Astaxanthin Summary: ultraviolet light protection

Ultraviolet radiation has long been known to cause epidermis photoaging and skin cancer. Special SKH1 hairless mice sensitive to UV light are often used to understand the effects of antioxidants and light-induced polyamines. Polyamines are central to normal growth and activation of polyamine metabolism (putrescine in particular) is implicated in tumor promotion. In one study, female SKH1 hairless mice were weened at eight weeks and fed six different diets containing 5-ppm beta-carotene, 10-ppm astaxanthin or retinol. After 4 months, one half of each group was exposed to ultraviolet light, sacrificed, and then putrescine, spermidine and spermine concentrations were measured in the epidermis. After irradiation, astaxanthin alone or in combination with retinol was remarkably effective in preventing increases of free putrescine after damage was induced. The putrescine of the control group increased 4.1-fold whereas the groups fed astaxanthin increased only 1.5-fold. Astaxanthin also had a stronger inhibitory effect on putrescine accumulation than dietary retinol. Additionally, spermidine and spermine concentrations were significantly lower in those groups fed astaxanthin (Table 1). Taken together, the results indicate that astaxanthin exerts a specific action on transglutaminase enzymes to consume these polyamines in response to skin irradiation (Savoure, 1995).

Table 1: Increase (+) or decrease (-) in polyamine concentrations after irradiation (nmol/mg protein). PUT: putrescine, SPD: spermidine, SPM: spermine.

	PUT	SPD	SPM
Control	+409%	0	-5%
+retinol	+223%	-16.5%	-15%
+ ret + asta	+153%	-34%	-43%
+astaxanthin	+160%	-25%	-29%

In rat kidney fibroblasts, addition of astaxanthin exhibits superior protection against UVA light-induced oxidative stress compared to lutein and beta-carotene. Cell cultures were grown in differing concentrations of carotenoid-supplemented media and exposed to UVA light for four hours. Subsequently, various parameters were assayed. Catalase (CAT) and superoxide dismutase (SOD) were significantly decreased following the UV insult exposure compared to

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control cultures, whereas thiobarbituric acid reactive substances (TBARS) were significantly increased. Beta-carotene at a level of 1000 nM and lutein at 100 nM were necessary to protect against UV-induced loss of CAT, whereas it only required 5 nM of astaxanthin. Similarly, levels of 500 nM beta-carotene, 1000 nM of lutein and only 5 nM of astaxanthin were required to protect against loss of SOD activity compared to control cultures. Increases in thiobarbituric acid reactive substances (TBARS) were also measured as indices of oxidative stress. Supplementation of beta-carotene at 100 nM, lutein at 1000 nM and astaxanthin at only 1 nM prevented the UVA-induced increase in TBARS (Table 2). The authors suggest that carotenoids other than beta-carotene, and particular astaxanthin, may be important biological antioxidants (O'Connor, 1998).

Table 2: Protective effect of beta-carotene, lutein, astaxanthin against UVA-induced modulations in catalase, superoxide dismutase and TBARS levels in rat kidney cells. (O'Connor, 1998)

	CAT (U/mg protein)	**SOD (U/mg protein)**	**TBARS (nmol MDA/mg protein)**
Beta-carotene (nM)			
Control	8.59 +/- 0.37	10.28 +/- 0.84	3.68 +/- 0.23
0	4.76 +/- 0.02*	3.39 +/- 0.92*	7.04 +/- 0.15*
10	5.43 +/- 0.56*	4.02 +/- 1.06*	6.64 +/- 0.45*
100	6.32 +/- 0.09*	6.89 +/- 1.62*	4.39 +/- 0.25
500	7.11 +/- 0.64*	9.30 +/- 1.28	4.49 +/- 0.05
1000	7.85 +/- 0.21	9.80 +/- 0.98	4.22 +/- 0.46
Lutein (nM)			
Control	7.35 +/- 0.53	9.78 +/- 0.35	2.34 +/- 0.25
0	4.05 +/- 1.02*	3.83 +/- 1.84*	5.30 +/- 0.67*
10	4.77 +/- 0.80*	6.68 +/- 1.05*	6.01 +/- 0.18*
100	5.47 +/- 0.56	8.38 +/- 0.52	4.02 +/- 0.30*
500	6.13 +/- 0.81	7.05 +/- 1.58*	3.92 +/- 0.18*
1000	8.63 +/- 0.34	10.34 +/- 0.67	2.60 +/- 0.65

