

NAME: COUTROUPIS ELIZABETH
MATRIC NUMBER: 18/MHS07/013
COURSE: BCH 204
DEPARTMENT: PHARMACOLOGY

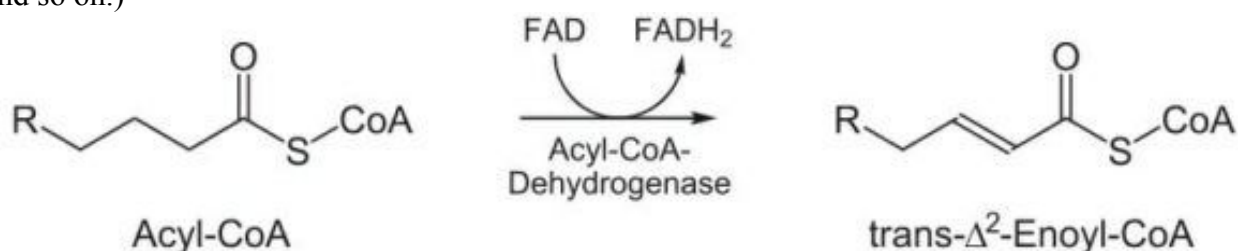
Beta oxidation is a metabolic process involving multiple steps by which fatty acid molecules are broken down to produce energy. More specifically, beta oxidation consists in breaking down long fatty acids that have been converted to acyl-CoA chains into progressively smaller fatty acyl-CoA chains. This reaction releases acetyl-CoA, FADH₂ and NADH, the three of which then enter another metabolic process called *citric acid cycle* or *Krebs cycle*, in which ATP is produced to be used as energy. Beta oxidation goes on until two acetyl-CoA molecules are produced and the acyl-CoA chain has been completely broken down. In eukaryotic cells, beta oxidation takes place in the mitochondria, whereas in prokaryotic cells, it happens in the cytosol.

Beta oxidation takes place in four steps: dehydrogenation, hydration, oxidation and thiolysis. Each step is catalyzed by a distinct enzyme.

Briefly, each cycle of this process begins with an acyl-CoA chain and ends with one acetyl-CoA, one FADH₂, one NADH and water, and the acyl-CoA chain becomes two carbons shorter. The total energy yield per cycle is 17 ATP molecules (see below for details on the breakdown). This cycle is repeated until two acetyl-CoA molecules are formed as opposed to one acyl-CoA and one acetyl-CoA. The four steps of beta oxidation are described below and can be seen in the links to the figures at the end of each explanation.

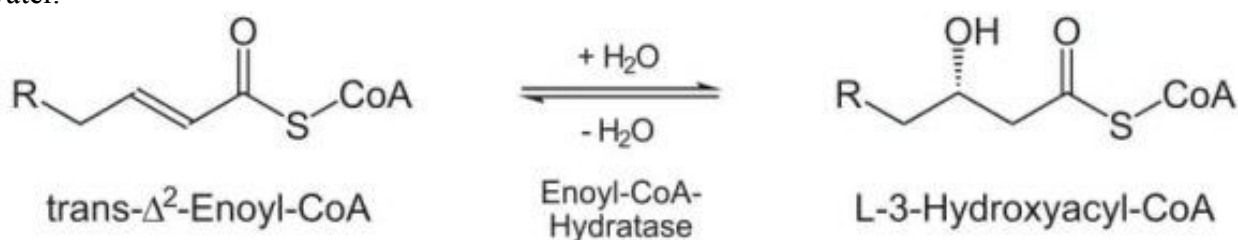
Dehydrogenation

In the first step, acyl-CoA is oxidized by the enzyme acyl CoA dehydrogenase. A double bond is formed between the second and third carbons (C2 and C3) of the acyl-CoA chain entering the beta oxidation cycle; the end product of this reaction is trans- Δ^2 -enoyl-CoA (trans-delta 2-enoyl CoA). This step uses FAD and produces FADH₂, which will enter the citric acid cycle and form ATP to be used as energy. (Notice in the following figure that the carbon count starts on the right side: the rightmost carbon below the oxygen atom is C1, then C2 on the left forming a double bond with C3, and so on.)



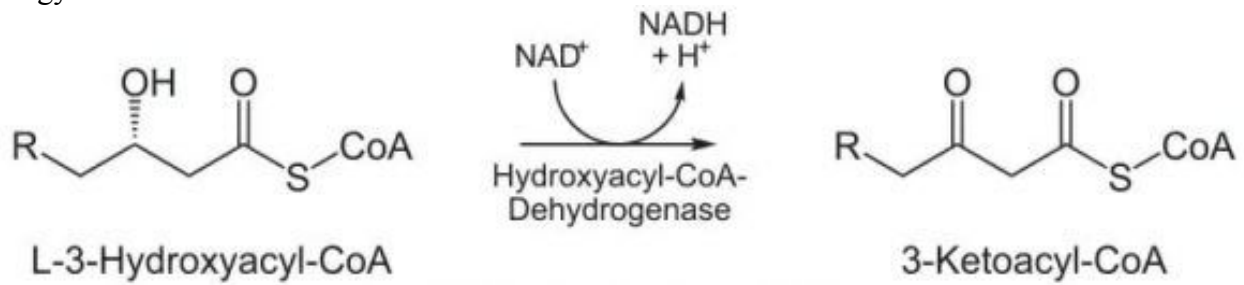
Hydration

In the second step, the double bond between C2 and C3 of trans- Δ^2 -enoyl-CoA is hydrated, forming the end product L- β -hydroxyacyl CoA, which has a hydroxyl group (OH) in C2, in place of the double bond. This reaction is catalyzed by another enzyme: enoyl CoA hydratase. This step requires water.



Oxidation

In the third step, the hydroxyl group in C2 of L-β-hydroxyacyl CoA is oxidized by NAD⁺ in a reaction that is catalyzed by 3-hydroxyacyl-CoA dehydrogenase. The end products are β-ketoacyl CoA and NADH + H. NADH will enter the citric acid cycle and produce ATP that will be used as energy.



Thiolysis

Finally, in the fourth step, β-ketoacyl CoA is cleaved by a thiol group (SH) of another CoA molecule (molecule CoA-SH). The enzyme that catalyzes this reaction is β-ketothiolase. The cleavage takes place between C2 and C3; therefore, the end products are an acetyl-CoA molecule with the original two first carbons (C1 and C2), and an acyl-CoA chain two carbons shorter than the original acyl-CoA chain that entered the beta oxidation cycle.

