Oxidation-Stable Linoleic Acid by Inclusion in Alpha-Cyclodextrin

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Abstract

Linoleic acid is the most common polyunsaturated fatty acid, and as a building block of cell membranes and skin lipids essential to the skin's barrier function. Its skin-care and restorative properties make it interesting for use in cosmetics and dermatology. But its sensitivity to oxidation and tendency to go rancid prevented its use in cosmetic preparations – until now.

Complexing the linoleic acid with α-cyclodextrins effectively stabilises the active ingredient trapped in the cavity and prevents odours by protecting it against oxidation. Investigations into the storage and light stability and headspace analysis of the formulations give evidence of the stability of a suitable inclusion compound. This opens up the possibility for the first time of using linoleic acid in various cosmetic formulations and personal care products.

Introduction

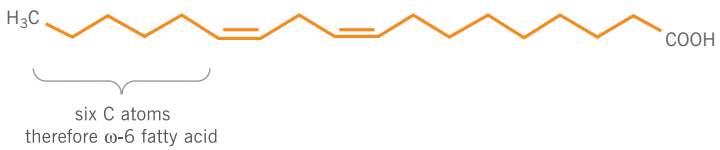
Being the body's biggest organ, the human skin protects us in many ways. The outermost skin layer, the cornified layer (stratum corneum), acts as a permeability barrier: It resists the ingress of foreign substances while limiting transepidermal water loss. The barrier function of the stratum corneum is of great importance for the skin function as a whole, as any insult that compromises the barrier damages the epidermis. Here, the stratum corneum acts as a biosensor[1], responding to environmental influences and superficial injuries. Every disturbance of the permeability barrier generates molecular signals, which trigger a series of repair responses. The barrier function itself is provided to a large extent by the intercellular lipids. The signals initiate increased synthesis and secretion of lipids and stimulate mitosis in the living layer of the epidermis[2]. All processes ultimately lead to a restoration of the original properties of the barrier[3].

Polyunsaturated fatty acids play a special role here. Linoleic acid, linolenic and arachidonic acid are essential for humans. The body utilises fatty acids in the form of triglycerides to store energy. However, polyunsaturated fatty acids are also indispensable as biochemical raw materials for making other important compounds. Linoleic acid and linolenic acid have to be taken in food, since mammals, including humans, lack the enzymes for introducing C=C double bonds between the C10 carbon atom and the end methyl group of the fatty acid chain.

A mixture of essential fatty acids is often referred to as vitamin F. Vitamin F contains polyunsaturated ω-6 and ω-3 fatty acids with chains of 18 or more carbon atoms and containing at least two double bonds. At 40 to 70 wt. %, linoleic acid (9, 12 - octadecadienoic acid, see box 1), is the most prevalent component of vitamin F.

Box 1 Linoleic acid

Linoleic acid (9, 12-octadecadienoic acid) is a doubly unsaturated ω-6 fatty acid. Exclusively the (cis,cis)-9.12-octadecadienoic acid stereoisomer occurs in nature. Evening primrose seeds, borage seeds, sunflower seeds, cornseeds, walnuts, peanuts and soya beans are all rich in ω-6 and ω-3 fatty acids. Linoleic acid is a colourless, oily liquid that dissolves readily in most organic solvents. Linoleic acid is insoluble in water. It is essential for animals and humans.



(cis,cis)-9, 12-Octadecadienoic acid