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ABSTRACT

Topical skin care products are used to improve skin health by keeping skin moisturized, protected from sun damage, and supporting skin recovery. In addition to applying topical products, skin health can be enhanced by eating a healthier diet or taking nutritional supplements. A nutritional supplement was formulated with fish oil, vitamin K2 and D, alpha-lipoic acid, co-enzyme Q10, quercetin, citrus bioflavonoids (naringin and hesperidin), d-limonene, resveratrol, carotenoids (lycopene, lutein and astaxanthin), purple corn extract and rosemary extracts to support skin protection and repair functions. A clinical study was designed with 40 subjects to evaluate the influence of the nutritional supplement on facial characteristics and photoprotection. Non-smoking subjects with Fitzpatrick skin types I and II were recruited for the study. A solar simulator was used in the assessment of the photoprotection capacity. Facial skin characteristics were evaluated by a board-certified dermatologist and instruments. Small sun-protected areas of study subject skin were irradiated with three UV doses, 1 minimal erythema dose (MED), 2MED and 3MED. Erythema was measured by a dermospectrophotometer, with non-irradiated skin as a control. After 8 weeks of supplementation, there was a statistically significant decrease in skin erythema, while there was no change in the non-irradiated skin. Eight weeks of supplementation also improved facial skin radiance, texture and overall appearance with statistical significance. In addition to dermatological assessments, subjects self-evaluated their skin. By self-assessment, subjects felt their skin firmness was improved and that was confirmed by measuring skin elasticity with a cutometer. This study suggests that this nutritional supplement protects the skin and improves appearance.

INTRODUCTION

Skin care products are in high demand to delay or reduce the signs of skin aging. One of the major contributing skin aging factors is the sun. The sun produces harmful radiations including ultraviolet (UV). The most harmful, UVC, is absorbed predominantly by the atmosphere, but UVB and UVA reach the Earth surface, affecting the human skin. UVA penetrates deeper into the dermis, whereas UVB causes the sun damage in the epidermis mostly. UVA and UVB are known to cause skin photoaging, by inducing free radicals and DNA damages. In addition to sunscreen, which prevents the sun damages on the skin, nutritional supplements have been widely studied for minimizing UV damage in the skin. For example, carotenoids, vitamin E (Tocopherols), flavonoids, vitamin C (ascorbate) and n-3 fatty acids (citation) are shown to reduce UV damage within the skin [1, 2]. In another study, consumption of flavanols daily for 12 weeks reduced skin erythema from a solar simulator and improved skin health including hydration [3].

The skin and other organs in the human body ensure protection from environmental stressors through different mechanisms, like DNA protection and repair. We age when there is insufficient protection and repair. In order to support skin health from within, a nutritional supplement was formulated with fish oil, vitamin K2 and D, alpha-lipoic acid, co-enzyme Q10, quercetin, citrus bioflavonoids (naringin and hesperidin), d-limonene, resveratrol, carotenoids (lycopene, lutein and astaxanthin), purple corn extract and rosemary extracts.

In this study, we evaluated the effects of the nutritional supplement on preventing or suppressing skin erythema induced by UV irradiation, as well as improving the skin appearance.

OBJECTIVE

- To determine the effects of a nutritional supplement on cellular protection in the skin from applied UV radiation in generally healthy adults
- To evaluate the changes in skin health or characteristics after consuming a nutritional supplement for 8 weeks

