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Skin health

The skin is the largest organ in the human body, and its primary function is to act as a barrier to protect the body from damage caused by outside forces, contaminants, microorganisms and radiation exposure. Exposure of the skin to UV light has the potential to induce the formation of reactive oxygen species (ROS) and free radicals which can damage organelles and modify the structures of important molecules such as proteins, lipids and genetic material. Sunlight, particularly UVB (wavelength 290–320 nm), is responsible for sunburn, but also causes cellular damage. UVA light (wavelength 320–400 nm) burns less than UVB, but is able to penetrate deep into the dermis unlike UVB, which is capable of penetrating only as far as the boundary between the epidermis and the dermis. UVA light makes up the majority of sunlight, and is absorbed by a wide range of molecules, which can become photosensitisers, and can do more damage to the skin due to its greater ability to penetrate. Environmental pollutants such as ozone and oxides of nitrogen and sulfur are also able to produce free radicals in the skin, thereby also risking skin damage.[1] Although formed in the outer layers of the epidermis, these radicals induce damage in deeper layers in a manner similar to UV light.

A number of nutraceuticals have been claimed to exhibit useful activities in the area of skin health, including proanthocyanidins and the pine bark extract Pycnogenol, carotenoids, polyunsaturated fatty acids (PUFAs), tea, soy, glucosamine and melatonin.

Grape seed proanthocyanidin extract

The protective effect of grape seed proanthocyanidin extract (GSPE) against UVB-promoted photo-oxidation of PUFAs has been studied in micelles. As a result it was suggested that GSPE could be used as an adjuvant in skin protection from sunlight damage.[2] One per cent GSPE formulated into a skin cream and applied 30 minutes prior to UVA/UVB radiation, has been reported to produce a 9% increase in sun protection

factor, which was suggested to result from the scavenging of oxygen free radicals.[3] GSPE was found to be effective in reducing the hyperpigmentation of women with chloasma, and was maximally effective after six months, but no further improvements were reported after this period.[4] The proprietary product Pycnogenol has also been researched in this role: UV radiation-induced erythema in human volunteers was reduced after oral supplementation with 1.10 mg/kg body weight.[5] Further research on the effects of UV radiation from sunlight exposure in women found that supplementation with 25 mg Pycnogenol three times daily for 30 days resulted in approximately 38% decrease in skin area affected by melasma (cutaneous hyperpigmentation).[6]

Carotenoids

Lutein has been widely marketed as a filter for high-energy blue light with particular benefits for human eyes (see Chapter 7), but this perceived property may also benefit skin, and it is available in a range of topical and oral formulations. Epidemiological evidence has found a link between diets rich in lutein and other carotenoids, and reduction of incidence of melanoma in humans, and animal work has been used to investigate a number of UV-induced effects.[1] It has been claimed that it can also reduce UVA- and UVB-induced erythema caused by reactive oxygen species. Supplementation with lutein has been shown to result in its deposition in the skin, and carotenoid supplementation (containing mainly carotene plus 0.12 mg lutein) has been shown to result in less erythema in human subjects in response to UV irradiation. Work with mice showed that those supplemented with lutein had significantly fewer tumours of smaller size after irradiation with UVB light.[7] Long-term supplementation with a carotenoid mixture (β-carotene, lutein, lycopene, 8 mg each) over 12 weeks was reported to ameliorate UV-induced erythema in humans.[8]

Polyunsaturated fatty acids

The topical use of PUFAs in cosmetics and topical skin formulations is restricted due to the formation of malodorous secondary oxidation products. Research into the topical application of fish oil has shown a statistically significant improvement in erythema and scaling, and marked improvement in plaque thickness. A fish oil concentrate has been shown to benefit patients suffering from atopic dermatitis.[9] Atopic eczma has been treated with evening primrose oil, due to the 9% content

of γ-linolenic acid (GLA). Although this had a product licence as a medicine until November 2002, this has now been withdrawn. Early meta-analysis of placebo-controlled studies found insignificant effects compared with controls,[10] but a later analysis revealed an improvement in atopic eczma.[11] One further trial evaluated skin parameters in healthy elderly people after supplementation with 360–720 mg GLA (from borage oil) daily, over two months. Cutaneous layer function was improved by 11%, and dry skin reduced by 14–42%.[12]

