EuroSun 2026

The European Conference on Sun Protection

27-28 May 2026 | Basel, Switzerland

Abstract Book

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P-01

Assessing the Dermal Penetration of UV-Filters in Different Environmental Conditions

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UV filters are chemicals that absorb UV light. They prevent skin from UV damage and are not intended to penetrate the body. However, recent studies have confirmed that UV filters can reach the systemic circulation [1]. Hence, new sunscreen formulation strategies are needed to ensure UV filters are not absorbed into the body. Additionally, test models that discriminate between penetrating and non-penetrating formulations in an early phase of development are needed. Ideally, these models should also allow for foreseeing the effects of outdoor activities (swimming, sweating) on the dermal penetration of UV filters. We have recently established an ex vivo model that can do so. The model and data showing the influence of different formulations and environments on the dermal penetration of UV filters will be presented.

Reference: 1. Matta MK et al. Effect of Sunscreen Application Under Maximal Use Conditions on Plasma Concentration of Sunscreen Active Ingredients: A Randomized Clinical Trial. JAMA. 2019. 321(21):2082-2091. doi: 10.1001/jama.2019.5586

P-02

Exploring UV-filter Skin Penetration & Retention by in vivo Confocal Raman Spectroscopy

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Background

When developing sunscreens, a key challenge is to ensure that the active ingredients, the UV-filters, remain on the skin or in the top layers of the stratum corneum (SC) - without penetrating further and becoming systemically available.

Formulators also need reliable insight into the retention-time of the UV-filters on the skin and in the SC, during water contact, wiping/drying, or just general daily activities.

Objectives

To explore the capabilities of in vivo confocal Raman spectroscopy for analyzing UV-filter distribution on the skin surface and in the SC and for assessing the effect of real-life activities on UV-filter retention.

Methods

In vivo Raman spectroscopy (gen2-SCA skin composition analyzer, RiverD International) was used to analyze UV-filter concentration profiles from the skin surface to 24 microns below the skin surface. This was done immediately after product application, and at several timepoints thereafter.

In a separate experiment the effect of (dry) wiping the skin and of showering on UV-filter concentration profiles was measured,

Results

A gradual decrease in UV-filter concentration was observed in the first 4hrs after product application. Dry wiping the skin after product application and showering removed most of the UV-filter from the skin.

Conclusion

In vivo Raman spectroscopy facilitates analysis of the concentration of UV-filters on and in the skin, anywhere on the body. Because the technique is non-invasive, this enables concentration monitoring over time and to study the effects of real-life activities. This information can be used to optimize formulations and substantiate performance claims.

P-03

An Upcycled Camellia japonica Pericarp Extract/3-O-Ethyl-L-Ascorbic Acid Complex for Protection and Repair Against UV-Induced Photodamage

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Ultraviolet radiation (UVR) plays a critical role in skin inflammation, photoaging, and photocarcinogenesis by increasing DNA damage, oxidative stress, and inflammatory responses in human keratinocytes. In addition, UV-induced vascular remodeling, accompanied by increased vessel permeability and the release of inflammatory cytokines, further aggravate skin photodamage. Therefore, there is growing demand for products that can simultaneously provide both photoprotective effects against UVR and restorative effects on UV-damaged skin.

In this study, we developed a synergistic complex (CE-EA complex) consisting of 3-O-ethyl-L-ascorbic acid and Camellia japonica pericarp extract and investigated its protective and restorative effects against UVB-induced skin damage. First, the effects of the CE-EA complex on UVB-exposed human keratinocytes were evaluated by analyzing cell viability, DNA damage, apoptosis, and the expression of inflammation-related mediators. The complex significantly attenuated UVB-induced cellular damage by reducing oxidative stress and suppressing pro-inflammatory responses in keratinocytes. In particular, treatment with the CE-EA complex effectively decreased markers associated with DNA damage and apoptosis, indicating its cytoprotective potential against UVB insult.

To further examine the indirect effects of UVB-damaged keratinocytes on neighboring skin-related cells, conditioned medium collected from UVB-irradiated keratinocytes was applied to vascular endothelial cells and melanocytes. In endothelial cells, the conditioned medium induced vascular hyperpermeability and increased inflammatory cytokine expression, whereas these effects were markedly alleviated by treatment with the CE-EA complex. In melanocytes, conditioned medium from UVB-damaged keratinocytes promoted melanin synthesis, while the CE-EA complex suppressed this melanogenic response.

