ISSN: 2476 - 2415

Short Communicaion

International Journal of Clinical & Experimental Dermatology

UV-protective Properties of Topical of Astaxanthin Half side Controlled Pilot Study

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Submitted:21 Apr 2021;**Accepted**:28 Apr 2021;**Published**:08 Jun 2021

Citation: *Daisy KOPERA, Ji-Hoo KIM (2021) UV-protective Properties of Topical of Astaxanthin Half Side Controlled Pilot Study, International Journal of Clinical & Experimental Dermatology 6(1): 13-16.*

Abstract

Background: *Astaxanthin, a product of green algae, a naturally occurring reddish pigment from the carotenoid group, is known as a potent antioxidant reducing free radicals.*

Objective: *The aim of this pilot clinical study is to determine whether astaxanthin in topical formulation has antiinflammatory and uv-protective Properties through its antioxidant potency.*

Material and Methods: *The UV-protective effect of Astaxanthin AstaCos® OL50 versus a placebo tested in a half side controlled setting on 21 healthy volunteers Fitzpatrick skin type 2 or 3. A light testing system was used for irradiation of volar aspects of both forearms, one with Astaxanthin formulation, the other with placebo. Twenty four hours later photodocumentation and colormetric measurement of erythema values in all treated areas was performed.*

Results: *After equal uv-exposure, the erythema value after 24 hours on the astaxanthin side is on average 25% lower than on the placebo side. Astaxanthin suppresses visual erythema formation in over 71.42% of cases.*

Discussion: *Uv-exposure causes inflammation, accelerated skin aging and non melanoma skin cancer. Topical Astaxanthin reducing the inflammatory effects of uv-irradiation could prevent later stages of photoaging and malignant skin disease.*

Zusammenfassung

Hintergrund: *Astaxanthin, ein Produkt aus Grünalgen, ein natürlich vorkommendes rötliches Pigment aus der Gruppe der Carotinoide, ist als starkes Antioxidans bekannt, das freie Radikale reduziert.*

Zielsetzung: *Das Ziel dieser klinischen Pilotstudie ist es, festzustellen, ob Astaxanthin in topischer Formulierung durch seine antioxidative Potenz uv-protektive Effekte hat.*

Material und Methoden: *Die UV-schützende Wirkung von Astaxanthin AstaCos® OL50 im Vergleich zu einem Placebo wurde in einer halbseitigen kontrollierten Einstellung an 21 gesunden Probanden mit Fitzpatrick-Hauttyp 2 oder 3 getestet. Mit einem Lichttestsystem wurden die volaren Seiten beider Unterarme bestrahlt, einer mit der Astaxanthin-Formulierung, der andere mit Placebo. 24 Stunden später erfolgten Fotodokumentation, farbmetrische Messung der Erythemwerte in allen behandelten Bereichen.*

Ergebnisse: *Nach gleicher uv-Belichtung ist der Erythemwert nach 24 Stunden auf der Astaxanthin-Seite im Durchschnitt 25% niedriger als auf der Placebo-Seite. Astaxanthin unterdrückt die visuelle Erythembildung in über 71,42% der Fälle.*

Diskussion: *Uv-Exposition verursacht Entzündungen, beschleunigte Hautalterung und Nicht-Melanom-Hautkrebs. Die topische Anwendung von Astaxanthin, das die entzündlichen Effekte der UV-Bestrahlung reduziert, könnte spätere Stadien der Lichtalterung und bösartige Hauterkrankungen verhindern.*

Introduction

Astaxanthin, a product of green algae, is a naturally occurring reddish pigment from the carotenoid group [1]. It is produced primarily by green algae. The name is derived from the Greek (astakos=lobster, xanthos=yellowish) since crustaceans but also fish feed on these algae and thus acquire their characteristic reddish color. In these animals astaxanthin has vitamin-like effect, it promotes fertility and immune defense. Commercially, astaxanthin is used in fish farming to make the flesh reddish (eg. Salmon or salmon trout) and is approved as a feed additive for this purpose [2]. Due to its strong antioxidant effect, it can protect the skin from exposional damage and delay exposure-induced skin aging [3, 4]. It has never been tested topically in controlled clinical studies.

