

BCH 204: Beta Oxidation Of fatty acids

Assignment:

Describe the three (3) stages of Beta Oxidation.

Beta Oxidation is the pathway for catabolism of fatty acids. It begins from Beta carbon, third carbon and takes place in the mitochondria.

Three stages of Beta Oxidation:

1) Activation of fatty acids.

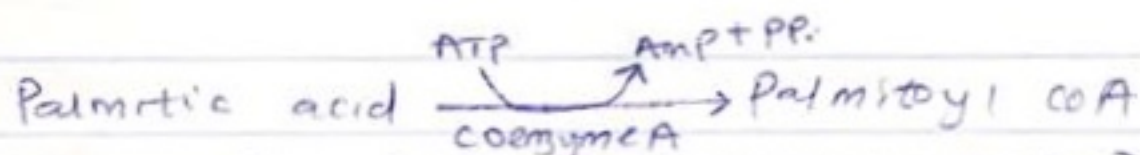
2) Transport of fatty acyl-CoA into mitochondria.

3) Beta Oxidation.

Activation of fatty acids

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

E.g



ATP is converted to AMP and pyrophosphate (PP_i) which is cleaved by Pyrophosphatase to two inorganic phosphates (2 P_i) therefore two high energy phosphate bonds are cleaved; so the equivalent of two molecules of ATP is used for fatty acid activation.

Activation of fatty acid takes place on the outer membrane of mitochondrion.

Transport of fatty acyl-CoA into Mitochondria.

Fatty acyl-CoA from the outer membrane react with carnitine in the outer mitochondrial membrane forming "Fatty acylcarnitine" the enzyme used is carnitine acyltransferase I (CAT I).

Fatty acyl carnitine passes to the inner membrane where it reforms to fatty acyl-CoA which enters the matrix. The enzyme used is carnitine acyltransferase II (CAT II).

fatty acyl-CoA.

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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 Degredation consists of four sequential stages. Therefore, these stages are repeated until all carbons of fatty 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 - and β -carbon to form an Enoyl CoA.

FADH₂ produced interacts with electron transport chain generating ATP.

Enzyme used: Acyl-CoA dehydrogenase.

2. β -Hydroxyacyl-CoA is oxidised by NAD⁺ to β -Ketoacyl-CoA. NADH produced interacts with electron transport chain to generate ATP.

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

For odd chain fatty acids.

Beta oxidation of odd-chain fatty acids produce acetyl CoA and 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 propionyl-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 acid is near the carboxyl end of fatty acyl chain.

Overall reaction of Beta-oxidation:

