IKUOMOLA ESTHER OLAMIBRUN
18/MHS06/029
General Microbiology / Microbial Metabolism : MCB 202
Medical Laboratory Science

Describe the mechanism of aerobic Respiration.

Aerobic Respiration is an enzymatically controlled release of energy in a stepwise catabolic process of complete oxidation of organic food into carbon-dioxide and water with oxygen acting as terminal oxidant.

The common aerobic respiration consist of three steps - glycolysis, Krebs cycle and terminal oxidation.

(1) Glycolysis :

also called (EMP) Embden-meyerhof-parnas pathway) which does not require O_2 although it can take place in the presence of oxygen. Glycolysis is the process of breakdown of glucose or similar hexose sugar to molecules of pyruvic acid through a series of enzymes mediated reactions releasing some energy (as ATP) and reducing power (as $NADH_2$).

Glycolysis occur in the cytoplasm.

Step involved in Glycolysis

1) Phosphorylation - Glucose — Glucose-6-phosphate (Hexokinase)
(2) Isomerization - Glucose-6-phosphate - fructose-6-phosphate
(3) Phosphorylation : fructose 6-phosphate - ~~phospho~~ fructose 1-6 disphosphate
(4) Splitting : fructose 1-6-disphosphate - Glyceraldehyde 3 phosphate
(5) Dehydrogenation and Phosphorylation : 1,3-diphosphoglyceric acid
(6) formation of ATP : 3-phosphoglyceric acid
(7) Isomerization : isomer 2- phosphoglyceric acid
(8) Dehydration : Phosphoenol pyruvate
(9) formation of ATP : Pyruvate
(10) total (Net) Product of Glycolysis =

2ATP = 4ATP

$$Glucose + 2NAD^+ + 2ADP + 2H_3PO_4 + 2H_3PO_4 \rightarrow 2 \text{ Pyruvate} + 2NADH + 2H^+ + 2ATP$$

Krebs - cycle : This process occurs in Mitochondria, also called Citric acid cycle ; Krebs cycle is stepwise oxidative and cyclic degration of activated acetate derived from pyruvate

- oxidation of Pyruvate

Pyruvate $\xrightarrow{\text{Enters}}$ Mitochondria — It is decarboxylated oxidatively to produce CO_2 and NADH, the product combines with Sulphur Containing Coenzyme A to form Acetyl CoA (This occurs in the presence of an enzyme Complex pyruvate dehydrogenase, Lipoic acid, TPP, transacetylase and Mg^{2+}).

Component of krebs cycle

(1) Condensation - Acetyl CoA + Oxalo acetate = tricarboxylic & Coa
enzyme : citrate synthetase

(2) Dehydration : Citrate $\xrightarrow[\text{synthetase}]{\text{Aconitase}}$ cis - aconitate + H_2O

(3) Hydration cis - Aconitate + H_2O $\xrightarrow{\text{Aconitase}}$ Isocitrate

(4) Dehydrogenation : Isocitrate + NAD^+ $\xrightarrow[Mn^{2+}]{\text{Isocitrate dehydrogenase}}$ Oxalosuccinate + NADH + H^+.

(5) Decarboxylation : Oxalosuccinate $\xrightarrow{\text{Decarboxylase}}$ α - Ketoglutarate + CO_2

(6) Dehydrogenation and Decarboxylation →
α - Ketoglutarate + CoA + NAD^+ $\xrightarrow[\text{dehydrogenase (TPP, lipoic acid)}]{\alpha\text{ketoglutarate}}$ Succinyl CoA + NADH + H^+ + CO_2

(7) formation of ATP/GTP
Succinyl CoA + GDP/ADP + H_3PO_4 $\xrightarrow[\text{thiokinase}]{\text{Succinyl}}$ Succinate + CoA + GTP/ATP

(8) Dehydration
Succinate + FAD Succinate $\rightarrow$ Dehydrogenase, fumarate + $FADH_2$

(9) Hydration :
fumarate + H_2O $\xrightarrow{\text{fumarase}}$ malate

(10) Dehydration
Malate + NAD(P)$^+$ $\xrightarrow[\text{Dehydrogenase}]{\text{malate}}$ Oxaloacetate + NAD(P)H + H^+

Terminal oxidation

this process occur towards the end of Electron Process and involves the passage of both electrons and protons of reduced coenzymes to oxygen

$$FADH_2 \rightleftharpoons FAD + 2H^+ + 2e^-$$

$$\frac{1}{2}O_2 + 2H^+ + 2e^- \longrightarrow H_2O$$