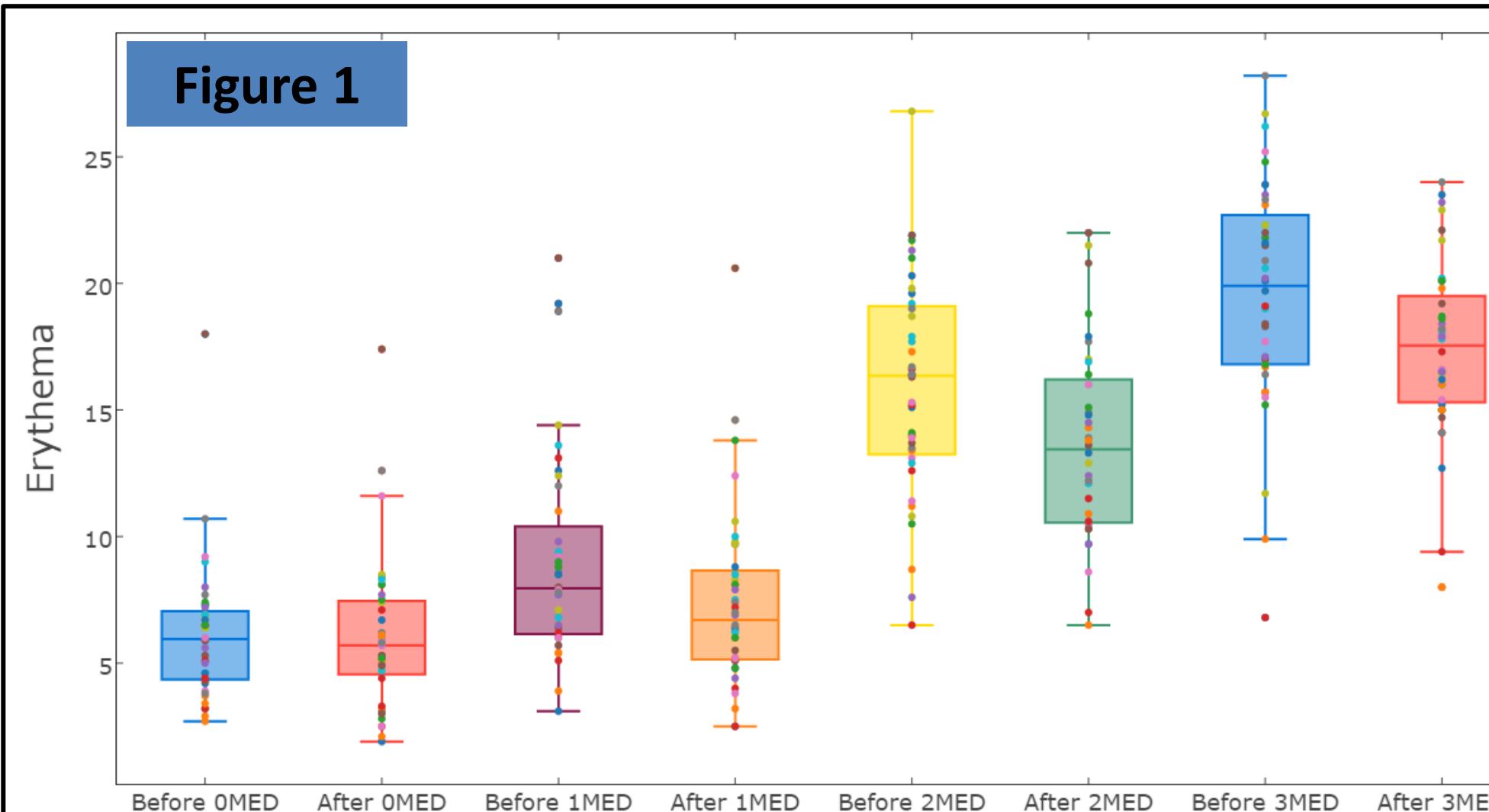
METHODS

Forty healthy non-smoking participants from 40 to 75 years of age volunteered to participate in the study. Participants were screened for Fitzpatrick skin type I and II, normal body mass index (BMI), chronic diseases, skin diseases or abnormalities, as well as other potential interferences, such as pregnancy, nursing, or consumption of other dietary supplements. The study was approved by an Institutional Review Board and conducted according to Helsinki Declaration. The study was registered on ClinicalTrials.gov (#NCT02525224).