Taken together, these findings suggest that the CE-EA complex exerts dual functions by protecting keratinocytes from UVB-induced damage and by ameliorating paracrine responses involved in vascular dysfunction and hyperpigmentation. Therefore, the CE-EA complex may serve as a promising candidate for multifunctional skin care applications targeting both photoprotection and post-sun repair.

P-04

Benzophenone-3: Remediation with Microalgae and the Following Investigation of Endocrine Disruptor Potential

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Background
Ultraviolet (UV) radiation is a major environmental factor contributing to skin damage, including photoageing and skin cancer. As a result, sunscreen use has increased significantly. Sunscreen formulations contain physical filters, such as titanium dioxide and zinc oxide, which reflect UV radiation, and chemical filters that absorb UV energy and dissipate it as heat. Benzophenone-3 (BP-3) is one of the most widely used chemical UV filters due to its high photostability and UV absorption capacity. However, BP-3 has been detected in marine environments through wastewater discharges and recreational activities. Because of its persistence and lipophilicity, it can accumulate in marine organisms and has been associated with ecological effects, including coral reef bleaching. In addition, BP-3 has been identified as a potential endocrine disruptor with estrogenic activity through interaction with estrogen receptors.
Methods
This study investigates the estrogenic activity of BP-3 on estrogen receptor α (ERα) using the ERα-CALUX assay, before and after treatment with microalgae used for contaminant removal.
Conclusions
Microalgae represent a promising and sustainable strategy for the removal of sunscreen-derived contaminants. Assessing the reduction of BP-3 estrogenic activity after microalgal treatment may contribute to environmentally safer approaches for managing UV filter pollution.

P-05

Marine Protein Extracts as Natural UV-Boosters for Sunscreen Formulations

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Background
Solar UV radiation is a major driver of skin damage, including photoageing, oxidative stress, and carcinogenesis. Conventional sunscreens rely on chemical or mineral filters, which increasingly raise concerns regarding environmental persistence, skin penetration, and potential endocrine effects. Natural bioactive compounds capable of enhancing UV protection while reducing the required amount of traditional filters represent an emerging strategy in sunscreen development. Marine processing by-products are a promising yet underexplored source of bioactive peptides with potential photoprotective activity.
Methods
Low-molecular-weight protein extracts (5 kDa) obtained from fish processing by-products (tuna, sea bream, and sea bass) were evaluated using HaCaT human keratinocytes. Cells were treated with three extract concentrations (0.03%, 0.05%, and 0.1% w/v) and cytotoxicity was assessed by MTT assay. To evaluate UV protection, keratinocytes were pre-treated with the extracts and subsequently exposed to UV radiation for 1 hour (2.0 mV/cm²). Post-irradiation cell viability was quantified using the MTT assay.
Results
Neither extract showed cytotoxic effects on HaCaT cells. Instead, both extracts increased cell viability across tested concentrations, with the sea bream/sea bass extract showing the strongest proliferative effect. UV irradiation significantly reduced viability in untreated controls, confirming UV-induced cytotoxicity. Pre-treatment with the protein extracts markedly improved cell survival after UV exposure, indicating a clear cytoprotective effect.
Conclusions
Fish processing by-products represent a sustainable source of bioactive proteins with promising UV-booster activity in human keratinocytes. These findings support the potential use of marine-derived peptides as adjuvants in next-generation sunscreen formulations, contributing both to enhanced photoprotection and to the valorisation of marine waste within a circular bioeconomy framework.

P-06

Leachate-Based Ecotoxicological Assessment of TiO2 Sunscreens in Freshwater and Seawater

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Background:

Environmental concerns around sunscreen ingredients are increasing, since realistic ecotoxicological data for inorganic UV filters in finished products remain limited.

Objectives:

To assess the ecotoxicity of micro- and nano-sized TiO2 both as isolated UV filters and after incorporation into sunscreen formulations, using a protocol that simulates human immersion in the aquatic environment.

Methods:

Sunscreen leachates were obtained in freshwater and seawater under a standardized immersion scenario to simulate realistic conditions. A multi-species battery was applied - by using bacteria, algae and crustaceans – to investigate multi-endpoints, including bioluminescence inhibition, growth inhibition, immobilization and behaviour. Titanium released into leachates was quantified by ICP-MS.