Astaxanthin (nM)			
Control	7.58 +/- 0.25	9.78 +/- 0.54	4.88 +/- 0.49
0	3.84 +/- 0.56*	3.81 +/- 1.85*	9.30 +/- 0.81*
0.1	5.82 +/- 0.53*	5.90 +/- 1.20*	8.97 +/- 1.23*
1	6.08 +/- 0.73*	7.16 +/- 0.07*	5.43 +/- 0.51
5	7.06 +/- 0.49	7.06 +/- 1.60*	5.32 +/- 0.29
10	7.67 +/- 0.08	9.73 +/- 0.48	3.56 +/- 0.17

*Indicates significant difference from control cells ($P<0.05$), n=6.

In one contradictory study, SKH hairless mice fed either beta-carotene, lycopene or astaxanthin as sole carotenoid sources tended to have higher probability of epidermal tumors. The authors state that it would be prudent to consume foods with mixed carotenoids in addition to vitamins E and C, since they are thought to complete the antioxidant cascade (Black, 1998).

Patents:

ANTI-SUNTAN COSMETIC - PAJ 00-04-76 63083017 JP NDN-075-0340-7295-6

INVENTOR(S)- TSUBOI, MAKOTO; MATSUI, KENJI; ANDO, YUTAKA

PATENT APPLICATION NUMBER- 61227497 DATE FILED- 1986-09-25 PUBLICATION NUMBER- 63083017 JP DOCUMENT TYPE- A PUBLICATION DATE- 1988-04-13 INTERNATIONAL PATENT CLASS- A61K00742 APPLICANT(S)- ICHIMARU PHARCOS CO LTD PUBLICATION COUNTRY- Japan

PURPOSE: To obtain a cosmetic having anti-suntan effect and effective in protecting skin from sunlight, by using baicalin, senega saponin, etc., as a component optionally in combination with astaxanthin, (beta)-carotene, etc.
CONSTITUTION: The objective cosmetic contains a compound selected from baicalin, baicalein, senega saponin and onjisaponin or contains the above compound and a compound selected from astaxanthin, (beta)-carotene and shikonin. Ultraviolet rays (UV-A), (UV-B) can be absorbed and shielded on the cuticle by the application of the cosmetic. It is also effective in absorbing and shielding light extending over a wide wavelength range from ultraviolet ray to visible light.

Cosmetic or dermatologic compositions with controlled release of the active agent containing a photoconvertible carotenoid – US 5,712,311. January 27, 1998. OTHER DESIGNATED COUNTRY(S)- BE; DE; ES; FR; GB; IT. (Attached)

Cosmetic or Dermatological Composition with Controlled Release of Active Principle Containing a Photoconvertible Carotenoid – US 5,712,311 January 27, 1998. (Attached)

Make-up cosmetic composition containing powdered Phaffia yeast- US 5,674,506. October 7, 1997. (Attached)

External preparation for skin. Japanese Patent #08073311 [in Japanese]. Suzuki, K., H. Masaki, and M. Takei. 1996a.

External preparation for skin. Japanese Patent #08073312 [in Japanese]. Suzuki, K., H. Masaki, and M. Takei. 1996b.

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Savoure N., G. Briand, M.C. Amory-Touz, A. Combre, M Maudet and M. Nichol. 1995. Vitamin A status and metabolism of cutaneous polyamines in the hairless mouse after UV irradiation: action of beta-carotene and astaxanthin. Int. J. Vitam. Nutr. Res. 65(2):79-86.

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