Frequently Asked Questions (FAQs)

Q1: What are fatty acids?

Ans: Fatty acids are a class of compounds containing a long hydrophobic hydrocarbon chain and a terminal carboxylic group. Fatty acid synthesis in animals occurs in cytosol and in plants cells in chloroplast stroma.

Q2: Name the predominant fatty acids that are found in mammals?

Ans: The most predominant types of fatty acids that are found in mammals include Lauric acid, Myristic acid, Palmitic acid, Stearic acid, Palmitoleic acid, Oleic acid, Linoleic acid, Linonic acid and Arachidonic acid.

Q3: Differentiate between saturated and unsaturated acid?

Ans: Saturated fatty acids have no double bonds in the chain. Their general formula is CH_3-$(CH_2)_n$ – COOH where n specifies the number of methylene groups between the methyl and carboxylic carbons. Examples of predominant saturated fatty acids are lauric acid, myristic acid, palmitic acid and others. While unsaturated fatty acids have one or more double bonds, and called monounsaturated or poly unsaturated respectively. The double bonds in naturally occurring fatty acids are generally in a cis as opposed to a trans configuration. The double bonds of polyunsaturated fatty acids are almost never conjugated.

Q4: What are the three domains of Acetyl CoA?

Ans: The Acetyl CoA carboxylase has following three domains:

1. A biotin carboxyl group carrier protein.
2. Biotin carboxylase which adds CO2 to biotin.
3. A transcarboxylase which transfers the CO2 group from biotin to acetyl CoA to form malonyl CoA allosterically regulated.

Q5: What the main ways that producing acetyl-CoA in the cytosol?

Ans: There are 3 principle ways of producing acetyl-CoA in the cytosol of the cell.

1. Amino acid degradation produces acetyl-CoA.

2. Fatty acid oxidation in the matrix of the mitochondria produces acetyl-CoA which is converted into citrate which is transported into the cytosol by the tricarboxylate transporter. ATP-citrate lyase convertes citrate in the cytosol into acetyl-CoA.

3. Glycolysis generates pyruvate which can be carboxylated in the mitochondria into oxaloacetate and then converted into citrate which is transported into the cytosol by the translocase. ATP-citrate lyase converts citrate in the cytosol into acetyl-CoA.

Q6: How is acetyl CoA transported out of the mitochondria?

Ans: Citrate transferred into the cytosol is broken back to oxaloacetate and **acetyl-CoA** by ATP-citrate lyase (using ATP and **CoA**). Oxaloacetate can be reduced to malate by malate dehydrogenase and NADH. Malate can be converted to pyruvate by malic enzyme and $NADP^+$.

Q7: What is the rate limiting step in fatty acid synthesis?

Ans: Conversion of acetyl-CoA to malonyl-CoA is the rate limiting step in fatty acid synthesis. The reaction is catalyzed by acetyl-CoA carboxylase, a biotinylated protein.

Q8: How is fatty acid synthesis regulated?

Ans: Acetyl-CoA is formed into malonyl-CoA by acetyl-CoA carboxylase, at which point malonyl-CoA is destined to feed into the fatty acid synthesis pathway. Acetyl-CoA carboxylase is the point of regulation in saturated straight-chain fatty acid synthesis, and is subject to both phosphorylation and allosteric regulation.

Q9: Mention the main physiological role of fatty acids?

Ans: Fatty acids have four major physiological roles:

v. Fatty acids are building blocks of phospholipids and glycolipids. These amphipathic molecules are important components of biological membranes

vi. Many proteins are modified by the covalent attachment of fatty acids, which targets them to membrane locations.

vii. Fatty acids are fuel molecules. They are stored as triacylglycerols (also called neutral fats or triglycerides), which are uncharged esters of fatty acids with glycerol. Fatty acids mobilized from triacylglycerols are oxidized to meet the energy needs of a cell or organism.

viii. Fatty acid derivatives serve as hormones and intracellular messengers.

Q10: What is the main difference between the essential and non-essential fatty acids?

Ans: The main difference between the essential and non-essential is that essential fatty acids cannot be produced by the body and have to be consumed through food or dietary supplements. While non-essential fatty acids can be produced by the body although they can still be ingested from some of the food that we eat.

Q11: What do you mean by Type I and Type II fatty acid synthases?

Ans: **Type I** systems utilize a single large, multifunctional polypeptide and are common to both mammals and fungi (although structural arrangement of fungal and mammalian synthases differ). Type I fatty acid synthase system is also found in corynebacteria, mycobacteria and nocardia). In these bacteria, FSA 1system produces palmititic acid and cooperates with the FAS11 system to produce a greater diversity of lipid products. **Type II** is found in bacteria and archaea, and is characterised by the use of discreate, monofunctional enzymes for fatty acid synthesis. Inhibitors of this pathway (FAS11) are being investigated as possible antibiotics.

Q12: Give the overall process of fatty acid synthesis?

Ans: The over all process of fatty acid synthesis is:

8 Acetyl-CoA + 7ATP + 14NADPH + $14H^{+}$ $\rightarrow$ palmitate + 8 CoA + 7ADP + 7Pi + $14NADP^{+}$ + 6H2O

Q13: Discuss the reduction process involved in biosynthesis of fatty acids?

Ans: Reduction of the Carbonyl Group, the acetoacetyl-ACP formed in the condensation step now undergoes reduction of the carbonyl group at C-3 to form D-hydroxybutyryl-ACP. This reaction is catalyzed by ketoacyl-ACP reductase(KR) and the electron donor is NADPH. Notice that the D--hydroxybutyryl group does not have the same stereoisomeric form as the L-hydroxyacyl intermediate in fatty acid oxidation.