Octocrylene as used as a UV filter in cosmetics: a safety review

Why is octocrylene important for UV protection?

Octocrylene is an organic ultraviolet (UV) filter that absorbs mainly UVB radiation and short UVA wavelengths.[1]

It is used in sunscreens along with other UV filters, as well as in face creams and lip care products to provide adequate sun protection factor (SPF), to stabilise other filters and to protect cosmetics formulations from UV radiation.[2]

According to European Cosmetics Regulation (EC) No. 1223/2009, octocrylene is authorised as a UV filter in cosmetic formulations at a maximum concentration of 10.0% in its acid form.

What is the concern with octocrylene?

Like all chemicals used in cosmetics, the safety profile of octocrylene is constantly under scrutiny. Octocrylene is suspected by the lay public to have an endocrine disruption potential. It may be associated with photocontact allergy but rarely causes skin sensitisation reactions.[3]

Dermal absorption of octocrylene is very low

Four studies on the dermal absorption of octocrylene are available in the scientific literature and an additional study is available in the European Chemicals Agency (ECHA) summary of safety data.[3-7]

All of these studies were performed *in vitro* on human skin samples maintained alive. One study (Potard et al., 2000)[7] investigated the *in vivo* absorption of octocrylene in the stratum corneum of humans.

These studies showed that 16–24h after dermal application of octocrylene (8–10%), most of the octocrylene remains on the surface of the skin as non-penetrated material (>95%), with detectable amounts found in the stratum corneum, and low amounts or below detection limits in other skin layers (epidermis, dermis or receptor medium). None of these studies determined a percentage of dermal absorption.

Hayden and colleagues demonstrated that only 0.4% of octocrylene was found in the epidermis and approximately 0.05% in the fluid receptor.[5]

These studies demonstrate that dermal absorption of octocrylene is very low.

Octocrylene is systemically available in very limited amounts

Octocrylene is absorbed by the skin in limited amounts.[8-10] Studies in healthy controls using sunscreen products reported that very low levels of octocrylene were found in human milk,[9] whilst some metabolites were primarily detected in urine.[8]

The systemic availability of octocrylene in humans has also been investigated in a randomised clinical trial.[10] This included 24 controls treated with either sun protectant spray, lotion or cream, containing varying concentrations of octocrylene. This sunscreen was applied under indoor maximal use conditions: 4 times per day for 4 days, 2 mg/cm3, on 75% of body surface.

Maximum plasma concentrations (Cmax) of octocrylene ranged from 2.9–7.8 ng/mL, whilst the AUC increased from day 1 to day 4 of application. Terminal half-life ranged between 42–84 hours.[10]

This data suggests a possible accumulation of octocrylene over time under maximal use conditions. However, further studies are needed to determine the clinical significance of these findings.[10]

Octocrylene does not show any systemic effects in humans at doses used in cosmetic products

There have been no systemic effects reported in rabbits with dermal exposure to very high doses of octocrylene (534 mg/kg bw/day).

Oral intake of high doses of octocrylene (340 and 1,085 mg/kg bw/day) has been associated with effects on the liver and thyroid in rats. The induction of hepatic enzymes increased the clearance of thyroid hormones (T3 and T4), resulting in increased thyroid-stimulating hormone (TSH) levels through an indirect positive hormonal feedback mechanism.[3, 12]

Notably, rats are far more sensitive to those thyroid effects than humans, due to the shorter plasma half-life of thyroxine (T4) in rats and the considerable differences in transport proteins for thyroid hormones in rats compared to humans.[3, 13]

Notably, the doses used in this study were at a very high dose compared to those used in cosmetic products and skin application.

Octocrylene does not cause endocrine disruption or reproductive toxic effects

Based on available animal data, octocrylene does not induce developmental or teratogenic effects.[3, 11]

In an extended one generation reproductive toxicity study,[3] only rats treated with the highest dose of octocrylene via the oral route showed a decrease in the number of implantation sites and consequently a low number of pups. No other effects were seen on male and female fertility and reproductive parameters such as oestrus cycle, epididymal and testicular sperm parameters, and no effects were seen on sexual and neurodevelopmental parameters in any of the pups produced. Notably, this very high dose of 550 mg/kg bw/day cannot be considered to be relevant for the dermal use of octocrylene as a cosmetic ingredient.

These animal studies[3] have also demonstrated that octocrylene is not associated with any endocrine disruption effects such as oestrogenic or androgen/antiandrogen effects. This was confirmed in the extended one generation reproductive toxicity study conducted in rats that did not show any significant effects of octocrylene on female and male fertility and reproductive parameters.

Additionally, octocrylene did not induce any *in vitro* effects on human sperm.[14]

Therefore, based on currently available data, octocrylene does not show any endocrine disruption potential regarding reproductive and developmental parameters.

Octocrylene sensitisation is rare

The sensitising potential of octocrylene has been extensively reviewed in the scientific literature and contact allergy attributed to octocrylene is very rare in the general population (0.08–0.7% with 10% octocrylene).[15, 16]

Contrary to contact allergy, photoallergic contact dermatitis to octocrylene is more frequent in adults[17] than in children. Also, previous photosensitisation to topical ketoprofen is apparently a prerequisite.[16, 18, 19]

Although the mechanism for the co-reactivity of octocrylene and ketoprofen has not yet been determined, de Groot and colleagues (2014)[18] offer several hypotheses:
(i) the benzophenone moiety in ketoprofen may be responsible for photoallergy.
(ii) some people may be highly photosensitive to substances that are non-relevant allergens;
(iii) co-reactivity (concomitant sensitisation or prior or subsequent de novo photosensitisation) may be involved in place of cross-reaction.

The scientific data shows that octocrylene is safe for consumers

Octocrylene is an important UV filter used for its properties to absorb UVB and short UVA, and to stabilize other filters, allowing for optimal UV protection. There is no question that UV filters are beneficial ingredients in cosmetics as they protect from skin cancer.

Based on the current available safety data, octocrylene used as a UV filter in cosmetic products at a concentration of 10% can be considered as safe for consumer use.

There is no evidence of any endocrine disruption potential from experimental studies, which demonstrated no adverse effects on reproductive and developmental parameters.

The frequency of contact allergy and photocontact allergy in non-sensitised subjects is very rare regarding its wide use in cosmetic products, particularly in sunscreen products.

This executive summary is a short version of the complete article available in the JEADV supplement :
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