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DEPT: ANATOMY

COURSE: BCH204

**ASSIGNMENT:** Describe the three (3) stages of beta oxidation (showing pathways where necessary)

**ANSWER:**

Beta-oxidation is the catabolic process by which fatty acid molecules are broken down in the cytosol in prokaryotes and in the mitochondria in eukaryotes to generate acetyl coA which enters the citric acid cycle and NADH and FADH2which are co-enzymes used in the electron transport chain. It is named as such because the beta carbon of the fatty acid undergoes oxidation to a carbonyl group. Beta-oxidation is primarily facilitated by the mitochondrial trifunctional protein, an enzyme complex associated with the inner mitochondria membrane, although very long chain fatty acids are oxidized in peroxisomes The overall reaction for one cycle of beta oxidation is:

C*n*-acyl-CoA + FAD + NAD+
+ H
2O + CoA → C*n*-2-acyl-CoA + FADH
2 + NADH + H+
+ acetyl-CoA

 Beta oxidation of fatty acids resulting in cleavage of two-carbon units (α and β carbons) from the carboxyl end of fatty acyl-CoA with the formation of acetyl CoA. This reaction keeps occurring till the entire fatty acyl chain is broken down to acetyl CoA molecules. For eg. Palmitoyl CoA (16 carbon chain) on β-oxidation will give eight acetyl CoA molecules. It is further discussed in detail below.

* The acetyl groups produced from β-oxidation of the fatty acid participate in the [Kreb’s cycle](https://pharmaxchange.info/2013/09/krebs-cycle-citric-acid-cycle-tricarboxylic-acid-cycle-animation/) resulting in the formation of NADH and FADH2.
* The reduced coenzymes (NADH and FADH2) are oxidized by giving up the protons and electrons to oxygen present in the mitochondria to synthesize ATP by oxidative phosphorylation in the Electron Transport System.

**The three stages of beta oxidation are;**

1. Activation of fatty acids
2. Transportation of fatty acids
3. Oxidation or dehydration of fatty acids
	1. **Activation of fatty acids; fatty acids ↔fatty acyl coa:** fatty acids are activated by reaction with CoA to form fatty acylCoA. The reaction normally occurs in the endoplasmic reticulum or the outer mitochondrial membrane. This is an ATP-requiring reaction, yielding AMP and pyrophosphate (PPi). different enzymes are specific for fatty acids of different chain length.

 the first step in utilizing the fatty acid molecule for energy producing is the conversion of the fatty acid to a coA molecule in a two-step;

R-C̎o-OH+ATP+CoASH→R-C-SCoA+AMP+PPi

Note that the hydrolysis of two high energy phosphate bonds in ATP provides the energy source for the reaction. The inorganic pyrophosphate PPi is subsequently broken down to two phosphate ions by inorganic pyrophosphate. The action of this enzyme means very little PPi remains in the cell, making the synthesis of the fatty acyl-coA favored. This is an example of metabolic coupling the process whereby a thermodynamically unfavored reaction is allowed because it shares an intermediate (in this case PPi) with a favored one.

* 1. **Transportation of fatty acids:** the fatty acyl group is transported into the mitochondria matrix, where it undergoes beta-oxidation. In the intermembrane space of the mitochondria, fatty acyl CoA reacts with carnitine in a reaction catalyzed by carnitine acyltransferase I(CAT-1), yielding CoA and fatty acyl carnitine. Lipolysis, the removal of the fatty acid chains from the glycerol to which they are bound in their stages form as triglycerides is carried out by lipases. Once freed from glycerol, the fatty acids enter the blood which transports them attached to plasma albumin through the body.

**OXIDATION OR DEHYDRATION OF FATTY ACIDS:** a **dehydration reaction** is a conversion that involves the loss of [water](https://en.wikipedia.org/wiki/Water) from the reacting molecule or ion. Dehydration reactions are common processes, the reverse of a [hydration reaction](https://en.wikipedia.org/wiki/Hydration_reaction). Common dehydrating agents used in organic synthesis include [sulfuric acid](https://en.wikipedia.org/wiki/Sulfuric_acid) and [alumina](https://en.wikipedia.org/wiki/Alumina). Often dehydration reactions are effected with heating he classic example of a dehydration reaction is the [Fischer esterification](https://en.wikipedia.org/wiki/Fischer_esterification), which involves treating a carboxylic acid with an alcohol in the presence of a dehydrating agent:

RCO2H + R′OH ⇌ RCO2R′ + H2O

Two [monosaccharides](https://en.wikipedia.org/wiki/Monosaccharide), such as [glucose](https://en.wikipedia.org/wiki/Glucose) and [fructose](https://en.wikipedia.org/wiki/Fructose), can be joined together (to form [sucrose](https://en.wikipedia.org/wiki/Sucrose)) using dehydration synthesis. The new molecule, consisting of two monosaccharides, is called a [disaccharide](https://en.wikipedia.org/wiki/Disaccharide).

The process of [hydrolysis](https://en.wikipedia.org/wiki/Hydrolysis) is the reverse reaction, meaning that the water is recombined with the two hydroxyl groups and the disaccharide reverts to being monosaccharides.

In the related [condensation reaction](https://en.wikipedia.org/wiki/Condensation_reaction) water is released from two different reactants.

In [organic synthesis](https://en.wikipedia.org/wiki/Organic_synthesis), there are many examples of dehydration reaction, for example dehydration of alcohols or sugars.

examples of dehydration synthesis reactions are the formation of triglycerides from fatty acids and the formation of glyosidic bonds between carbohydrate molecules, such as the formation of maltose from two glucose molecules.

