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Topic: Mitochondria

Mitochondria

- ✚ **Mitochondria** are referred as “**Power house**” or “**Biochemical machine**” of cells.
- ✚ First recognized by **Kolliker** (1850).
- ✚ Name ‘Fila’ was give by Flemming (1882).
- ✚ Term ‘Bioplast’ coined by Altman (1890).
- ✚ The present named was coined by Benda (1898).
- ✚ Dimension of Mitochondria 3μ to 7μ x 0.5μ size (l x w)

Structures:-

- ✚ Mitochondria are double membranous structures enclosing an inner matrix.
- ✚ An outer & inner membranes separated by a space of 60A° to 70A°
- ✚ Each membrane is about 60 to 70A° , lipoproteinous & has organization similar to biological membranes.

- + The outer membrane is quite smooth & has many copies of a transport protein called PORIN, which forms large aqueous channels through the lipid bilayer.
- + It bears pits & pores of 25Å to 30Å and has a protein lipid ratio of 0.8. It is permeable for medium sized molecules and ions.
- + The inner membrane has a protein/ lipid = 0.3
- + It is permeable for only smaller molecules and not for ions and forming series of in folding CRISTAE.
- + It contains the components of ETS and Oxidative phosphorylation.
- + Outer chamber between two membranes and filled with a fluid rich in coenzymes.
- + Inner chamber or central chamber surrounded by inner membrane and filled with a granular matrix.

MATRIX:-

- + Matrix contains more than 75 types of enzymes, circular DNA molecules, 55s ribosome and certain granules.
- + The inner membrane has an outer cytosol or c- face toward the perimitochondrial space and an inner matrix or M-face toward matrix.
- + **CRISTAE**- it's no increases with activity of the cell.
- + Attached to M-face of inner mitochondrial membrane are repeated units of stalked particles called elementary particles, inner membrane subunits or oxysomes.
- + They are also identified as F0 and F1 particles at every 100Å on cresty about 10^4 to 10^5 .

✚ Each particle has following 3 components.

- I. Head or F1 ATPase- circular, 80\AA to 100\AA dia, and contains soluble ATPase.
- II. Stalk or Fs- $50\text{\AA} \times 40\text{\AA}$, containing oligo mycin sensitivity conferring proteins (OSCP).
- III. Base or Fb – cuboids, $100\text{\AA} \times 40\text{\AA}$ embedded in the inner membrane and contains hydrophobic proteins.

✚ These particles serve as proton channels and are the sites for ATP synthesis.

FUNCTIONS:-

- I. Production of Energy.
- II. It synthesizes about 20 structural proteins .
- III. It also synthesizes glycogen and yolk.
- IV. It accumulates ions like Cu^{2+} PO_4 etc.
- V. It serves as store for carcinogenic hydrocarbons . natural fats and other lipids vitamin A,C and E.
- VI. Urea synthesis in mammals occurs partly in mitochondria.
- VII. Chytochrome 450 present in mitochondria is involved in the synthesis of steroids in Adrenal cortex.
- VIII. Mitochondria in liver are associated with the formation of ketone bodies from excess of Acetyl coA.
- IX. The enzymes present in the outer membrane are involved in degradation of Adrenaline serotonin, and Tryptophan, metabolism of phospholipids, elongation of C_{14} and C_{16} fatty acids etc.

