

## MODULATION OF UV-LIGHT-INDUCED SKIN INFLAMMATION BY D-ALPHA-TOCOPHEROL AND L-ASCORBIC ACID: A CLINICAL STUDY USING SOLAR SIMULATED RADIATION

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**Abstract**—*Objective:* In this clinical trial we studied whether oral supplementation with D-alpha-tocopherol ( $\alpha$ -Toc), L-ascorbic acid (Asc), or  $\alpha$ -Toc combined with Asc influenced the solar simulated radiation (SSR) induced skin inflammation in healthy volunteers. *Methods:* We investigated the following groups in a prospective, randomized and placebo controlled study: Group (1)  $\alpha$ -Toc 2 g / day, group (2) Asc 3 g / day, group (3)  $\alpha$ -Toc 2 g / day combined with Asc 3 g / day, and group (4) placebo. Before and 50 days after supplementation we analyzed  $\alpha$ -Toc and Asc concentrations in keratinocytes. The dose response curve of UV erythema was determined by reflectance spectrophotometry and the minimal erythema dose (MED) by visual grading before and after supplementation. *Results:* 50 days after supplementation  $\alpha$ -Toc keratinocyte levels were increased in groups (1) and (3), Asc concentrations were elevated in groups (2) and (3), and the  $\alpha/\gamma$ -Toc ratio increased in groups (1) and (3). The dose response curve of UVR induced erythema showed a significant flattening and the MED increased from  $103 \pm 29$  mJ/cm<sup>2</sup> (before supplementation) to  $183 \pm 35$  mJ/cm<sup>2</sup> (after supplementation) in group (3), while there were no significant changes in groups (1) and (2) after vitamin supplementation. *Conclusion:*  $\alpha$ -Toc and Asc act synergistically in suppression of the sunburn reaction. © 1998 Elsevier Science Inc.

**Keywords**—Photoprotection, Antioxidants, Tocopherol, Ascorbate, Free radicals, Reactive oxygen species, Skin, Inflammation

### INTRODUCTION

The skin is continuously exposed to environmental insults, one if not the most important stress factor is solar radiation. Solar radiation causes a variety of biological effects on the skin, including inflammation, pigmentation, immunomodulation, photoaging and cancer [1]. The sunburn reaction is the most studied effect and has been well documented clinically and histologically. The mediators which induce this clinical response are only partially defined. ROS generated by endogenous photosensitizers [2,3], or released from inflammatory cells [4], prostaglandine endoperoxides [5], nitric oxide and peroxynitrite [6,7], as well as prooxidant cytokines such as TNF- $\alpha$ , IL-1 and IL-6 have been identified as mediators of the UVR induced inflammatory response [8–11]. Consequently, administration of antioxidants may be a promising strategy to counteract solar light induced skin inflammation.  $\alpha$ -Toc and Asc are physiolog-

ical antioxidants and potential photoprotective agents [12–22]. The American Academy of Dermatology has developed a guideline of care for photoaging/photodamage and recommended topical antioxidants as a medical treatment of photodamage [23]. In cutaneous photoprotection a safe and effective systemic antioxidant supplement (nutrient) is desirable, because it could provide convenient and prophylactic use at population levels [24]. The purpose of this study was to evaluate the effects of dietary  $\alpha$ -Toc and Asc mono- and combination therapy on the sunburn reaction and to measure keratinocyte concentration of the vitamins before and after supplementation.

### MATERIALS AND METHODS

#### *Study subjects*

Forty healthy volunteers (20–47 years old) with skin types II Fitzpatrick were selected for this study [25]. Exclusion criteria were smoking, heavy alcohol intake,

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