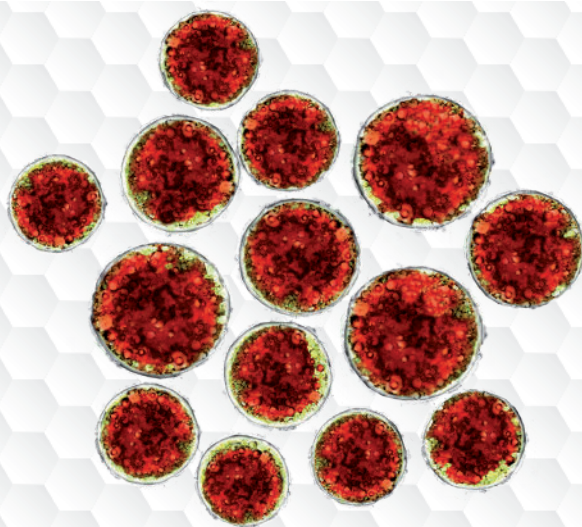


Natural Astaxanthin

The positive effects of algae-based astaxanthin on your skin health



Executive Summary

To utilize the potential of astaxanthin in skin health a supplementary diet or topical applications in cosmetics are recommended. To increase power of efficiency those applications can also be combined. Astaxanthin, derived from the microalga *Haematococcus pluvialis*, has proven several positive effects on the human skin, especially on wrinkle depth, elasticity, moisture, age spots and skin texture. Blood plasma samples and samples of residual skin surface components indicate a reversal of age-related skin changes. Beyond its esthetic benefits, astaxanthin demonstrably supports the natural protection of the human skin against ultraviolet rays.

Benefits of natural astaxanthin for human skin:

- Prevents oxidative damage
- Improves skin elasticity by strengthening the collagen layer
- Reduces the size of wrinkles and improves skin micro texture
- Revitalizes photoaged skin by quenching free radicals in all skin layers and prevents UV-damage

Introduction

The skin is the largest and most exposed human organ and plays a key role in everyone's health and appearance. Besides esthetic aspects, the skin's health is vital for the body's overall protection.

The human skin consists of three different layers (figure 1): epidermis, dermis and subcutaneous tissue. These layers protect the human body from invasion of microorganisms and pathogens as well as from physiological damage. Furthermore, they prevent excessive transpiration. Besides its barrier functions, the skin is exposed to ultraviolet rays by the sun on a daily basis.

In the following, recent in-vivo studies of potential benefits of an astaxanthin-supplemented diet for the human skin, based on a publication by *Davinelli et al.* in 2018 (see table 1)^[3], are presented.

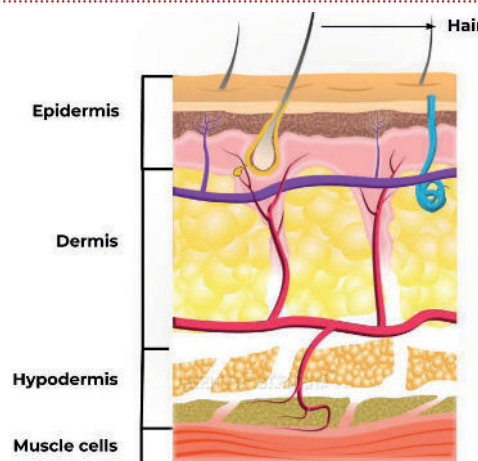


Figure 1: Structure of the skin^[2]

What is the power of natural astaxanthin

Astaxanthin is a naturally occurring pigment that gives the reddish color to marine organisms such as crabs, shrimps and salmons. Chemically, astaxanthin belongs to the carotenoid group, specifically to the xanthophylls. In natural surroundings, it can be found in photosynthetic organisms like bacteria, algae and yeasts. The highest concentrations of natural astaxanthin can be accumulated from the sweet water microalga *Haematococcus pluvialis*. Due to its unique molecular structure, astaxanthin contains both lipophilic and hydrophilic properties, and it can combine with cell membranes from inside and outside.^[1]