Subjects consumed 2 nutritional supplement capsules twice daily for 8 weeks. At the baseline visit prior to supplementation, the skin health was evaluated by each subject, a board-certified dermatologist and by skin measurement instruments, such as a cutometer (Dermalab, Cortex Technologies, Hadslund, Denmark). A solar simulator (165-150v.3 powered by a xenon lamp power supply model XPS 200, Solar Light Co. Glenside, PA) was used to induce erythema at 3 doses (1 MED, 2 MED and 3 MED) in non-sunexposed buttock skin. Erythema was measured with a dermospectrophotometer on the irradiated sites, 24 hours after irradiation. Non-irradiated skin measurement was also done as comparison. Two millimeter skin punch biopsies were done on the 3 MED sites to measure apoptotic cell counts after H&E staining. Six cross sections slides were read blindly by a board certified dermatologist and then averaged for each subject. Irradiation, punch biopsies and skin attribute assessments were repeated after 8 weeks of nutritional supplementation to evaluate the changes.

RESULTS

In order to evaluate the efficacy of the nutritional supplement, skin erythema levels after irradiation were measured using a dermospectrophotometer before and after 8 weeks of supplementation.



	Before	After
No Irradiation	6.0 ± 1.0	5.9 ± 1.0
1 MED	8.6 ± 1.0	7.6 ± 1.0*
2 MED	16.3 ± 1.0	14.4 ± 1.0*
3 MED	19.5 ± 1.0	17.7 ± 1.0*

Figure 1 and Table 1. Mean skin erythema levels are shown in the chart above with individuals represented as colored dots. Solar simulator was used to irradiate the non-sunexposed buttock skin with erythema doses (1 MED, 2 MED, and 3 MED), and compared to the non-irradiated normal skin (0 MED). Before and After represents before supplementation and after 8 weeks of supplementation. Data in the table represents least square means ± standard error of the means (SEM). *P<0.05 as compared to baseline levels.

Four sites were evaluated, 3 irradiated sites (1MED, 2MED, 3MED) and normal, non-irradiated control skin (0 MED). After 8 weeks of supplementation, there was statistically significant reduction in erythema, with non-statistically significant changes in the normal skin. A representative skin photograph from a subject is shown in Figure 2. The skin biopsies were taken from 3MED sites, followed by H&E staining and the sunburn cell counts. Six sections were done for each subjects and averaged for the count. The mean number of sunburn cell count before supplementation was 11.6, which was reduced to 5.7, after 8 weeks of supplementation (Table 3), demonstrating the nutritional supplement provided photoprotection.

