Vital ET™: A Potent New Ingredient For Effective Delivery of Tocopherol Phosphates

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Biography

Mark Rerek is Director of Skin Care R&D at International Specialty Products (ISP). In this position he is responsible for the development and scale-up of novel materials for the skin care market. He joined ISP in 1996. Prior to joining ISP, he worked for Unilever Research for 12 years. He is the author of 24 papers and 11 patents. He received a Ph. D. in Inorganic Chemistry from Northwestern University, a M.A. in Inorganic Chemistry form SUNY-Binghamton and a B.A. in Chemistry from Kenyon College.

Introduction

The beneficial use of vitamins in general, and specifically vitamin E, continues to be an active area in dermatology and cosmetic science. It is clear that vitamin E, especially in the form of α–tocopherol, is a potent anti-oxidant and is widely used by the body to protect lipids in cell membranes from oxidative damage[1]. However, the role of vitamin E in skin is much less clear, both from an understanding of its intrinsic role as well as clear demonstration of clinically relevant, in-vivo benefits[2].

α–Tocopherol is stored in the liver and adipose tissue. In the liver it is bound and transferred by a specific cytosolic protein, α–tocopherol transfer protein (α–TTP). When circulated through plasma, tocopherol is transported by several forms of lipoproteins including very low density lipoproteins (VLDL) and high density lipoproteins (HDL)[3]. It is believed that most α–tocopherol is delivered through HDLs to cells for use in the membrane or within the cell.[4] It is not unreasonable to assume that when delivered topically, α–tocopherol needs to associate with a transport protein to gain access to the dermis, especially the fibroblasts, unless some other delivery vehicle is provided in the formulation.[5]

Another significant formulation challenge is to keep α–tocopherol stable until use. The most common approach is to use the ester α–tocopheryl acetate. Although the ester is more stable than α–tocopherol, it has a different efficacy profile. For instance, it has been shown that α–TTP binds α–tocopherol to an extent more than 50 times greater than α–tocopheryl acetate.[3]

A second approach to vitamin and drug stabilization is phosphorylation.[6] Phosphorylation is the transformation of an alcohol to a phosphate ester through transfer of a phosphoryl group ($-PO_3H_2$). Phosphorylation is commonly used by the body, usually through the phosphorylating agent adenosine triphosphate (ATP). Evidence has been found for tocopherol phosphate in common foods as well as present in humans, indicating that phosphorylation of tocopherol is a natural process.[7] This study also showed that feeding with tocopherol phosphate enhances both tocopherol and tocopherol phosphate levels. It has also been shown that phosphorylated vitamin C is accumulated into cells as vitamin C.[8]

Phosphorylation does more than just provide a chemically stable storage form of Vitamin E. Tocopherol phosphate has been shown to have significant anti-proliferative activity for rat aortic smooth muscle cells in-vitro; this assay is used as a screen for agents to combat arteriosclerosis.[7] Very recently, work in several laboratories has shown that tocopherol phosphate inhibits oxidized LDL uptake, another key process in arterial plaque formation.[9]

Tocopherol Phosphate for Skin Care

Since phosphorylation makes α–tocopherol more hydrophilic, we have treated it with a complexing agent, disodium lauryliminodipropionate, to approximate the natural lipoprotein complex of α–tocopherol to facilitate delivery to the appropriate areas of the dermis. We call this product Vital ET™. The two main complexes formed are disodium lauriminodipropionate tocopheryl phosphate and disodium lauriminodipropionate ditocopheryl phosphate (INCI: disodium lauriminodipropionate tocopheryl phosphates). The presence of both species as distinct complexes are observed as parent ions in electrospray mass spectrometry, and behave as covalent complexes when examining vapor pressure osmometry of their solutions.

We have shown that Vital ET™ is very effective at rapidly reducing the redness and elevation of inflammatory acne lesions.[10] Studies have also shown that Vital ET™ is effective at preventing and ameliorating redness from UV exposure.[10] It appears that Vital ET™ is very effective at reducing a wide