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# Essential Fatty Acids: A Systematic Review

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**ABSTRACT**

**Essential fatty acids have to be supplied in our diet as they are essential part of normal growth and nutrition of mammals, including man and hence called essential fatty acids. Main sources of Essential fatty acids – eicosapentaenoic acid ( EPA) and docosahexaenoic acid(DHA) and alpha Linolenic acid (ALA are sea foods, eggs, vegans don't include animal origin foods. They are usually long chain on saturated fatty acids. Animal tissues contain enzyme desaturases, which are capable of desaturating saturated fatty acids, normally at position 9 (Enzymes are also present that can produce polyunsaturated fatty acids), but the additional double bonds are created between first double bond at position 9 and carbon group at position. Maximum studies reveal that Vegans consume very low of Eicosapentaenoic acid and Docosahexaenoic acid, unless they take supplements. Studies indicate that adipose, serum; plasma, Platelets and erythrocytes levels of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) are higher in omnivores than Vegans.**

**Keywords: Essential, Fatty, acids, DHA, ALA, Sea food, EPA**.

**Aim: The main purpose of this review was to summarize relevant findings of studies on sources, synthesis and biological significance of essential fatty acids.**

## INTRODUCTION

Essential fatty acids are straight chain polyunsaturated fatty acids. These are also related to prostaglandins in the same sense that essential fatty acids act as the precursor for the biosynthesis of prostaglandins. Essential fatty acids have to be supplied in our diet as they are essential part of normal growth and nutrition of mammals, including man and hence called essential fatty acids.

These are also known as vitamin-F, this can be explained as- when rats given diet devoid of fat, but otherwisecomplete, the rats failed to grow and developed skin lesions. These deficiency symptoms were prevented by adding certain specific highly unsaturated fatty acids in the diet. Therefore, the term vitamin-F was coined for them, although they are now always referred to as essential fatty acids.

Our body requires large number of fatty acids, most of these fatty acids can be synthesised by our body cells from carbohydrates present in the body. Such fatty acids which can be synthesised by the cells within our body from carbohydrates are known as known essential fatty acids.

However, some of fatty acids needed by our body cannot be synthesised by our body as they lack certain enzyme in the system whereas plant can synthesise some of them.

Therefore, those fatty acids which cannot be synthesised by our body from carbohydrates are known as essential fatty acids. They are usually long chain on saturated fatty acids.

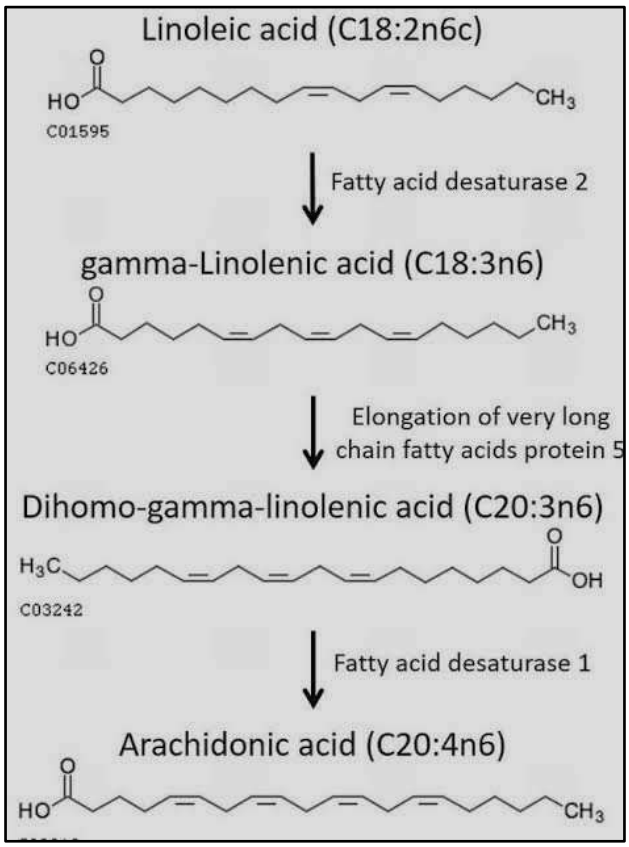
Animal tissues contain enzyme desaturases, which are capable of desaturating saturated fatty acids, normally at position 9 (Enzymes are also present that can produce polyunsaturated fatty acids), but the additional double bonds are created between first double bond at position 9 and carbon group at position 1.

