Persistence of Skin Color and Fluorescence after Treatment with Dihydroxyacetone

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We congratulate Pierard and Pierard-Franchimont [1] for their novel use of dihydroxyacetone (DHA) as a marker for turnover of stratum corneum. Aside from extensive topical use of DHA in sunless ‘tanning’ preparations, the only other application we are aware of is that of Stenberg and Larkö [2]. They used DHA as a marker in sunscreens to determine amounts applied by users. From our broad experience in photo-protection with DHA alone, and with DHA plus juglone or lawsone [3, 4], we present additional comments. The authors’ description of the Maillard browning reaction and production of melanoidins is correct, but naphthoquinones such as juglone and lawsone do not fit into this scheme. We observed that, in combination with DHA, the compounds do bind to skin. However, when applied alone, they act as dyes to impart their color to the skin, and are readily washed off. In contrast, DHA is white and yields colorless solutions. It combines with reactive groups of skin proteins to produce covalently bound brown pigments. We call compounds like DHA browning agents [3], because they undergo the Maillard browning reaction with skin surface proteins.

Our statement that pigments produced by DHA resist soap-and-water bathing relates to therapeutic use. Persons sensitive to long-wavelength UVA or visible radiation apply DHA daily to maintain protection. A convenient sequence is to apply DHA in the evening, wash or bathe as usual next morning, and use a broad-spectrum sunscreen as needed during the day [5, 6]. This protocol allows the patient to choose from a number of commercial DHA products without concern that the vehicle may interfere with sunscreen use. Since lawsone absorbs UVB radiation, DHA plus lawsone affords broad-spectrum protection for all types of photosensitivity [4]. This combination also resists bathing [7]. A heavy application of DHA plus lawsone yielded a sun protection factor (SPF) of 5 after a soap-and-water shower. Two days later, after two more showers, the treated area still exhibited an SPF of 4.

The authors’ comparison of chromatic measurements of DHA-treated skin with persistence of fluorescence at dansyl-chloride-treated sites raises an interesting point: DHA-treated skin also fluoresces. The time sequence of development of color and fluorescence varies with the DHA preparation and application details. In a typical experiment, 6% DHA in 50% aqueous isopropanol was applied twice, 1 h apart, to the un-tanned inner aspect of the forearm. The treated site was left uncovered. Bright-blue fluorescence under a Wood’s lamp developed within 1 h, and was gradually replaced by salmon/peach fluorescence as visible color developed within 3 h. At
24 h, the skin was dark brown and had a beautiful salmon fluorescence. Within the limitations of
difficulty in detecting faint color and fluorescence, color persisted for about 9 days, and
fluorescence persisted for 20 days or more. During this time, the subject performed a gentle
soap-and-water wash (no scrubbing, pat dry) daily. Since it is doubtful that many subjects will
avoid washing the forearm for prolonged
intervals, DHA fluorescence may provide a practical means of assessing turnover of stratum
corneum.

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