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Oxidation of Beta Carbon in a Carboxylic Acid to Generate Adenosine Triphosphate

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DESCRIPTION

Beta oxidation is a metabolic process in which fatty acid molecules are broken down to produce energy in many phases. Beta oxidation, in further detail it is the process of breaking down long fatty acids that has converted to acyl-CoA chains into smaller fatty acyl-CoA chains. This reaction produces the elements acetyl-CoA, $FADH_2$, and NADH, all of which enter the citric acid cycle, also known as the Krebs cycle, where ATP is created as energy (Williams et al., 2018). The acyl-CoA chain is entirely broken down when two acetyl-CoA molecules are created through beta oxidation. Beta oxidation occurs in the mitochondria of eukaryotic cells, but not in the cytoplasm of prokaryotic cells.

Fatty acids must first enter the cell through the cell membrane, then bond to coenzyme A (CoA) to create fatty acyl CoA, which is subsequently transported to the mitochondria, where beta oxidation occurs in eukaryotic cells (Naquet et al., 2020).

Eukaryotic cells mitochondria and prokaryotic cells cytosols both undergo beta oxidation. Fatty acids must first enter the cell in case of eukaryotic cells. Beta oxidation can also occur in peroxisomes when fatty acid chains are too lengthy to enter the mitochondria (Islinger et al., 2018).

First, fatty acid protein transporters allow fatty acids to penetrate the cell membrane and enter the cytoplasm, which is otherwise impossible due to the negatively charged fatty acid chains. The enzyme fatty acyl-CoA synthase then converts the fatty acid chain to acyl-CoA by adding a CoA group to it.

The acyl-CoA chain will enter the mitochondria in one of two routes, depending on its length:

1. The acyl-CoA chain can freely diffuse through the mitochondrial membrane if it is short.

2. The carnitine shuttle must transfer the acyl-CoA chain across the membrane if it is more lengthy. The enzyme Carnitine Palmitoyltransferase 1 (CPT1), which is located on the outer mitochondrial membrane, transforms the acyl-CoA chain into an acylcarnitine chain, which is transferred across the membrane by Carnitine Translocase (CAT). CPT2, which is linked to the inner mitochondrial membrane, transforms acylcarnitine to acyl-CoA once within the mitochondria because acyl-CoA is inside mitochondria, it can undergo beta oxidation.

If the acyl-CoA chain is too lengthy to be digested in the mitochondria, it will be broken down in the peroxisomes by beta oxidation. According to research, very long acyl-CoA chains are broken down until they are 8 carbons long, after which they are delivered to the mitochondria and start the beta oxidation cycle instead of $FADH_2$ and NADH, beta oxidation in the peroxisomes produces H_2O_2 , which produces heat.

Beta oxidation steps

Dehydrogenation, hydration, oxidation, and thyolisis are the four processes of beta oxidation. A different enzyme catalyzes each step.

Each cycle of this process starts with an acyl-

CoA chain and finishes with one acetyl-CoA, one $FADH_2$, one NADH, and water, with the acyl-CoA chain shrinking by two carbons. Each cycle yields 17 ATP molecules in total energy (Anderson et al., 2017). This cycle is repeated until two acetyl-CoA molecules, formed as opposite to one acyl-CoA and one acetyl-CoA, are produced. The four steps of beta oxidation are outlined below.

Dehydrogenation: The enzyme acyl CoA dehydrogenase oxidizes acyl-CoA in the first phase. The acyl-CoA chain enters the beta oxidation cycle with a double bond created between the second and third carbons (C_2 and C_3); the end result of this reaction is trans-Δ^2-enoyl-CoA (trans-delta 2-enoyl CoA). This process employs FAD to make $FADH_2$, which enters the citric acid cycle to form ATP, which is then used as energy.

End of beta oxidation: After a four-carbon acyl-CoA chain is broken down into two acetyl-CoA units, each containing two carbon atoms, beta oxidation stops for even-numbered acyl-CoA chains. To produce ATP, acetyl-CoA molecules enter the citric acid cycle.

Beta oxidation proceeds in the way for odd-numbered acyl-CoA chains, with exception of final step: instead of a four-carbon acyl-CoA chain being broken down into two acetyl-CoA units, a five-carbon acyl-CoA chain is broken down into a three-carbon propionyl-CoA and a two-carbon acetyl-CoA unit. Propionyl-CoA is then converted to succinyl-CoA, which ultimately enters the citric acid cycle to create ATP (Borjian et al., 2017).

Energy yield and end products

Each beta oxidation cycle produces 1 $FADH_2$, 1 NADH, and 1 acetyl-CoA, which is equivalent to 17 ATP molecules in terms of energy:

- 2 ATP=1 FADH2 (x2 ATP).
- 3 ATP=1 NADH (x3 ATP).
- 12 ATP=1 acetyl-CoA (x12 ATP).
- 2+3+12=17 ATP total.

The theoretical ATP yield, on the other hand, is higher than the actual ATP yield. In actuality, each beta oxidation cycle produces the equivalent of 12-16 ATPs.

The fatty acyl-CoaA chain becomes two carbons shorter with each cycle, in addition to the energy yield. Furthermore, beta oxidation produces a large volume of water, which is advantageous for eukaryotic species like camels have limited access to drinkable water.

CONCLUSION

A series of studies was also funded by the NIH Common Fund to assess the ethical, legal and social aspects of microbiome research. While the findings of these studies have yet to be published, they have already raised a number of important questions, including how products designed to manipulate the microbiome such as probiotic concoctions that include live microorganisms believed to benefit the body should be regulated, as well as whether people should start thinking about storing their microbiome while they are still healthy.

REFERENCES

Anderson, K,A, Madsen, A,S, Olsen, C,A, and Hirschey, M,D. (2017). Metabolic control by sirtuins and other enzymes that sense NAD+, NADH, or their ratio. *Biochim Biophys Acta Bioenerg.* **1858(12)**: 991-998.

Borjian, F, Johnsen, U, Schönheit, P, and Berg, I,A. (2017). Succinyl-coa: mesaconate coa-transferase and Mesaconyl-Coa hydratase, enzymes of the methylaspartate cycle in haloarcula hispanica. *Front Microbiol.* **8**: 1683.

Islinger, M, Voelkl, A, Fahimi, H,D, and Schrader, M. (2018). The peroxisome: an update on mysteries 2.0. Histochem.*Cell. Biol.* **150(5)**:443-471.

Naquet, P, Kerr, E,W, Vickers, S,D, and Leonardi, R. (2020). Regulation of coenzyme A levels by degradation: the 'Ins and Outs'. *Prog. Lipid Res.* **78**:101028.

Williams, N,C. and O'Neill, L,A. (2018). A role for the Krebs cycle intermediate citrate in metabolic reprogramming in innate immunity and inflammation. *Front. Immunol.* **9**:141.