

ME
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Medical Laboratory Science
BCH 204

Assignment

Describe the three (3) stages of beta oxidation
what is beta oxidation?

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

Three stages of Beta oxidation.

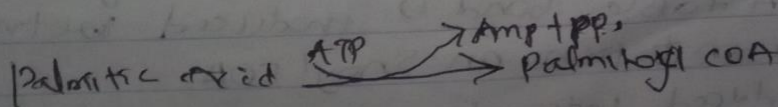
- 1) Activation of fatty acids
- 2) Transport of fatty acyl-CoA into mitochondria
- 3) Beta oxidation

Activation of fatty acids

Long chain fatty acids: They are activated by
atmospheric pressure (ATP) and coenzyme A (CoA
Synthase) to form fatty acyl-CoA, while short chain
fatty acids are activated in mitochondria

ATP is converted to Amp and Pyrophosphate
(PP_i) which is by Pyrophosphatase to two inorganic
phosphate ($2P_i$). Therefore 2 high energy phosphate bonds
are cleaved, so the equivalent of 2 molecules of ATP
is used for fatty acid activation

Activation of fatty acid, takes place in the out-
membrane of mitochondrion.



2. Transport of fatty acyl-CoA into mitochondria
Fatty acyl-CoA from the outer membrane reacts with carnitine on the outer mitochondrial membrane forming "fatty acylcarnitine" the fatty acyl 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

↓ Carnitine acyltransferase I

Fatty acyl carnitine

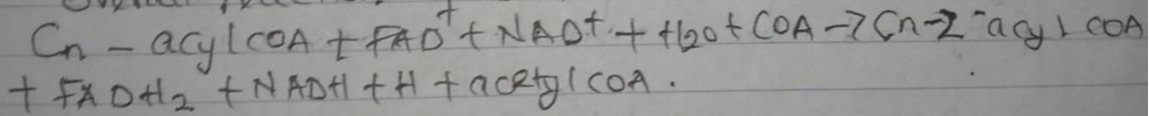
↓ Carnitine acyltransferase II

Fatty acyl-CoA in matrix of mitochondrion.

Which is also known as the carnitine shuttle system.

• Beta oxidation of fatty acid.

Overall reaction of beta oxidation



Beta oxidation or "Degradation" consists of 4 sequential stages, therefore these stages are repeated until all carbons of fatty acyl-CoA are converted to acetyl-CoA

Even chain fatty acids.

→ FAD accepts hydrogen 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 interaction with electron transport chain generating ATP

Enzyme used: Acyl-CoA dehydrogenase.

2. β -Hydroxyacyl-CoA is oxidized by NAD⁺ to β -ketoacyl-CoA

NADH produced interacts with electron transport chain to generate ATP.

~~Enzyme used: Acyl-CoA dehydrogenase~~

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 4 steps of beta oxidation producing acetyl-CoA until the last cleavage when the 3 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 4 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.