Natural astaxanthin has great anti-inflammatory effects. Furthermore, it is considered to be the most powerful antioxidant and highly effective at counteracting reactive oxygen species (ROS). It neutralizes harmful free radicals in a way that does not harm somatic cells. Unlike other antioxidants, astaxanthin does not become a pro-oxidant which can harm the body. Compared to other well-established synthetic or natural antioxidants, natural astaxanthin has been proven to be significantly more effective. Therefore, it is also called the “diamond of radical scavengers” (for details, see our dossier “Natural astaxanthin – nature’s most powerful antioxidant”).

Natural astaxanthin is classified as a novel food in the European Union and was considered safe by the United States Food and Drug Administration (FDA) with GRAS (generally recognized as safe) status. Numerous scientific studies have demonstrated the positive effects of natural astaxanthin on human health.

Cosmetic benefits

The results of two human clinical studies by *Tominaga et al.* in 2012 suggest that “astaxanthin derived from *Haematococcus pluvialis* may improve the skin condition.”^[4]

The first study took 8 weeks and was an open-label, non-controlled study with 30 healthy female participants who received a dose of 6mg astaxanthin oral supplementation (1 capsule twice a day) and 2ml topical application (78.9µM astaxanthin solution) per day. Another 1ml of the latter was also applied to the whole face of each subject every morning and evening after washing. Measurement parameters were wrinkle, elasticity, age spot, skin texture and moisture content. These parameters were controlled by using different photo analysis tools with normal or UV lamps. The results of the study show a visual wrinkle decrease (figure 2), as well as a significantly improvement in elasticity and skin texture.

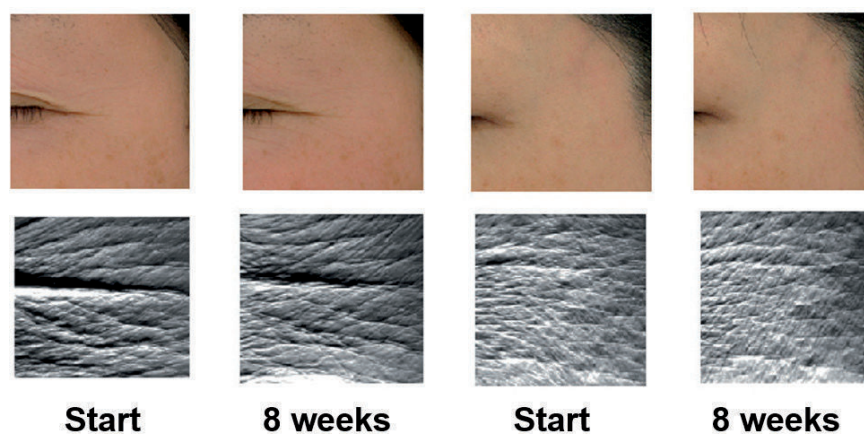


Figure 2: Photographs of skin surface and replica images of crow's feet^[3]

The second study took 6 weeks and was a randomized, double-blind, placebo-controlled study with 36 healthy male participants who received a daily oral supplementation of 6mg astaxanthin (1 capsule twice a day). Measurement parameters were wrinkles, elasticity, moisture, sebum oil and transepidermal water loss (TEWL).

Results show a significant increase in skin elasticity and decrease in TEWL as well as a non-significant decrease in sebum oil. Based on their studies, *Tominaga et al.* conclude that astaxanthin derived from the alga *Haematococcus pluvialis* can improve skin conditions in all layers by combining oral and topical application for both men and women.

A more recent study from 2017 by *Chalyk et al.* suggests that a continuous astaxanthin intake reduces oxidative stress and subsequently results in morphological changes of residual skin surface components (RSSCs), consistent with the reversal of the skin-ageing process.^[5] The study took 4 weeks and contained 31 participants (17 men and 14 women) over the age of 40 who received a daily dose of 4mg astaxanthin.

