



## Sunscreen products: What do they protect us from?

C. Couteau, O. Couteau, S. Alami-El Boury, L.J.M. Coiffard\*

Université de Nantes, Nantes Atlantique Universités, LPiC, MMS, EA2160, Faculty of Pharmacy, 1 rue G. Veil-BP 53508, Nantes, F-44000 France

### ARTICLE INFO

#### Article history:

Received 16 February 2011

Accepted 26 May 2011

Available online 12 June 2011

#### Keywords:

SPF

PF-UVA

*In vitro* test

Non-melanoma skin cancer

Erythema

### ABSTRACT

Whereas for fifty or so years acquiring a tan has been the trend for aesthetic reasons relating to current beauty criteria, the health authorities are now advocating vigilance in this area, prompted by the knowledge of the harmful effects of the sun, especially from its ultra-violet rays. In the European Union, sunscreen products are considered cosmetics and tests on their effectiveness can be performed *in vivo* or *in vitro* to determine four effectiveness indicators: the SPF (Sun Protection Factor), the PF-UVA (UVA Protection Factor), the SPF/PF-UVA ratio and the critical wave length. It is the erythematous SPF which is measured in the vast majority of cases: it can therefore be confirmed that sunscreen products protect us from sunburn under good conditions of use. We thought it would be interesting to calculate other indicators to assess protection against non-melanoma skin cancers (NMSC) and to quantify the effectiveness of the product against UVA1 or UVA2. To characterize the products tested, we have determined *in vitro* different SPF and PF-UVA values, by using not just the erythematous weighting factor but also the weighting factor relating to the non-melanocytic skin cancer (SPF<sub>cnm</sub> and PF-UVA<sub>cnm</sub>), by getting away from any weighting factor (SPF<sub>m</sub> and PF-UVA<sub>m</sub>) and lastly, by varying the integration limits to quantify the effectiveness of the tested product in the UVB (290–320 nm), UVA1 (340–400 nm) and UVA2 320–340 nm fields. In this way, and using these new indicators, we have been able to qualify eleven commercial products—ten cosmetic products and one medical device. It can be interesting to take into account the non-melanocytic skin cancer protection in order to qualify the sunscreen products.

© 2011 Elsevier B.V. All rights reserved.

### 1. Introduction

For many years, until really quite recently, the fashion for pale complexions outstripped that of tanned complexions (Witkowski and Parish, 2001). Parasols, hats, etc. were the physical methods used to avoid tanning as much as possible. It was not until the 1930s that this trend was reversed and tanned complexions took centre stage. The first sun creams and oils also made their appearance during this period (Gastou, 1923). The lack of regulations in this field left the door wide open to manufacturers who could market a wide variety of products (Urbach, 2001). One example is the Sun-bi-Sun® product from the Ducray laboratories, made up of a double cream mixing in variable proportions when squeezed from the tube; the active ingredient was bergapten, a photosensitising molecule which is now banned in cosmetics. Regulations since the 1970s have changed radically and sunscreen products are now required to meet a certain number of criteria: the SPF/PF-UVA ratio must be less than or equal to 3 and the critical wave length of the product (wave length below which the product is 90% effective) must be higher than or equal to 370 nm. As the method to

determine the SPF *in vivo* (Colipa) was based on a ratio of doses likely to trigger solar erythema and the PF-UVA on a ratio of doses likely to trigger the Meirowski phenomenon, it can be said that any sunscreen product marketed and compliant with the Commission recommendations no. 2006/647/EC of 22 September 2006 (OJEU of 26.09.2006) protects from sunburn. Action to prevent skin cancers occurring is essential, more than action to prevent sunburn. Based on this, we have tested and compared various products on the market with the same index providing cover for different situations in terms of photoprotection.

### 2. Experimental

#### 2.1. Materials

The various marketed products tested are presented in Table 1. They are mainly cosmetic products, with the exception of Daylong actinica® which has the status of class I medical device.

#### 2.2. Experimental methods

Thirty milligrammes of product exactly weighed were spread on PMMA plates (Europlast, Aubervilliers, France) over the whole surface (25 cm<sup>2</sup>) using a cot-coated finger. 15 mg remains on the finger

\* Corresponding author. Tel.: +33 2 40 41 28 73; fax: +33 2 40 41 29 87.

E-mail address: [laurence.coiffard@univ-nantes.fr](mailto:laurence.coiffard@univ-nantes.fr) (L.J.M. Coiffard).

