

# Enjoyment without regret: Light damage – prevention & regeneration

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In moderate doses, sunlight stimulates our organism and psyche. In too high doses, UV radiation causes the skin to age prematurely and light damage to occur. Read below how these can be avoided or treated.

**H**eat in low doses is beneficial, while high doses are harmful and cause burns. In the case of solar radiation, which is converted into heat on the skin, the harmfulness depends on the acquired self-protection and the effectiveness of the applied sunscreen. Without the protection, it is recommended to start with initially short stays in the sun, increasing them as the self-protection builds up through melanin formation.

## This is how solar radiation works

The body's own melanin converts almost 100% of the sun's UV radiation into heat, but just like artificial light protection filters, it has a limited protective effect. This depends on the distribution of the melanocytes and the melanosomes they provide for transport into the keratinocytes.

- **UVA radiation** (315-380 nm) penetrates to the dermis without sufficient protection, generates radicals and damages the collagen structures. Skin ageing is accelerated. The risk of erythema is low, but there is a risk of specific forms of skin cancer as a result of DNA damage.
- **UVB radiation** (280-315 nm) reaches the epidermis and is responsible for sunburn (erythema) and increasing the risk of skin cancer. However, UVB also induces the formation of melanin and thus an increase in self-protection time. Low doses of UVB are beneficial for health because of the formation of vitamin D<sub>3</sub> (cholecalciferol).
- **UVC radiation** (100-280 nm), which is also contained in sunlight, is already absorbed in the upper atmosphere.

## Light protection factors

- **Definition:** For UVB radiation, the sun protection factor (SPF) of a product is defined as follows: The minimum erythema dose of the protected skin divided by the minimum erythema dose

of the unprotected skin. This results in: self-protection time x SPF = maximum time spent in the sun.

- **Effectiveness:** The applied protection has the following effectiveness in percent: SPF 6: 83.3, SPF 15: 93.3, SPF 25: 96, SPF 30: 96.7, SPF 50: 98, SPF 50+: >98.
- **Quantity:** Sun protection factors are determined by measurement with the help of test persons after an application of 2 mg of sun cream per square centimetre of skin. The same amount must be applied by subsequent users to achieve the measured light protection.
- **UVA/UVB filters:** The EU symbol UVA (in closed ring) means: The UVA protection of a product is at least one third of the UVB filter. The indication of the critical wavelength informs about the bandwidth of the UVA filters in the long-wave range. With a bandwidth below 325 nm, there is only low UVA protection, above 370 nm there is high UVA protection.

## Self-protection time

In Central Europe, for example, the Celtic skin type has a self-protection time of only 5-10 minutes. The self-protection time has its minimum at 12 noon local time (one hour later on daylight saving time), a minimum on 21 June in the northern hemisphere and on 21 December in the southern hemisphere. At the equator there are two minima, on 21 March and 23 September. The altitude in the mountains, especially clean air, reflections from water, sand and snow reduce the self-protection time, while it increases with cloud cover. In case of fog and high fog, high scattered radiation is to be expected.

**The UV index (UVI)** of the German Federal Office for Radiation Protection provides orientation. In Germany, it is 0 in winter (no protection necessary), a maximum of 8 in summer and up to 13 at the equator and the highest

position of the sun (e.g. in Singapore at sea level). According to the rule of thumb, the applicable SPF is at least 2 x UVI, for infants 4 x UVI applies. Infants must not be exposed to direct radiation without protection!

### Radical formation

Solar radiation produces radicals – with protective, regenerative or harmful effects. Radicals...

- and radiation stimulate melanin formation (skin protection),
- start vitamin D<sub>3</sub> synthesis (health),
- together with heat have an anti-inflammatory effect (healing) and
- strengthen the immune system (prevention against infections).

In the case of a high intensity of radicals...

- they trigger inflammation (sunburn),
- stimulate collagen-degrading enzymes (skin ageing) and
- produce DNA changes (carcinogenesis).

### Are antioxidants helpful?

Light protection filters convert radiation directly into heat, before it can form radicals, and are not consumed in the process. Thus, provided that an effective sunscreen has been applied, radical formation is very low and additional radical scavengers (antioxidants) are not necessary. On the contrary, they can be counterproductive as they inhibit tyrosinase and melanin formation. In high doses, antioxidants can even trigger radical chain reactions under these conditions.

Even in the after-sun treatment, antioxidants make little sense, as the regeneration phase is radically controlled. In contrast, care should always be taken to optimally support the skin's **Natural Moisturising Factor** (NMF), which mainly consists of amino acids. This is because it represents the natural radical protection.

Important: Sunscreen products do not protect against the sun's intense infrared radiation, which significantly accelerates premature skin ageing, among other things through collagen degradation. The high water content of hydrogels offers some protection, but only for a short time.

### After the sunburn

**Anti-inflammatory:** ω-3 and ω-6 fatty acids in the form of nanodisperse aqueous solutions of linseed, kiwi seed, evening primrose, borage and rosehip seed oil as well as phosphatidylcholine and echinacea extract have an anti-

inflammatory effect. The prerequisite is that they are applied in the evening and not under sun exposure.

**Antibacterial:** If there is a risk of bacterial interactions, boswellia extract (frankincense inhibits proteases), azelaic acid (5-α-reductase inhibitor) and phosphatidylserine (macrophage activation) are suitable additives.

**Regenerative:** Retinoids such as vitamin A, vitamin B<sub>3</sub> (niacinamide) and provitamin B<sub>5</sub> (D-panthenol) have a regenerative effect.

### Photosensitisation

Orally taken medications such as psychotropic drugs, cytostatics, chemotherapeutic drugs and St. John's wort preparations (over-the-counter) can cause **photosensitisation** and associated irritation.

The same applies to cosmetic ingredients that are either already contained in a product (such as declarable terpenes) or only form allergenic secondary substances on the skin under the influence of solar radiation and atmospheric oxygen. Examples are ascaridol from tea tree oil and peroxides from polyethylene glycols (PEG).

In addition, skin contact with hercules perennial and meadow hogweed (fucocumarins) can trigger light damage. Inflammatory processes must be treated medically. If hyperpigmentation is associated with this, it can be gradually removed by pharmaceutical and cosmetic acid peelings as well as microdermabrasion.

### Other light-related damage

Repeated and prolonged exposure to the sun can produce actinic keratosis, usually on uncovered scalp. Pharmaceutical treatments include diclofenac, 5-fluorouracil or photodynamic therapy (5-aminolevulinic acid/cold red light) and cosmetic treatment with boswellia extract.

Examples of constitutional light dermatoses are moonshine disease (life-threatening genetic defect), lupus erythematosus (autoimmune disease), metabolic disorders (e.g. erythropoietic protoporphyria), polymorphous light dermatoses and light urticaria.

In addition to preventive light protection products and sun abstinence, skin care can only provide symptomatic help in these cases. Anti-inflammatory (see above), anti-pruritic (e.g. urea) and astringent substances such as tannic acid and witch hazel as well as active agents to support regeneration and to prevent and treat hyperpigmentation are used here.

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