RSSC samples from the surface of the facial skin were taken at the beginning and the end of the study to determine changes. Furthermore, blood samples were taken on days 0, 15 and 29 to measure plasma levels of malondialdehyde (MDA), which allowed assessing systemic oxidative stress. After 29 days, the analysis of RSSC samples showed a significant decrease in corneocyte desquamation and microbial presence. Additionally, an increase of lipid droplet size in the samples was detected, especially in those by obese participants. These RSSC characteristics are usually found in younger people's skins and, according to the authors, “can therefore be interpreted as signs of a reversal of age-associated skin changes.”^[5]

MDA levels dropped from 100% on day 0 to 88.8% on day 15 and 78.3% by the end of the study, on day 29. This change reflects the general antioxidant effect of astaxanthin and is likely to decrease the effects of oxidative stress. Elevated MDA levels have also been well proven as an ageing indicator. The decrease of MDA level can therefore be interpreted as a sign of a reversal of age-related skin changes.

UV protection

In a study by *Ito et al.* in 2018, the effect of dietary supplementation with astaxanthin on UV-induced skin deterioration was investigated.^[6] To assess the protective factor of astaxanthin for UV-induced skin deterioration, the researchers determined the minimal erythema dose (MED) and analyzed UV-induced changes of moisture and transepidermal water loss (TEWL) at baseline and after 9 weeks of supplementation.

The study was carried out with 23 participants by using a randomized, double-blind, placebo-controlled parallel group trial. One supplementary capsule with 4mg astaxanthin was given to the participants every day during the study. The two groups were matched according to age, gender, minimal erythema dose (MED), moisture and transepidermal water loss (TEWL).

The result of the study shows an increase of MED (figure 3), which suggests a better natural protection from UV radiation, a reduction of moisture decrease in irradiated areas (figure 4) and an improvement of rough skin and skin texture in the astaxanthin group.^[5]

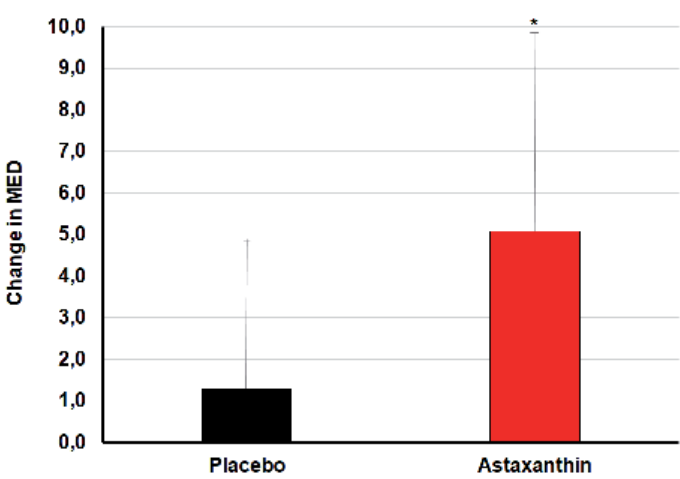


Figure 3: Change of minimal erythema dose (MED) from baseline of the two groups. Error bars indicate the standard deviation.^[6]

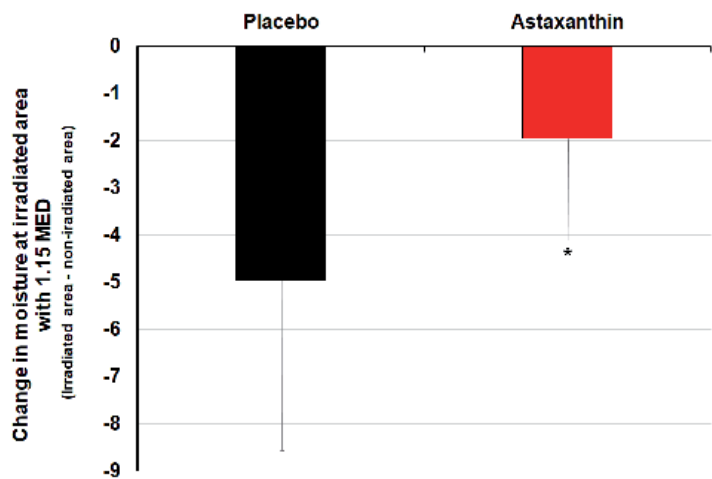


Figure 4: Dietary supplementation with astaxanthin attenuates the decrease of moisture in the irradiated areas. Change of moisture seven days after irradiation. Error bars indicate the standard deviation.^[6]

As mentioned above, enclosed you can find a summary of published studies on the benefits of astaxanthin on the human skin.