Tea

Since tea catechins inhibit UV-induced skin cancers in experimental animal models, it is thought that they may have application as treatments for skin ailments.[13] A number of formulated skin preparations, including sunscreens, contain tea extracts as they are believed to have a soothing effect on the skin as well as acting as antioxidants.[14] Black tea polyphenols have been shown to protect against UVB-induced erythema, an inflammation response in mouse and human skin, and (—)-epigallocatechin gallate (EGCG) and (—)-epicatechin gallate (ECG) inhibit 5α-reductase present in skin, which is associated with androgen-dependent dermatological disorders such as acne.[15] Sebum production from the male human forehead is also inhibited by topical application of EGCG, suggesting its possible use for acne treatment.[13]

Reports concerning protection from UV radiation may allow for improved formulations of sunscreens. Photocarcinogenesis treatment with EGCG has been investigated in mice. Significant reduction in tumours has been reported after topical, but not oral application. EGCG is believed to act through a mechanism other than inhibition of photo-immunosuppression.[16]

Soy isoflavones

Many cosmetic products contain hyaluronic acid, a natural glycoaminoglycan normally present in skin, which is known to hydrate the skin, allowing it to appear smoother. A number of *in vitro* studies have shown that genistein and daidzein can stimulate hyaluronic acid production in the skin.[17] Genistein has been reported to inhibit skin cancer and cutaneous ageing induced by UV light in mice, and also photodamage and associated discomfort in humans. It is thought that the mechanism of action involves protection of oxidative and photodynamically

damaged DNA, downregulation of UVB-activated signal transduction cascades, and antioxidant activity.[18]

Coenzyme Q10

Ageing and photoageing are associated with an increase in cellular oxidation, possibly caused by declining levels of coenzyme Q10 (Co Q10). Topical application of Co Q10 has been shown to penetrate into viable layers of the epidermis and to reduce the level of oxidation, resulting in a reduction in wrinkle depth. It has also been found to be effective against UVA-mediated oxidative stress in human keratinocytes, and to prevent oxidative DNA damage.[19]

Glucosamine

Although the major use of glucosamine in the Western world is in the area of joint health, numerous patents and publications have appeared in Japan and Korea on its application for skin problems. Oral glucosamine has been shown to improve skin dryness and smoothness,[20] and a significant reduction in wrinkles and fine lines was reported in one group of women.[21]

Another nutraceutical used to treat osteoarthritis, methylsulfonylmethane (MSM), is also widely used for improvement of skin, nails and hair, but there is only anecdotal and no published evidence to substantiate these uses.

Melatonin

Topical application of melatonin either alone or in combination with vitamins C and E has been shown to reduce UV-induced skin erythema after topical application 30 minutes before exposure.[22]

Activity of nutraceuticals on hair growth

Stimulation of hair growth is the 'holy grail' for cosmetic scientists, but as yet there is little clear evidence for the use of nutraceuticals in this area. Many plant extracts have been investigated for possible use. One report surveyed 1000 plant extracts in an *in vitro* test system. GSPE was the most successful product, causing growth of hair follicle cells in mice at a level of 230% compared with controls. The most active fraction of

GSPE was the catechin and epicatechin polymers of 3.5 average polymerisation.[23]

The possibility of soy has been considered, based on the premise that its antiandrogenic effects may reverse androgen-mediated disorders such as hair loss. Men with male pattern baldness have been shown to have higher levels of circulating 5α-dihydrotestosterone (DHT), which binds to androgen receptors in hair follicles. Hair loss treatments have been produced to block DHT, but no evidence has yet been published for the effects of soy on this.[24] The possibility of soy having an effect are based upon its effect in prostate cancer, which is controlled by androgens, thus fuelling speculation that flax lignans may also have an effect.

Spermidine has recently been investigated, particularly for telogen effluvium, a common form of alopecia, which is often caused by prescription medicines and stress. A clinical trial using 0.5 mg oral supplementation for two months was shown to reduce the symptoms compared with controls.[25]

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