

Abstracts

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In vitro assessment of water resistance of sun care products: a reproducible and optimized in vitro test method

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The aim of the study was to develop a simple reproducible and reliable in vitro water resistance (WR) method to assess the sun care products. This paper is the result of a scientific collaboration between seven different international industrial laboratories and testing institutes. The same group has already achieved an in vitro protocol for the sun protection factor (SPF) determination [1]. The in vitro WR of sunscreens was tested by applying the same principle as in vivo, which determines the percentage of retention of sunscreen products by assessing the SPF before and after water immersion. Special care was taken to study the parameters influencing the WR and the possibility to

follow the kinetics of sunscreen retention during water immersion. The influence of different water qualities has been tested, and osmoted water (1–3 IS cm⁻¹) was chosen for the main ring study. Measurement was carried out after 5, 20 and 40 min of immersion. Histograms of selected products demonstrate the percentage of WR at all measuring times and centres, and the regression coefficient to the in vivo determination was shown and statistical calculations clearly demonstrate the reproducibility of the results between the different evaluation centres. The presented method is a practical, convenient and relevant tool for WR screening of sun care and skin care products. It even has the potential to be the starting point for the replacement of the in vivo method in future.

Evaluation of black tea gel and its protection potential against UV

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In this study, aqueous and alcoholic extracts of black tea were obtained. The black tea extracts were tested in vitro for their ultraviolet (UV) absorption profile. It was found that both extracts showed UV absorption and followed the same path based on the wavelength. Aqueous extract showed a stronger absorptivity per weight basis than the alcoholic extract of black tea. A peak was obtained between 250 and 300 nm. After 300 nm, UV absorption decreased fast towards 400 nm with a low absorptivity. The black tea aqueous extract was formulated as a gel with the help of a

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carbomer resin and tested *in vivo* in six subjects for evaluating its protection potential against the UV (200–400 nm) using an artificial UV source consisting of a high pressure metal halide discharge lamp. Based on erythema evaluation, it was found that erythema appeared after 4 h and reached a peak at 24 h on control site. On the contrary, no erythema was observed in any of the six subjects on black tea gel applied sites. Therefore, it was concluded that black tea gel protected the skin from a broad range UV (200–400 nm) radiation. The black tea gel can be safely applied in large amounts on large skin surfaces without any toxicological concerns.

In vivo persistent pigment darkening method: proposal of a new standard product for UVA protection factor determination

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The European Commission (EC) has recommended assessing the level of ultraviolet A (UVA) protection afforded by sunscreen products using the *in vivo* persistent pigment darkening (PPD) method or other methods giving equivalent results. In this context, the reproducibility of the *in vivo* PPD method is of importance. To check the validity of the UVA protection factor (UVAPF) tests, the Japanese Cosmetic Industry Association (JCIA) recommends using a standard product (JCIA standard) with an expected UVAPF 3.75 (SD 1.01). However, considering the increase in UVA efficacy of the new sunscreen products available in the market, with UVAPF up to 30, it seemed useful to develop a new standard product to be used when testing products with expected UVAPF ≥ 10 . The PPD method was used in six centres to determine the UVAPF of the two products. Reproducibility of results was also studied by testing two batches of the new product at two different times. There was no statistical difference between the six centres with regard to the JCIA standard. The ring study showed that the mean value of UVAPF (4.3) was higher than that given by JCIA (3.75). These data enable the proposal of a new acceptance range for the JCIA standard product (3.4–5.2) derived from actual results from European laboratories. Whereas this range is different from that proposed by JCIA (2.74–4.76), there is an overlapping of the values. Data on the new standard product show that reproducibility is not influenced by the batches of this product. The mean UVAPF value obtained is 12.1. An acceptance range (9.6–14.6) is proposed for the new standard. Data presented here demonstrate that if an identical protocol is used, reproducible results can be expected and that the PPD method is reproducible and reliable.

Influence of different parameters on droplet size and size distribution of sprayable sunscreen emulsions with high concentration of UV-filters

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The purpose of this study was to evaluate the possible influence of different formulation and technological parameters such as sunscreen type and concentration, viscosity, propellant gas, actuator and valve type on size and size distribution of droplets in emulsions of waterproof sunscreens conditioned in aerosol cans. Different kinds of emulsion, W/Si and W/O, were prepared with high concentrations of organic and inorganic UV-filters. These formulations were incorporated in aerosol cans with gas (a blend of butane, propane and isobutane). The size and size distribution of the droplets were analysed by laser diffraction using a Malvern Spraytec. The results showed that the sprayability of the formulation and the particle size characteristics of the emitted sprays are dependent on the physicochemical properties of the formulations. Sprayable waterproof sunscreen emulsions, with a high sun protection factor and negligible percentage of emitted droplets below 30 μm , were successfully developed by optimizing formulation parameters and using appropriate actuators and valves.