Intervention	Study Design	Control	Population	Duration	Outcomes	Dosage	Author, Year
Administration of ASX capsules	Randomized double-blind, controlled study	Placebo	Healthy female subjects (14/diet group)	8 weeks	↓ DNA damage biomarkers; ↑ of NK cells, T cells, B cells, and IL-6	2 or 8 mg	Park, 2010
Administration of ASX capsules	Monitoring of oxidative stress and skin aging	None	31 middle-aged volunteers	4 weeks	↓ MDA; ↓ RSSC	4 mg	Chalyk, 2017
Administration of ASX capsules	Randomized, double-blind, parallel-group, placebo-controlled	Placebo	65 healthy female subjects	16 weeks	↓ Wrinkle parameters ↓ IL-α	6 or 12 mg	Tominaga, 2017
Administration of ASX cream	Pilot study	None	3 healthy female subjects	2 weeks	↓ Wrinkle parameters	0.7 mg/g of ASX cream	Seki, 2001
Topical application of ASX	Pilot study	None	3 healthy male subjects	N/S	↓ Erythema	N/S	Yamashita, 1995
Administration of ASX capsules	Randomized, single-blind, placebo-controlled	Placebo	49 healthy female subjects	6 weeks	↓ Wrinkle parameters	2 mg	Yamashita, 2006
Oral and topical treatment with ASX	N/S	N /S	28 healthy female subjects	8 weeks	↓ Wrinkle parameters	6 mg	Tominaga, 2009
Two oral forms (ASX capsules; tablets collagen)	Randomized, double-blind placebo-controlled	Placebo	44 healthy female volunteers	12 weeks	↑ Viscoelastic parameters; ↓ TEWL; ↑ Procollagen type I; ↓ MMP-1 and MMP-12	2 mg	Yoon, 2014
Capsules of ASX combined with topical application of ASX	Open-label noncontrolled	None	30 healthy female subjects	8 weeks	↓ Wrinkles; ↓ Age spot size; ↑ Elasticity; ↑ skin texture	6 mg and 2 mL (78,9 μM solution)	Tominaga, 2012
Administration of ASX capsules	Randomized double-blind controlled	Placebo	36 healthy male subjects	6 weeks	↓ Wrinkles; ↑ Elasticity; ↓ TEWL; ↑ Moisture content; ↓ Sebum oil	6 mg	Tominaga, 2012

Abbreviations: ↑, increase; ↓, decrease; ASX, astaxanthin; NK, natural killer; IL-6, interleukin-6; MDA, malondialdehyde; RSSC, residual skin surface components; N/S, not specified; TEWL, transepidermal water loss; MMP, matrix metalloproteinase.

Table 1: Summary of human intervention studies on skin and astaxanthin^[3]

References

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2. Graphic Structure of skin: <https://learnfatafat.com/structure-of-skin/>
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BDI-BioLife Science (BLS) specializes in the development of innovative technologies to produce high-quality algal materials for the life sciences industry.

State-of-the-art in-house research facilities as well as years of cooperation with renowned universities create the basis for BDI's chief knowledge in algal research. Our department of product development turns ideas into finished formulations and supports you along the way from the raw material to the white label product. At the cultivation plant located at the Ökopark in Hartberg/Austria, BDI-BioLife Science produces algae with the specially developed, closed algae cultivation process to produce natural astaxanthin, tailor-made for the cosmetics (AstaCos®) and food supplement (astafit®) industries.



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