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Note

Stripping method to quantify absorption of two sunscreens in human

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Abstract

With the aim to know the remanence of two sunscreens, PEG-25 PABA and benzophenone, two cases have been considered: the application of aqueous solution of two filters studied for the application of oil-in-water (O/W) emulsions containing the same two filters on the skin of 21 voluntary women. In order to determine the quantity of filter remaining in the stratum corneum after times of application, which vary from 1 to 7 h, a series of six strippings have been carried out. The sunscreen agents were assessed by HPLC. With this study, it has been possible to emphasize the best remanence of benzophenone 4. Moreover, the incorporation of photo-protective agents in a O/W emulsion promotes their penetration, and this is particularly due to benzophenone 4.

Keywords: Benzophenone 4; PEG-25 PABA; Penetration; Remanence; Stripping

1. Introduction

On certain aspects, sun exhibition can be beneficial (D vitamin synthesis). However, it can have serious consequences on skin such as actinic ageing or something worse: skin cancers of different types according to the proportion and exhibition length (Patel et al., 1992; Horiot et al., 1995; Berset et al., 1996; Vanquerp et al., 1999). Thus, it is very important to use sunscreen agents in order to protect oneself from the effects of UV (Berardesca et al., 1991; Cole and Van Fossem, 1992; Sayre et al., 1992; Lotte et al., 1993). At present, research as far as sunscreens are concerned moves towards the conception of new molecules, which have a total innocuity, a small capacity to overcome the skin barrier, a good substantiality and an important remanence. The aim of our work was to establish a comparison between the remanence of two hydro-soluble sunscreens, a derivative of the para-aminobenzoic

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acid and benzophenone, with a stripping method performed on healthy and Caucasian volunteers.

2. Materials and methods

2.1. Chemicals

PEG-25 PABA (Univul P25™) and benzophenone 4 (Univul MS4O™) were obtained from BASF (Ludwigshafen, Germany).

2.2. Vehicles

The sunscreen agents were deposited on skin in water (6 mg/ml and 16 mg/ml, respectively, for benzophenone 4 and PEG-25 PABA) and in an oil-in-water (O/W) emulsion (80% distilled water and cetearyl alcohol, ceteareth-12 from Sidobre Sinnova, Meaux, France, paraffinum liquidum from Cooper, Melun, France, BHT from Lambert-Riviere, Fontenay-sous-Bois, France, propylene glycol from Laserson & Sabetay, Etampes, France, methyl paraben sodium and propyl paraben sodium from Merck, Nogent-sur-Marne, France). The sunscreen concentrations were 0.6 and 1.6%, respectively, for benzophenone 4 and PEG-25 PABA.

2.3. Stripping method

Informed consent was obtained from 21 healthy women aged 22-34 (25 ± 3 years). These volunteers were Caucasian subjects. They were kept recumbent for 15 min in a stripping room where the temperature was maintained at 20°C. A treated skin area of 4 cm^2 is situated at the level of the forearm. It is fixed by self-adhesive tapes in order to avoid lateral losses. Twenty-five microlitres of aqueous solution were applied with a microlitre syringe or 25 mg of cream with a glass spatula weighed before and after the deposit. Strippings were performed at 1, 2, 5 and 7 o'clock after treatment on the same volunteers. We con-

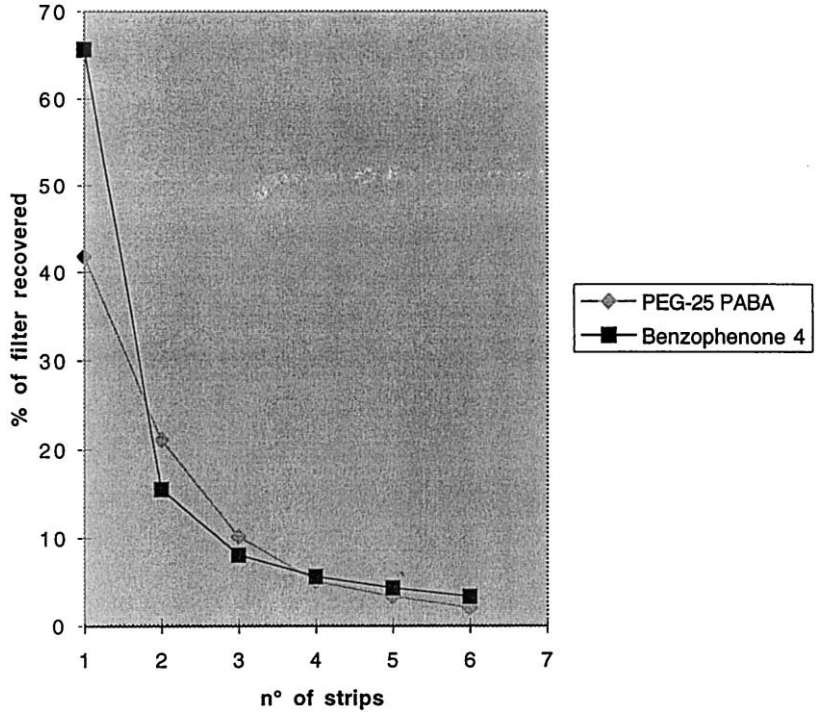

Fig. 1. Quantity of filter recovered after 1 h according to the number of strips.

