UMEH EMEM EPHRAIM

17/mhs02/093

MLS

BCH204: Beta oxidation of fatty acids.

Assignment:

Describe the three stages of Beta Oxidation.

Beta oxidation is the pathway for metabolism of fatty acids. It begins from Beta carbon, third carbon & takes place in the mitochondria

Three stages of Beta oxidation

1) Activation of fatty acids.
2) Transport of fatty acid CoA into mitochondria
3) Beta oxidation.

Activation of fatty acids.

Long chain fatty acids: They are activated by ATP and co-enzyme A (Acyl-CoA synthase) to form fatty acyl-CoA. While short chain fatty acids are activated in mitochondria.

Eg

Palmitic acid —(ATP; AMP+PP; coenzyme A)→ Palmitoyl CoA

ATP is converted to Amp and pyrophosphate (PP) which is cleaved by pyrosphate to two inorganic phosphate (2Pi) Therefore two high energy phosphate bond are cleaved. So the equivalent of two molecules of ATP is used for fatty acid activation.

Transport of fatty acid CoA into mitochondria.

Fatty acyl-CoA from the outer membrane react with acting in the outer mitochondrial membrane forming "Fatty acylcantine" the enzyme used is carnitine acyltransferase I (ATI) Fatty acylcarnitine passes to the inner membrane where it reforms to fatty acyl-CoA which enters the matrix. The enzyme used is carnitine acyltransferase I (ATI)

Fatty acyl-CoA
↓ carnitine-acyltransferase I

Fatty acyl carnitine

↓ carnitine acyltransferase II

Fatty acyl-CoA in matrix of mitochondrion.

Also known as the carnitine shuttle system

Beta oxidation of fatty acids

Beta oxidation or Degradation consists of four sequential stages. Therefore, these stages are repeated until all carbons of fatty ~~acids~~ acyl-CoA are converted to acetyl CoA.

For even-chain fatty acids

1) FAD accepts hydrogens from a fatty acyl-CoA in the first step. A double bond is produced between the α & β carbine to form an enoyl CoA.

FAD H_2 produced interacts with electron transport chain generating ATP

Enzymes used: Acyl-CoA dehydrogenase.

2) β-Hydroxyacyl-CoA is oxidized by NAD^+ to β-Keto acyl-CoA. NADH produced interacts with electron transport chain to generate ATP.

Enzymes used: L-3-hydroxyacyl-CoA dehydrogenase.

For Odd chain fatty acids:

Beta oxidation of odd-chain fatty acids produce acetyl CoA & Propionyl-CoA.

As these fatty acids repeat the four steps of Beta oxidation producing Acetyl CoA until the last cleavage when the three remaining carbons are released as propionyle-CoA which can be converted to glucose.

For unsaturated fatty acids:

Beta oxidation of unsaturated fatty acids require enzymes in addition to the four that catalyze the repetitive steps of Beta-oxidation. The reaction pathway differs depending on whether the double bond is at an even or odd-numbered carbon position.

So, the Beta oxidation occurs until a double bond of the unsaturated fatty acids is near the carboxyl end of fatty acyl chain.

Overall reaction of Beta-Oxidation: Cn-acylCoA + FAD + NAD^+ + H_2O + CoA → Cn-2 acyl CoA + $FADH_2$ + NADH + H + acetyl CoA.