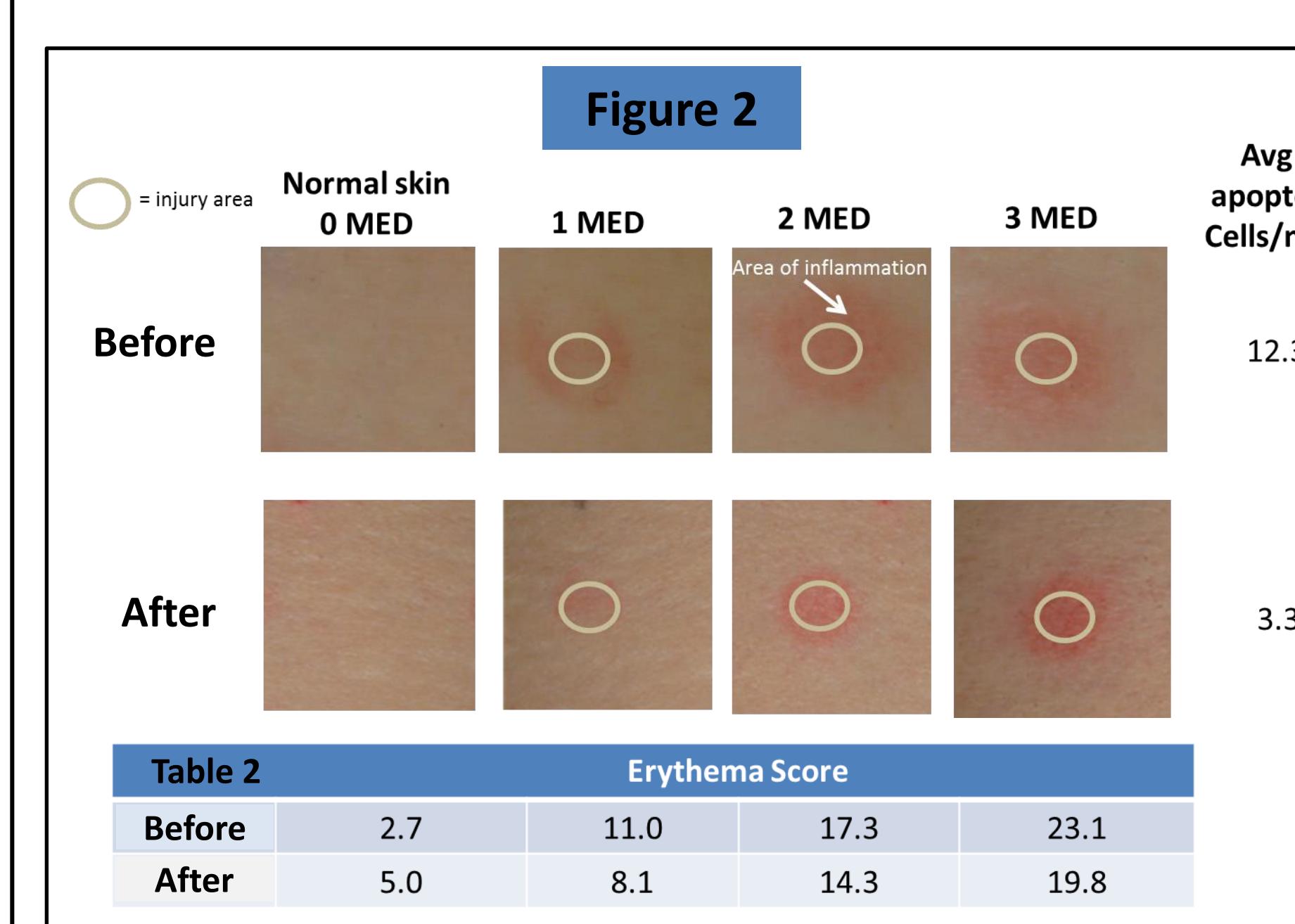


Figure 2 and Table 2. Skin photographs and erythema scores of a representative subject is shown. On the right of the 3 MED photographs, there are the average apoptotic cell counts from 6 cross-section of the subject, taken from 3MED sites.

	Before	After
Total	11.6 ± 1.1	5.7 ± 0.6*
(cells/field)	(2.5 to 30.8)	(0.0 to 12.7)

Table 3. Average number of sunburn cell count before or after supplementation is shown, with range of number of cells per field. Data shown is least square means ± standard error of the means and ranges in parenthesis. *P<0.05 as compared to baseline levels

In addition to erythema and sunburn cell counts, other skin attributes were measured. The skin elasticity was measured using a cutometer, which demonstrated statistically significant increase in skin elasticity at week 8 ($p<0.001$). Both the dermatologist and subject performed assessments of skin health and characteristics, such as lines/wrinkles, firmness, radiance, texture and overall appearance, before and after supplementation. From the investigator evaluations, improvements were shown in the skin radiance ($p=0.001$), texture ($p<0.001$) and overall appearance ($p=0.007$). The subject assessments demonstrated a statistically significant improvement in skin firmness ($p=0.030$). There were no adverse events during the study period. Subjects tolerated the nutritional supplement well.

CONCLUSIONS

- The nutritional supplement provided significant skin protection and improved skin health.
- After 8 weeks of supplementation, there was a statistically significant decrease in skin erythema in the irradiated sites ($p<0.05$).
- In addition to reducing erythema, the supplement was able to reduce the average apoptotic cells count from 11.6 to 5.7 cells/mm² ($p<0.05$) at the 3MED site, following 8 weeks of consuming the nutritional supplement, demonstrating protection from UV-induced damage.
- Skin health and attribute assessments demonstrated improved elasticity, firmness, skin radiance, texture and overall appearance.

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