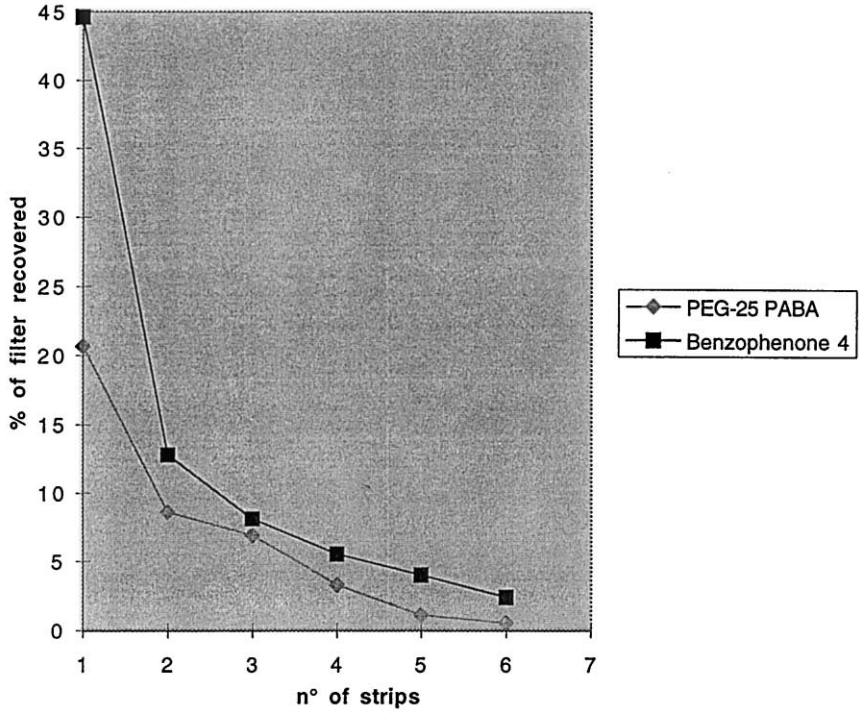

Fig. 2. Quantity of filter recovered after 7 h according to the number of strips.

sider that the first strip permitted us to get back the quality of filter which had not penetrated into the stratum corneum (Dupuis et al., 1986; Gean et al., 1989; Kompaore et al., 1991). In order to determine the remanence of a substance after some time of application, the first strip was taken into account. The stratum corneum was removed by six strippings with transparent adhesive tape (Blenderm™, 3M) (Martin et al., 1996; Marginean-Lazar et al., 1997). Ten millilitres of distilled water were added to the six strips, and each sample was shaken with a vortex mixer (Bioblock Scientific maxi-mix™ 92615). Then, we determined the sunscreen concentration in these solutions.

2.4. Apparatus and analytical procedures

The HPLC system was composed of a Water pump with 6000 A Model (Millipore Waters, Saint Quentin, France), a Water variable-wavelength detector with Lambda Max 481 LC model and a Merck integrator with D-2500 model (Merck, France). The analytical method has been described in a previous study (Vanquerp et al., 1999).

3. Results and discussion

Firstly, we have studied the behaviour of the filters in aqueous solution. Fig. 1 shows that after 1 h and for the first strip, 70% of benzophenone remained at the level of the stratum corneum, against only 40% for the PABA derivative. After 7 h (Fig. 2), benzophenone 4 was still more remanent than the PABA derivative (40% against 20%). This penetration of the PABA derivative could be due to its ethylene groupings, which allow it to emulsify itself in the surface cutaneous film and thus to penetrate. From Fig. 3, it is possible to visualize the quantity of filters that remained on skin according to the break time. As regards filters in solution, we can emphasize that

