.

The mitochondria are covered by two unit membranes, namely an outer and an inner mitochondrial membrane, each measuring about 60Å in thickness. The two membranes are separated by a space of 80 to 100Å. The space between the outer and inner mitochondrial membrane is called outer chamber. This chamber is filled with a fluid of low viscosity and density. The central space of the mitochodria is called the inner chamber. The inner chamber is filled with mitochondrial matrix. The matrix may contain filamentous material or dense granules. The inner mitochondrial membrane gives out certain finger like projections known as crystal.

Mitochondrial Particles :

The electron microscope has revealed the presence of very small particles adhered to the outside of outer membrane and inside of the inner membrane. These particles are called elementary particles. The particle of the outer membrane are stalkless. The particles of the inner membrane are stalked. Each stalked particle consists of a base piece, a stem and a head, regularly placed at a distance of 100Å.

Chemical composition : The mitochondria are found to contain 65 to 75% protein, 25 to 30 % lipid, 05 % RNA and small amount of the DNA. The lipid part of mitochondria is composed of 90% Pospho lipid, 5% Cholesterol and 5% free fatty acids. Small amount of sulphur, iron, copper and some vitamins are present. There are more than 70 enzymes and co-enzymes in mitochondria. These enzymes are distributed in the matrix and in the membrane.

Mitochondrial DNA :

Mitochondria contain one or more DNA called mitochondrial DNA or *m*-DNA. It is circular in shape. It is double stranded.

It can self replicate. It can also produce DNA like that of nuclear DNA.

Origin of mitocondria :

The following hypotheses have been postulated for the origin of mitochondria.

1. Division of pre-existing mitochondria : The new mitochondria originate by the division of the preexisting mitochondria become elongated and broken into small pieces. Each piece forms a new mitochondrion in later stages.

2. Orgin from the E. R. or plasma membrane : The mitochondria may be formed from the growth and influx of membranes from the plasma mebrane as well as from the endoplasmic reticulum.

3. De Novo Origin : The mitochondria may be synthesized from non-mitochondrial fragments. But there is no direct evidence for this hypothesis.

4. Prokaryotic origin : According to ALTMANN and SCHIMPER (1890) the mitochondria might have originated from prokaryotic cells like bacteria. The bacteria entered the cells as parasites. In the cause of time they maintained a symbiotic relationship with the eukaryotic cells. They form the mitochondria.

Functions :

The main function of mitochondria is oxidation of food stuffs. The energy related during oxidation is used by the mitochondria for the synthesis of energy rich compound, ATP. As mitochondria generate energy, they are called the Power house of the cell. The following are the important functions of mitochondria.

1. Oxidative decarboxylation.
2. Krebs Cycle.
3. Electron transport system.
4. Oxidative phosphorylation.
5. Synthesis of myofibrils.
6. Secretion.