During the course of evolution from humans and other animals, ability to insert double bonds at positions 12 and 15 has been lost, which is still retained in the plants.

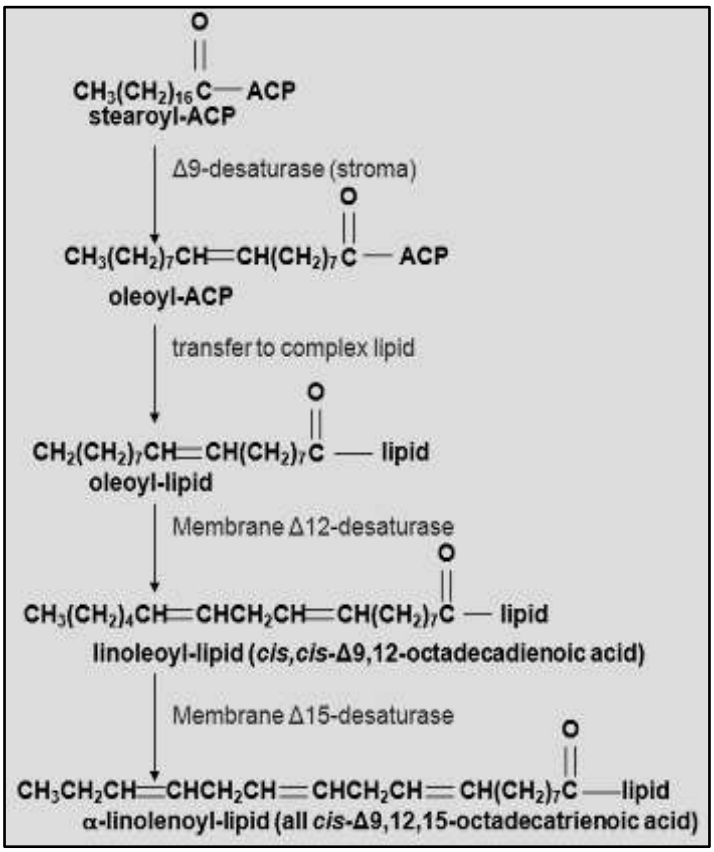
Our body can synthesise saturated fatty acids and mono unsaturated fatty acids i.e. oleic acid with no essential fatty acid activity. So, our body cannot convert oleic acid into linoleic acid and further to $\propto$-linolenic acid. But this conversion is possible in plants.

On the other hand, once the animals get linoleic acid from plant sources, they can convert this linoleic acid to $\gamma$-Linolenic acid, and then to homo- $\gamma$-Linolenic acid and finally to Arachidonic acid.

**In Animal Cells:**




**In plant cells:** The major lipids-Fatty acids in plants are synthesized in plastid and clustered in endoplasmic reticulum by glycerol lipids or triacylglycerols.



The most important essential fatty acids are –

- Linoleic acid
- γ-Linolenic acid
- Arachidonic acid

Structural formulae:

- Linoleic acid $C_{18:2}$ , $\Delta^{6,9}$($\omega^{6,9}$ if counted from -$CH_3$ side) $CH_3(CH_2)_4$-CH=CH-$CH_2$- CH=CH-$(CH_2)_7$COOH Cis, cis-9,12-octa decadienoic acid ( Non conjugated -$CH_2$ interrupted)
- γ-Linolenic acid $C_{18:3}$ , $\Delta^{6,9,12}$ ($\omega^{6,9,12}$ if counted from -$CH_3$ side) $CH_3(CH_2)_4$-CH=CH-$CH_2$- CH=CH- $CH_2$-CH=CH-$(CH_2)_4$COOH Cis, cis, cis-6,9,12-octa decatrienoic acid ( Non conjugated -$CH_2$ interrupted)
- Arachidonic acid $C_{20:4}$, $\Delta^{5,8,11,14}$ ($\omega^{6,9,12,15}$ if counted from -$CH_3$ side) $CH_3(CH_2)_4$-CH=CH-$CH_2$- CH=CH- $CH_2$-CH=CH- $CH_2$- CH=CH-$(CH_2)_3$COOH Cis, cis, cis,cis– 5,8,11,14- eicosatetraenoic acid ( Non conjugated -$CH_2$ interrupted)