Review Article

Global and systematic demonstration for the practical usage of a direct *in vivo* measurement system to evaluate wrinkles

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The global and systematic demonstration for the practical usage of a direct three-dimensional *in vivo* measurement system (PRIMOS) to evaluate wrinkles was investigated. Ten repetitive measurements of the corner of the eye of a subject showed that the coefficient of variation (CV)% value was 7.0% in a typical line-length roughness parameter R_a (the arithmetic mean of roughness), and that the CV% value in a typical surface area roughness parameter S_a was 2.4%. The relationships between the roughness values obtained from the corners of the eye and the age or wrinkle scores of Japanese women aged 10–70

years was examined. The values of several roughness parameters within the evaluation line length or surface area increased with age and showed a good correlation coefficient ($r > 0.743$). Similar relationships between the wrinkle scores and the values of roughness parameters were observed ($r > 0.699$). The roughness values were widely distributed even in the same wrinkle score because the measurement areas were limited and the values of skin roughness, including the microreliefs and/or small warts, were included in the calculation. However, changes in roughness values are considerable following treatment with potent active ingredients such as retinoic acid, so that this *in vivo* evaluation method is sufficient to objectively evaluate wrinkles. We conclude that the direct three-dimensional analysis of wrinkles *in vivo* should become a popular method to objectively evaluate wrinkles in clinical tests of wrinkle-smoothing ingredients or following cosmetic surgery to provide evidence of quantitative results.

Nanostructured lipid carriers as novel carrier for sunscreen formulations

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Incorporation of sunscreens into lipid carriers with an increased sun protection factor (SPF) has not yet been fully accomplished. In the present paper, the effectiveness of a sunscreen mixture, incorporated into the novel topical delivery systems, i.e. solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC), used as ultraviolet (UV) protector enhancers with a distinctly higher loading capacity has been developed and evaluated. SLN and NLC were produced by hot high pressure homogenization technique in lab scale production. Size distribution and storage stability of formulations were investigated by laser diffractometry and photon correlation spectroscopy. Nanoparticles were characterized by their melting and recrystallization behaviour recorded by differential scanning calorimetry. Lipid nanoparticles produced with a solid matrix (SLN and NLC) were established as a UV protection system. The loading capacities for molecular

sunscreens reported before now were in the range of 10–15%. It was possible to load NLC with up to 70% with molecular sunscreen, which is appropriate to obtain high SPFs with this novel UV protection system. The developed formulations provide a beneficial alternative to conventional sunscreen formulations. The UV protective efficacy of the lipid particles varied with the nature of lipid and UV wavelength.

Review Article

Pores in the epidermis: aquaporins and tight junctions

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Water homeostasis of the epidermis is important for the appearance and physical properties of the skin, as well as for water balance in the body. It depends on several factors, e.g. barrier quality, uptake of water into the epidermis, concentration of water-retaining humectants, and external humidity. Aquaporins (AQPs) are pores in the plasmamembranes of cells. Monomeric AQPs form barrel-like structures that are primarily water selective, some AQPs also transport glycerol and possibly other small solutes. In the epidermis, AQP3 is the predominant AQP. It is localized mainly in basal but also in suprabasal layers of the epidermis and is permeable for water as well as for glycerol, a humectant. Mice deficient in AQP3 exhibit reduced stratum corneum (SC) hydration and impaired SC barrier recovery after SC removal. In skin diseases associated with elevated transepidermal water loss (TEWL) and reduced SC hydration, altered expression of AQP3 was shown. Tight junctions (TJ) are cell–cell junctions, which play a central role in sealing the intercellular space of cell sheets and thereby establishing a paracellular barrier. Within the TJ, pores are postulated to exist, which allow the controlled diffusion of water and solutes via the paracellular pathway. In the epidermis, TJ structures were demonstrated in the stratum granulosum whereas TJ proteins were found in all viable layers. Mice which overexpress or are deficient of key-proteins of TJ die soon after birth because of a tremendous TEWL. In various skin diseases that are accompanied by elevated TEWL and reduced skin hydration, staining patterns of TJ proteins are altered. This review will summarize our current knowledge of the involvement of AQPs and TJ in the water homeostasis of the epidermis.