Results:

Titanium concentrations in undiluted leachates were low across test media. The isolated active ingredients induced species- and size-dependent effects: micro-sized TiO2 showed the highest toxicity to algae, while nano-sized TiO2 produced stronger effects in crustacean larvae. No EC50 values were reached for any sunscreen leachate. However, micro-TiO2 formulation caused about 40% growth inhibition in the freshwater algae, whereas no relevant effects were observed in bacteria or crustaceans exposed to leachates.

Conclusion:

Amulti-species and multi-endpoint testing strategy applied to sunscreen leachates provides a more realistic framework for evaluating the environmental safety of sunscreen formulations. Under the tested conditions, formulated TiO2 sunscreens showed lower ecotoxicological pressure than the corresponding isolated active ingredients, supporting the value of formulation-aware assessment in environmental safety screening.

P-07

UV Defense Mechanisms of PC-8 and Other Vitamin E Analogs Encapsulated into Lipid Nanocarriers

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Plastochromanol-8 (PC-8) is an antioxidant that, along with tocopherols and tocotrienols, belongs to the tocochromanol group. It is a homologue of γ-tocotrienol but has a longer unsaturated side chain (composed of eight isoprenoid units). The antioxidant properties of PC-8 are significantly enhanced in hydrophobic environments, suggesting that its unsaturated side chain improves quenching efficiency.

In this study, we compared the antioxidant potential of PC-8 with other vitamin E homologues (α-tocopherol, γ-tocopherol, and γ-tocotrienol) under UV exposure, after encapsulation in two different nanocarriers: liposomes and niosomes. In in-vitro spectrophotometric studies PC-8 also demonstrated a higher SPF value than the other tested compounds.

Our results show that PC-8, even at lower concentrations, provides superior photoprotection in both free and encapsulated forms. Under UV radiation, α-tocopherol exhibited the lowest antioxidant activity among the analyzed compounds.

These findings suggest that PC-8 is a promising compound for use as an active ingredient in photoprotective formulations, where it can serve a dual role – as both a stabilizing agent and an antioxidant.

Research project supported by program “Excellence initiative - research university” for the AGH University of Krakow”, grant no. 10509.

P-08

A Novel LED-DRS Approach for Assessing Blue Light Protection: A Pilot Study

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Background:
Visible light, especially high energy visible (HEV) light, is known to induce oxidative stress, skin damage and hyperpigmentation. So far, the assessment of blue light protection properties can mainly be derived from in vitro spectra measurements, analogous to the method described in ISO 24443 or from in vivo methods based on pigmentation induced by high doses of blue light. Furthermore, ex vivo techniques such as DCF fluorescence assays and electron paramagnetic resonance (EPR) are also available.

Objectives:
The aim of this project was to develop a novel tool for the non-invasive in vivo assessment of blue light protection.

Methods:
A new in vivo method based on diffuse reflectance spectroscopy (DRS)—previously applied to UV protection assessment—was adapted to quantify HEV light protection for ITA ranges I–III. The device is based on a blue LED, customized fiber optics and photodiode detection.
A pilot study (n=10) was conducted using five sunscreens, which were selected to represent different protection strategies including the P8 standard. The absorption and scattering properties of the formulations were characterized optically using UV/VIS spectroscopy, while the radical protection efficacy of the sunscreens was assessed ex vivo. EPR measurements on porcine ear skin were used as a reference method, as this technique is sensitive to all three protection strategies: absorption, scattering, and anti-oxidative mechanisms. The galenic structure and microarchitecture of the formulations were analyzed via multiphoton tomography (MPT) and fluorescence lifetime imaging microscopy (FLIM).

Results:
The results show a high correlation of DRS-based HEV-protection values with the EPR reference method. Based on these findings, a preliminary HEV protection factor (HEV-PF) was derived.

Conclusion:
The new DRS tool captures the primary blue light protection by optical attenuation (absorption and scattering) in accordance with reference methods.

P-09

ChemSperse™: A Multifunctionnal SPF Booster

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ChemSperse™ (INCI: Polyricinoleic acid) is an alternative to Polyhydroxystearic acid with more benefits for formulation. In addition to acting as a dispersing agent for mineral UV filters, ChemSperse™ improves emulsion quality and sensory experience by reducing whitening effect upon application. Its performance as SPF booster has been demonstrated *in vitro* and *in vivo* for products containing organic as well as inorganic UV filters. By facilitating the solubilization of Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (BEMT), a UV filter expected to be approved soon by the U.S. FDA, ChemSperse™ will be very useful for new products intended for the U.S. market.