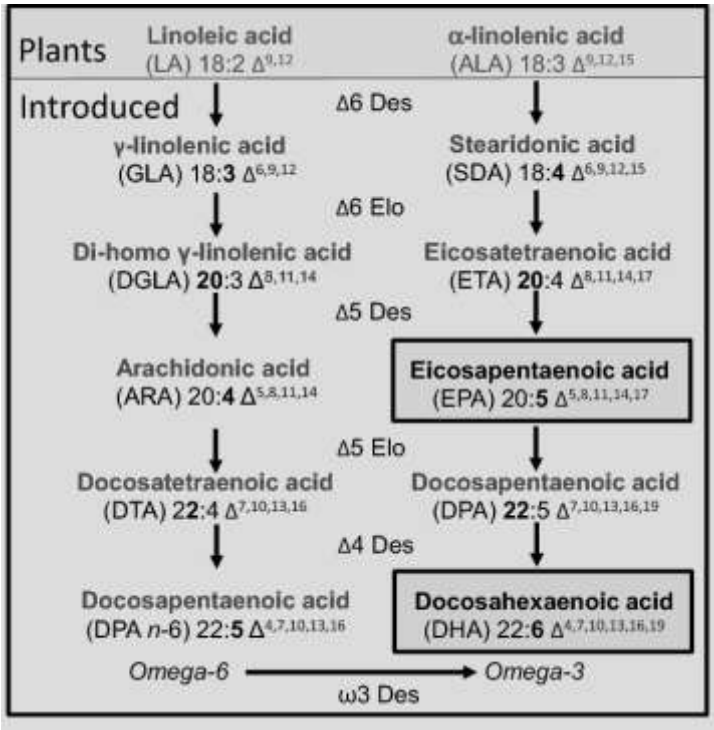
Actually speaking, it is no-1i.e. linoleic acid which is must in our diet , as the no-2 & 3 can be synthesised in our body fromno-1. In all these essential fatty acids, $\omega^{6,9}$is a major position for essential fatty acids to have a biological activity.

∝-Linoleic acid $C_{18:3}$ , $\Delta^{9,12,15}$ ($\omega^{3,6,9}$) also possesses essential fatty acid activity but to a lesser extent.

$CH_3$-$CH_2$- CH=CH-$CH_2$-CH=CH-$CH_2$- CH=CH- $(CH_2)_7$COOH

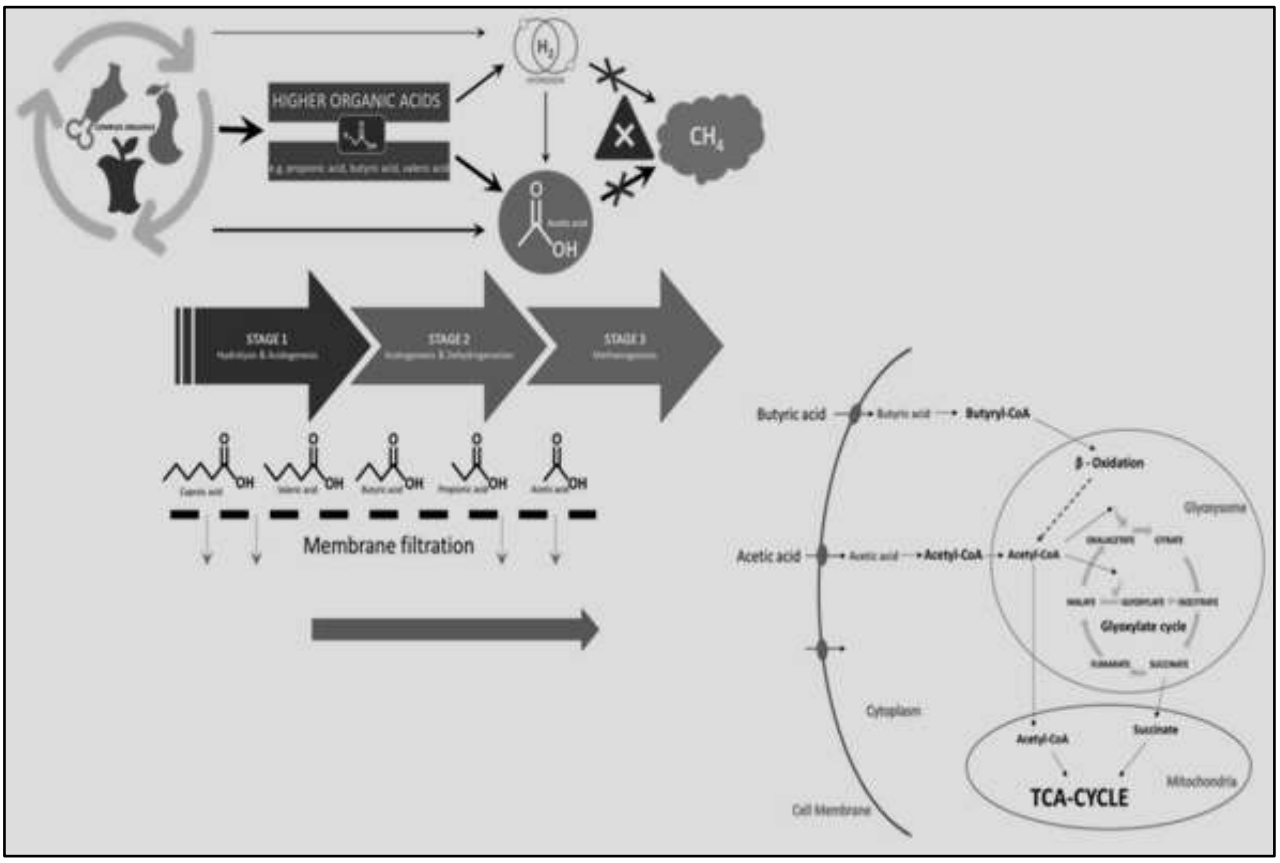
∝-Linoleic acid and some otherunsaturated fatty acids stimulate growth but are not effective in curing the skin lesions caused due to deficiency of EFAs. In our body, this acid acts as a precursor for longer chain fatty acids with 5 and 6 double bonds which have important function for the vision and brain. So,∝-Linoleic acid which comes from plant source is also an important essential fatty acid.