X. They form the spiral sheath of sperm.

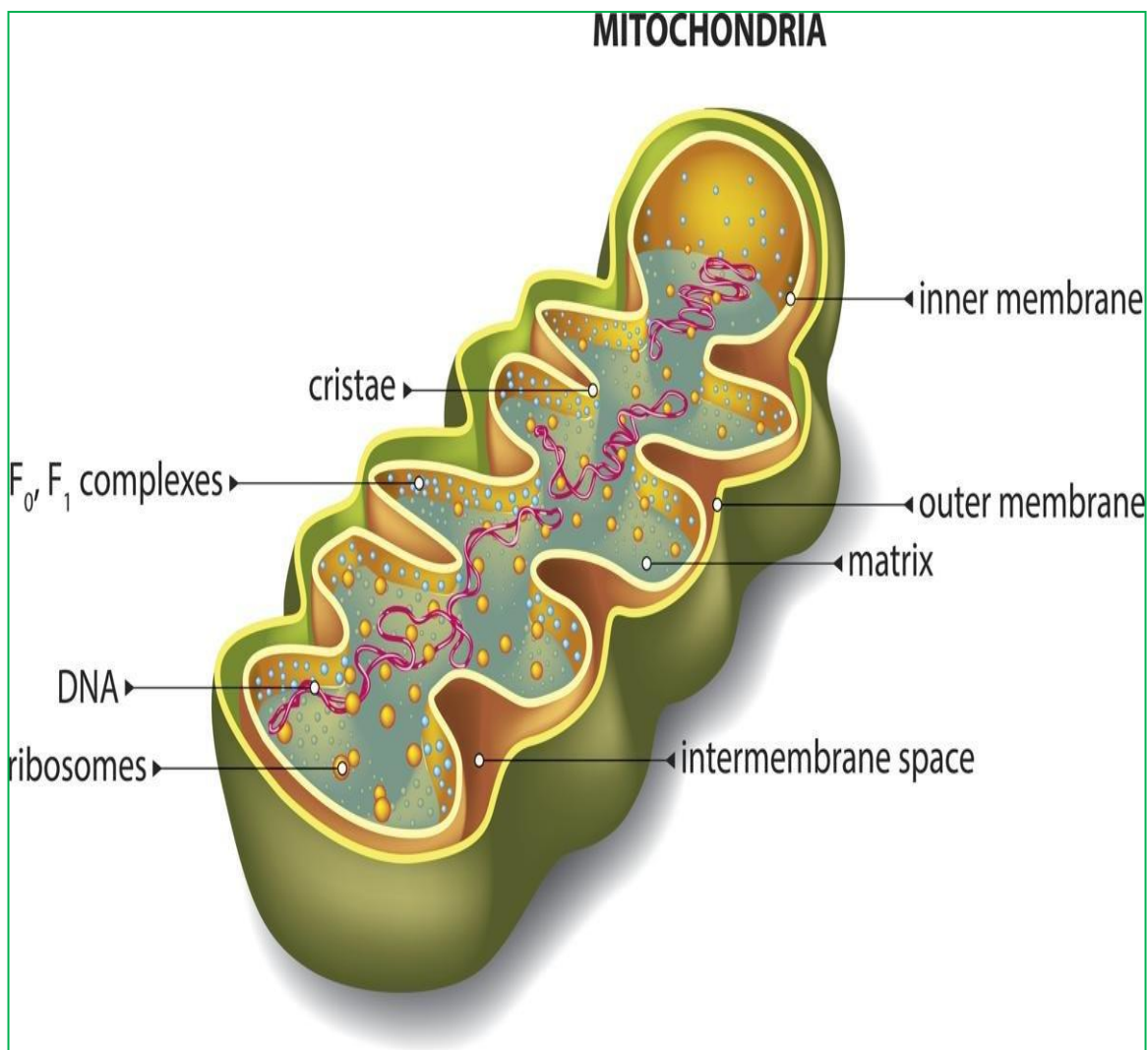


Fig :- Mitochondria

Chemical composition :

- ✚ 65 to 70 % Proteins , 25 to 30% Lipids, 0.5% RNA and small amount of ribosomes.
- ✚ Lipids – 95% phospholipids (lecithin & cephalin)
- ✚ 5% or less cholesterol and 5% free fatty acid and triglycerides.

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- ✚ Inner membrane- rich in phospholipids, called cardiolipins.
- ✚ Cardiolipins makes this membrane impermeable to a variety of ions and small molecules (Na^+ K^+ , Cl^- Na^+ AMP,GTP & CoA etc)
- ✚ **Outer membrane-** typical ratio of protein and phospholipids 50% / 50%.
- ✚ However it contains more unsaturated fatty acids and less cholesterol in mitochondria of liver
 - 67% protein- matrix
 - 21% inner membrane
 - 6% outer membrane
 - 6% outer chamber.
- ✚ Enzymes of outer membrane – enzymes involved in mitochondrial lipid synthesis .
- ✚ Enzymes of inter membrane space – enzymes that use the ATP molecules passing out of the matrix to phosphorylate other nucleotides.
- ✚ Enzymes of mitochondrial matrix- required for the oxidation of pyruvate and fatty acids for citric acid cycle.

Biogenesis of mitochondria :

Hypothesis –

- ✚ “De novo” origin.
- ✚ Origin from ER or P.M. – Morrison(1966).
- ✚ Origin by division of pre- existing mitochondria .No increase during interphase.
- ✚ Organelle division begins by an inward furrowing of the inner membrane as occur in cell division in many bacteria. After elongating one or more

centrally located cristae from a partition by growing across the matrix and fusing with the opposite inner membrane.

- ✚ This separates the matrix into two compartments . The outer membrane then invaginates at the partition plane constricting until there is membrane fusion between the two inner membrane walls. Thus two separable daughter mitochondria are formed.