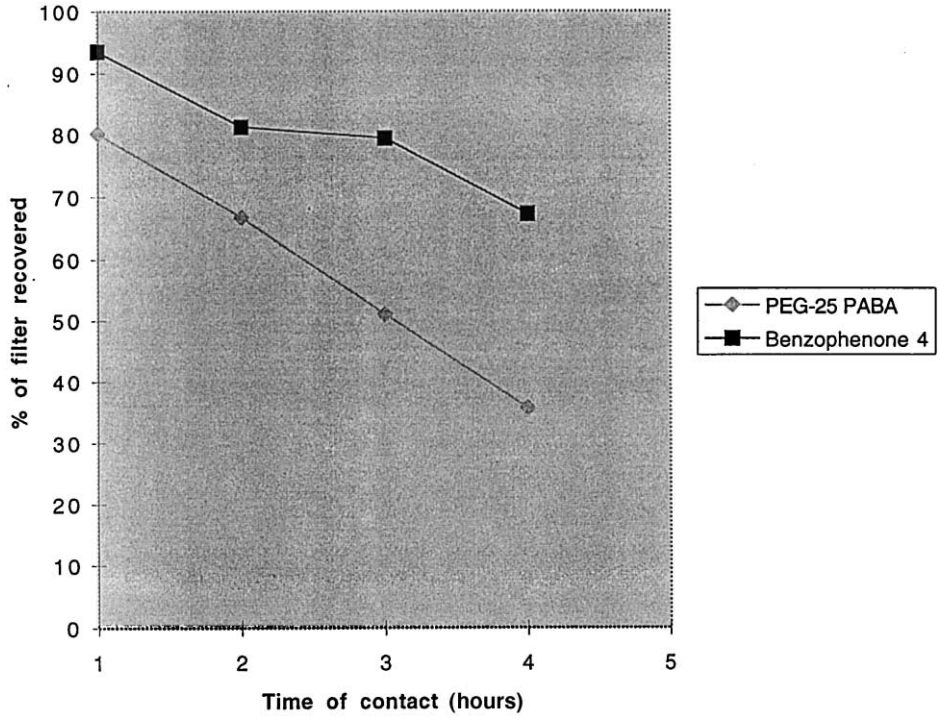

Fig. 3. Quantity of filter recovered according to the time of contact after application of an aqueous solution.

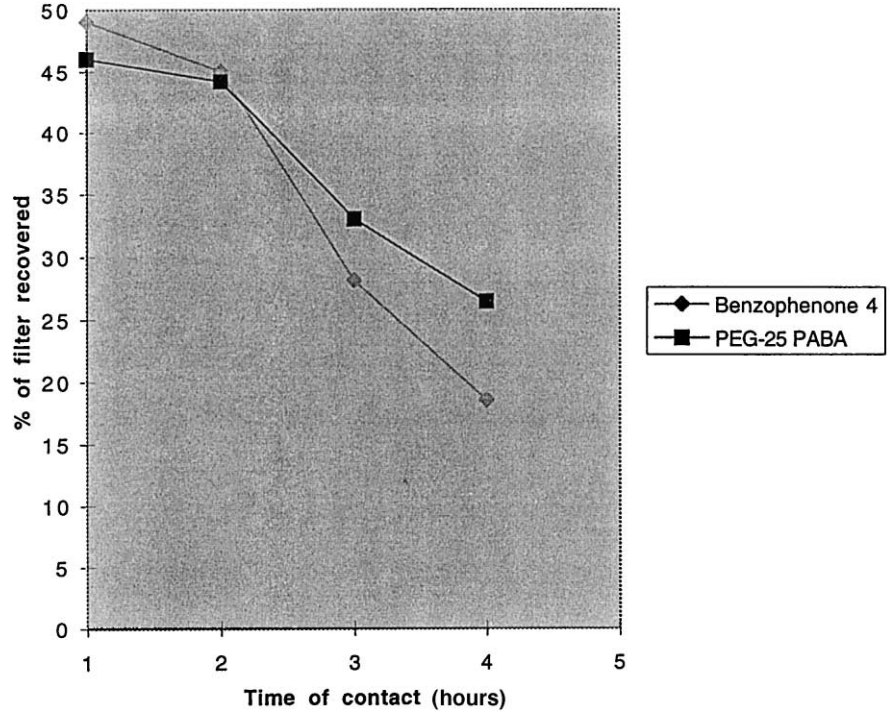

Fig. 4. Quantity of filter recovered according to the time of contact after the emulsion application.

benzophenone 4 seems much more remanent than the PABA derivative. Secondly, the incorporation of the same filters in an emulsion allows us to estimate the effect of the menstruum on their behaviour at the level of the stratum corneum. We note a smaller remanence compared with the results obtained with the aqueous solutions previously studied. After 2 h, only 45% of the filter (Fig. 4) remained, whichever one was considered.

This is not sufficient to provide an effective photo-protection and justify the rule that involves renewing the applications of anti-sun preparations every 2 h. After 7 h of application, only 20% of the filter initial concentration remained. Thus, the incorporation of filters in an oil-in-water emulsion promotes their penetration and particularly in the case of benzophenone 4.

The use of diluted aqueous solution proves indispensable in determining the intrinsic filter remanence (linked to its physicochemical characteristics). This theoretical value obtained, which allows the different filters to l12 be compared, must be accompanied by the remanence follow-up of the filters once incorporated into the cosmetic preparation wanted, which enables a relative remanence (linked to the menstruum used) to be established.

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