**Biosynthesis of γ-Linolenic acid and Arachidonic acid from Linoleic acid**




**Nutritional Significance of Essential Fatty Acids:**
Essential fatty acids are one of the important constituents of lipids, these contribute towards human health and nutrition. Out of the three essential fatty acids, i.e. linoleic, linolenic and arachidonic acid: thelinoleic and arachidonic acids are considered to be more important from essentiality point of view as these two can restore the growth,& cure the skin lesions in case of essential fatty deficiency.

On the other hand, linolenic acid can restore growth but it has no effect on the skin condition and thus doesn't possess full essential fatty acids activity. Out of the three essential fatty acids, the arachidonic acid the metabolite of linoleic acid is considered to be the most potent for essential fatty acids activity, as it can be converted into prostaglandins in wide variety of tissues.




**Major effects of Essential Fatty Acids deficiency:**

- Effect on Skin: EFAs deficiency causes dermatitis. Also increases the water permeability of skin i.e. skin becomes leakier to water.
- Effect on the weight and growth: EFAs deficiency reduces weight and retards growth.
- Effect on Circulatory system: EFAs deficiency affects blood circulation, heart gets enlarged, capillary resistance decreases and capillary permeability increases.
- Effect on Kidneys: EFAs deficiency, kidney gets enlarged.
- Effect on Lungs: EFAs deficiency, cholesterol is accumulated in lungs.
- EFAs deficiency effects, endocrine glands. Adrenal glands and thyroid glands gets affected resulting in reduction of weight.
- EFA deficiency affects male as well as female reproductive system.
- EFA deficiency also effects the general metabolism like change in fatty acid composition of most organs, increase in cholesterol levels in liver, adrenal gland and skin. Changes in heart and liver mitochondria increase in TGs synthesis.

**Biological Role of EFAs:** Linoleic and linolenic acids are termed as essential fatty acids because these must be supplied from the diet. Without them, animals will die. Both these give rise to longer chain omega-3 and omega-6 polyunsaturated fatty acids which perform two vital functions.

1. Essential fatty acids play a role in stability of biological membrane by creating desirable physical properties, which are necessary for the transport of substances across the membrane and also for the biochemical reactions that occur in the membrane.
2. The most important biological significance of essential fatty is that they are necessary precursors in the biosynthesis of a range of oxygenated compounds like prostaglandins, prostacyclin,thromboxane's, leukotrienes, hydroxy fatty acids etc. which perform various vital physiological activities.

## CONCLUSION

The Vegans consumption of Linoleic acid is higher in comparison to omnivores, with confirmation in tissues stores. There are inconsistent results of alpha linoleic acid intake by Vegans compared to omnivores. Maximum studies reveal that Vegans consume very low of Eicosapentaenoic acid and Docosahexaenoic acid, unless they take supplements. Studies indicate that adipose, serum; plasma, Platelets and erythrocytes levels of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) are higher in omnivores than Vegans.

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