The aim of this pilot clinical trial is to determine whether astaxanthin in topical formulation has UV-protective effects through its antioxidant potency.

Material and Methods

Twentyone healthy volunteers, men and women over 18 years of age (av. 22,61), with Fitzpatrick skin type 2 or 3 were recruited. In advance uv-B erythema test was performed one day before study start for determination of the minimal erythema dose=MED of each individual using the Skintrek PT3 exposure unit (Lumedtec GmbH, 21339 Lüneburg, Germany; CE 0484; medical device group 1, class B) [5, 6].

The same system was used for testing the uv-protective effect of 0.2% Astaxanthin AstaCos® OL50 in a vehicle emulsion versus placebo (the emulsion without astaxanthin) in a controlled split skin manner. The recommended amount of commercial uv-protectants is an amount of 2mg/cm² skin. For the (volar) flexor side of the forearm (= 2% of the skin surface) this corresponds to a quantity of 0.8 g comparing to 1 ml. Half an hour before uv-irradiation 1 ml of each test substance was applied on the forearms, right placebo (vehicle emulsion without astaxanthin), left astaxanthin formulation (0.2% Astaxanthin AstaCos® OL50 in a vehicle emulsion). After that the forearms were exposed to Skintrek PT3 emitting a uv-dose which according to the MED causes a clearly visible reaction on the skin, thus corresponding to "sunburn“. In total on each forearm six teatment areas were exposed to uv-intensities of MED minus 0.05 J/cm² in gradual steps of plus 0.05 J/cm². Example: individual MED=1.3 J/cm²; six test areas were exposed to 1.25, 1.3, 1.35, 1.4, 1.45, 1.5 J/cm² on each forearm.

Twentyfour hours after uv-exposure the reaction on both forearms was documented photographically. (Fig.1) Visual evaluation of the erythematous reactions was performed using a four step scale (zero, +, ++, +++ redness). (Tab. 1)
In addition, at this time the intensity of the redness in all test areas was measured colormetrically utilizing the DSM II ColorMeter, Cortex Technology, 9560 Hadsund, Denmark; CE certificate [7]. For each test area three measurements were taken and the mean value was determined. After that a mean value of erythema was calculated for right and left forearms. (Tab. 2)

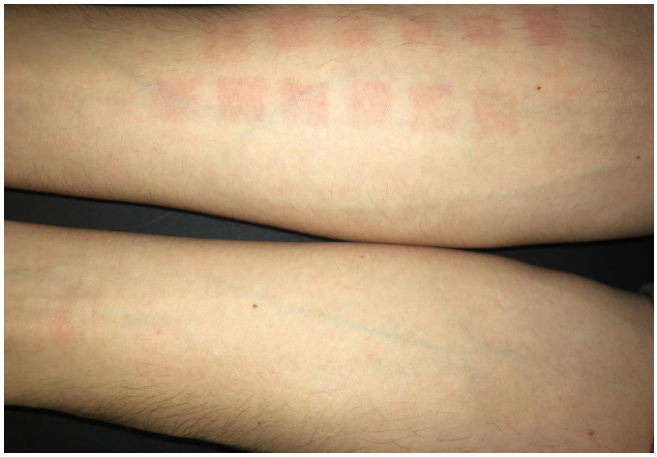

Figure 1: right and left forearms 24 hours after identical uv-exposure on either side (right forearm/below: placebo, left forearm/above: topical astaxanthin): left forearm showing no erythema, right forearm showing ++ erythema in the exposed test areas (the lateral radial aspect of the right forearm also showing the evaluation of MED one day before the clinical trial).

Table 1: Visual assessment of redness correlating to mean E-value difference on the placebo treated forearm. In total Astaxanthin prevented the development of erythema in 15 of 21 of subjects (71.42%).

