

DHA (Dihydroxyacetone):

The Key Ingredient in Sunless Solution

A self-tanning product was introduced in 1959, which contained DHA. Because of some people's problems with over exposure to UV and/or sunlight the number of self-tanners is on the increase. The first scientific papers on DHA were published in 1960. DHA's physicochemical properties, tanning mechanics and skin tolerance have been explored since these studies resulting in an improved method of application, a more natural looking and more uniform tan.

DHA was first used as an active ingredient during research on the treatment of diabetics, some of whom tolerated DHA better than glucose. Using DHA as a glucose substitute even lowered the blood sugar level in some subjects. During the same type of studies in 1957 the tanning properties of DHA were discovered in a children's hospital. DHA was administered orally as a treatment of a childhood glycogen-storage disease. The doctor noticed that children that spit up some of the DHA mixture developed brown spots where the DHA splashed on the skin. The doctor experimented by rubbing the mixture on her own skin, she tanned as well. Present day production of DHA still relies on fermentation, as it did in the late 1800's.

The Browning Action

An emulsion of approximately 5% DHA is applied to the skin; a brown "tan" forms in about 2 to 3 hours. The tan continues to darken for approximately 6 hours. The result can be a quite pleasing dark tan. The tan is absolutely water-resistant and diminishes only as the dead cells of the stratum corneum (SC) flake off – usually in one to two weeks.

2 DHA reacts solely with the SC; the entire DHA tan can be stripped off. The tans intensity depends on the type and thickness of this skin layer. Where the SC is thick (elbows, knees, for example), the tan is more intense. Where the layer is thin (the face), the tan is less intense. In order to achieve a more uniform tan, it is recommended to remove the loose scales from the skin before applying a DHA product, Another important factor in achieving a DHA tan is the pH levels of the skin and formulation. An alkaline pH causes the tan to orange, whereas a slightly acidic pH reduces this color problem.

Tests have shown that a surplus of water in the formulation can hinder the tanning reaction. When the DHA is in a glycine and water solution the browning rate decreases as the water content increases. There appears to be optimum water content. A solution of DHA in anhydrous glycerin produced only a slight tan on the skin, indicating that the water content in the SC (estimated to be 10 to 20%), is not sufficient for a tanning reaction, thus the importance of maintaining moisture in the skin. The tanning reaction does not depend on UV rays.

The Reaction

DHA interacts with the amines, peptides and free amino acids in the horny layer to generate a Maillard reaction. The first step of the reaction converts DHA to pyruvic aldehyde. Then the keto or aldo function reacts with an amine (the skins amino acids) to form a ketoimin or an aldoimin. The optimal pH range for this reaction is 5 to 6. The rest of the reaction is not fully known, it is known that the resulting products are cyclic and linear polymers that have a yellow or brown color.

DHA and Natural Tans

These polymers are called "melanoidins" to indicate their visual effect on the skin is comparable to those of UV-induced melanins. Although the names of the two tan-producers look similar,

they are chemically different. Melanin consists of long chains of aromates, originating mainly from tyrosine. Melanoidins are mainly aliphatic with only a few aromates in the side chains of the chemical composition.

Some people expect a tan to provide UV protection. However, unlike the melanin pigments, the DHA-derived polymers do not absorb significant amounts of UV B light, and therefore, cannot protect against UVB radiation. However, a DHA tan can be considered a UVA sunscreen to some extent.

In some formulations amino acids are added to the DHA, which could interact before application to the skin. Therefore you might see a two-compartment container on the market. The introduction of amino acids to a formulation requires careful study of the solution. Although coloration, from DHA, can occur in as little as 45 minutes compared to 2 hours, this tan might not be substantive and part of it could wash off easily.