Fatty acid desaturases (August 2016)

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Fatty acid desaturases are enzymes that convert a single bond between two carbon atoms in a fatty acyl chain to a double bond. A common property for all known desaturases is their requirement for molecular oxygen and a source of electrons.

The classification of desaturase enzymes is complicated by the fact that they can be classified by several criteria. First, they differ in their substrate preferences. Free fatty acids are very rare in the cell, and fatty acids are usually found bound to either coenzyme A, acyl-carrier proteins, or as part of a glycerolipid. Desaturase enzymes are specific for one of these forms, and often are also specific for a substrate of a particular size or size range. Next, the enzymes differ in their electron donor. Most fatty acid desaturases utilize electrons provided by either ferredoxin or cytochrome b_5, although some exceptions do occur. In many of the cytochrome b_5-dependent enzymes gene fusion has resulted in a cytochrome b_5 domain integrated into the enzyme. The enzymes can also be classified based on the position of the double bond that they introduce - some introduce it at a certain distance from the carboxylic end of the fatty acid, others determine the position based on its distance from the methyl end of the substrate, and yet others introduce the new double bond only at a particular position relative to an existing double bond. Finally, desaturases differ in the type of bond they introduce mdash some introduce a *cis* (Z) bond, others introduce a *trans* (E) bond, yet some introduce a mixture of both types.

Owing to the rapid increase in the number of different desaturases that were discovered in bacteria, algae, plants, fungi, and animals, the existing classifications in the Enzyme List became unsatisfactory. We have recently reviewed the existing literature and updated the list, resulting in a major revision of the fatty acid desaturase entries. We have revised most of our existing entries to eliminate ambiguity and added a large number of new entries, achieving close to full coverage of current knowledge in the field.

We tried to address all of the considerations described above. For example, EC 1.14.19.35 stands for *sn*-2 acyl-lipid ω-3 desaturase (ferredoxin), an enzyme that acts on acyl chains attached to position *sn*-2 of glycerolipids, introduces a double bond three carbons away from the methyl end of the chain, and accepts electrons from ferredoxin. Naturally, additional information can be gathered by looking at the reaction equations and reading the comment and references.

To see the entries, search the list for the name "desaturase" and scroll down to the entries that start with 1.14.19.