	Visual Assessment placebo side	difference in E-value	E-value placebo	E-value Astaxanthin
6/21 (28.57%)	0	1,78	9,49	7,71
6/21 (28.57%)	+	2,01	10,45	8,44
6/21 (28.57%)	++	3,42	10,25	6,83
3/21 (14.28%)	+++	5,20	12,77	7,57

Table 2: Erythema values 24 hours after uv-exposure evaluated visually and measured with DSM II ColorMeter.

volunteer number and visual judgement placebo vs Astaxanthin		E-value Placebo (right forearm)	E-value astaxanthin (left forearm)	E-value difference
1	0 / 0	8,30	7,73	0,57
2	++ / 0	12,15	9,00	3,15
3	0 / 0	7,20	4,95	2,25
4	+++ / 0	13,22	8,85	4,37
5	+ / 0	10,24	8,47	1,77
6	0 / 0	10,78	9,02	1,76
7	+ / 0	12,50	11,90	0,60
8	+ / 0	9,43	7,48	1,95
9	++ / 0	14,45	9,65	4,80
10	0 / 0	9,05	6,60	2,45
11	++ / 0	12,17	8,95	3,22
12	+ / 0	12,28	10,32	1,96
13	++ / 0	12,18	9,70	2,48
14	+++ / 0	13,82	8,33	5,49
15	+++ / 0	11,29	5,54	5,75
16	+ / 0	8,96	6,20	2,76
17	0 / 0	9,81	8,15	1,66
18	+ / 0	9,32	6,26	3,06
19	++ / 0	10,69	7,78	2,91
20	++ / 0	12,07	8,11	3,96
21	0 / 0	11,84	10,76	1,08
mean E-value		11,04	8,27	2,76

Results

Visual evaluation of the photographs taken at 24 hour after uv-exposure featured no erythematous reaction on all left forearms where 0.2% Astaxanthin AstaCos® OL50 in a vehicle emulsion has been applied 30 minutes before uv-irradiation (100%). On the right forearms where placebo (vehicle emulsion) has been applied 6/21 showed no erythematous reaction (28,57%), 6/21 showed + erythematous reaction (28,57%), 6/21 revealed ++ erythema (28.57%) and 3/21 expressed +++ erythema (14,28%). The visual judgement of erythema severity correlated with the increasing erythema values measured at 24 hours. In total according to this visual assessment astaxanthin prevented the development of erythema in 15 of 21 of subjects (71.42%). (Tab. 1)

The DSM II ColorMeter measurements revealed a median erythema value of 11.04 on the placebo side and 8.27 on the astaxanthin side. (Tab. 2) Thus, proving that there was on average 2.76 less redness on the forearm treated with topical astaxanthin compared to the forearm treated with placebo. This delta value compares to 25% less erythema-value in the astaxanthin treated test areas.

Discussion

Astaxanthin contains both a hydroxyl and a keto group. This unique structure plays important roles in neutralizing ROS with powerful antioxidant, anti-inflammatory, and antiapoptotic activities. Therefore it has been suggested as a dietary supplement for health applications [8, 9].

It has been discussed for several indications in cardiology, angiology and other medical diciplines [10, 11]. Uv-exposure causes inflammation, accelerated skin aging and non melanoma skin cancer. Topical Astaxanthin reducing the inflammatory effects of uv-irradiation could prevent photoaging and malignant skin disease.

In this pilot study astaxanthin has shown antiinflammatory and uv-protective abilities. Topical astaxanthin prevented the development of erythema after uv-exposure in 71.42% of subjects. Still, our setting reveals some limitations as there were 28.57% of subjects who did not show erythema formation on the placebo side. Perhaps our perception of the indivudual MED in advance was quite cautious and higher uv-doses would have demonstrated even

more distinct differences in erythema formation on the comparative sites either with or without astaxanthin. The representative figure is the difference in erythema value, as also in not uv-exposed skin a base redness/erythema value occurs according to the natural color of skin.

This reports on the first controlled half side controlled clinical in vivo study applying astaxanthin topically showing that there is some antiinflammatory potencial in this substance. Further clinical trials are needed for the establishment of topical astaxanthin as antiinflammatory and uv-protective agent and perhaps as a repellent of non melanoma skin cancer and skin aging.

Conflicts of interest: none

Funding: none

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