**Table 1**  
Characteristics of the products tested.

No.	Trade name (Laboratory)	SPF labelled	Statut
1	Lait solaire très haute protection Enfant à l'extrait de calendula (Klorane)	50+	Cosmetic product
2	Photoderm max fluide (Bioderma)	50+	Cosmetic product
3	Photoderm max spray solaire (Bioderma)	50+	Cosmetic product
4	Soins soleil à l'uncaria d'Amazonie lait velouté corps (Galénic)	30	Cosmetic product
5	Nivéa sun Spray protecteur hydratant (Beiersdorf)	50+	Cosmetic product
6	Ambre solaire UV sensitive spray protecteur peaux intolérantes au soleil (Garnier)	10	Cosmetic product
7	Eucerin Sun lotion (texture extra légère) (Eucerin)	50	Cosmetic product
8	Hyseac – fluide solaire – protection haute peaux mixtes à grasses (Uriage)	30	Cosmetic product
9	Polysianes Crème veloutée hydratante, non grasse – Haute protection visage (Klorane)	30	Cosmetic product
10	Polysianes crème veloutée hydratante, non grasse – Protection moyenne visage (Klorane)	20	Cosmetic product
11	Daylong actinica (Spirig)	–	Medical device

cot. SPF and PF-UVA of the creams were measured *in vitro*. Three plates were prepared for each product to be tested and 9 measures were performed on each plate. Transmission measurements were carried out using a spectrophotometer equipped with an integrating sphere (UV Transmittance Analyzer UV1000S, Labsphere, North Sutton, US) (Couteau et al., 2007, 2008; Alami et al., 2007).

To characterize the products tested, we have determined different SPF and PF-UVA values, by using not just the erythema weighting factor but also the weighting factor relating to the non-melanocytic cancer (SPF<sub>cnm</sub> and PF-UVA<sub>cnm</sub>) (Fig. 1), by getting away from any weighting factor (SPF<sub>m</sub> and PF-UVA<sub>m</sub>) and lastly, by varying the integration limits to quantify the effectiveness of the tested product in the UVB (290–320 nm), UVA1 (340–400 nm) and UVA2 (320–340 nm) fields (Table 2).

For each product the following ratios *R* and *R'* were calculated, according to:

$$R = \frac{\text{SPF}}{\text{FP-UVA}}$$

$$R' = \frac{\text{SPF}_{\text{cnm}}}{\text{SPF}}$$

Ratio *R* maintains compliance of the sunscreen product with the European recommendation. Ratio *R'* is a new indicator translating an effectiveness in preventing non-melanoma skin cancers.

The ratio *R* makes it possible to make sure of the conformity of the solar product with the European recommendation. The *R'* ratio constitutes a new indicator in order to evaluate effectiveness in the field of prevention of the non-melanoma skin cancer.

**Table 2**  
Formulas used to determine various SPF and PF-UVA.

Indicator	Formula
SPF	$\frac{\sum_{290}^{400} E_{\text{e}\lambda} S_{\lambda} \Delta\lambda}{\sum_{290}^{400} E_{\text{e}\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
PF-UVA	$\frac{\sum_{320}^{400} E_{\text{e}\lambda} S_{\lambda} \Delta\lambda}{\sum_{320}^{400} E_{\text{e}\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
Ratio <i>R</i>	$\frac{\text{SPF}}{\text{PF-UVA}}$
SPF medium (SPF <sub>m</sub> )	$\frac{\sum_{290}^{400} (1/T_{\lambda}) \Delta\lambda}{\sum_{290}^{400} \Delta\lambda}$
PF-UVA medium (PF-UVA <sub>m</sub> )	$\frac{\sum_{320}^{400} (1/T_{\lambda}) \Delta\lambda}{\sum_{320}^{400} \Delta\lambda}$
PF-UVA2 erythema (PF-UVA2)	$\frac{\sum_{320}^{340} E_{\text{e}\lambda} S_{\lambda} \Delta\lambda}{\sum_{320}^{340} E_{\text{e}\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
PF-UVA1 erythema (PF-UVA1)	$\frac{\sum_{340}^{400} E_{\text{e}\lambda} S_{\lambda} \Delta\lambda}{\sum_{340}^{400} E_{\text{e}\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
SPF non-melanoma skin cancer (SPF <sub>nmsc</sub> )	$\frac{\sum_{290}^{400} \text{Enmsc}_{\lambda} S_{\lambda} \Delta\lambda}{\sum_{290}^{400} \text{Enmsc}_{\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
Ratio <i>R'</i>	$\frac{\text{SPF}_{\text{nmsc}}}{\text{SPF}}$
PF-UVA non-melanoma skin cancer (PF-UVA <sub>nmsc</sub> )	$\frac{\sum_{340}^{400} \text{Enmsc}_{\lambda} S_{\lambda} \Delta\lambda}{\sum_{340}^{400} \text{Enmsc}_{\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
PF-UVA2 non-melanoma skin cancer (PF-UVA2 <sub>nmsc</sub> )	$\frac{\sum_{320}^{340} \text{Enmsc}_{\lambda} S_{\lambda} \Delta\lambda}{\sum_{320}^{340} \text{Enmsc}_{\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$
PF-UVA1 non-melanoma skin cancer (PF-UVA1 <sub>nmsc</sub> )	$\frac{\sum_{340}^{400} \text{Enmsc}_{\lambda} S_{\lambda} \Delta\lambda}{\sum_{340}^{400} \text{Enmsc}_{\lambda} S_{\lambda} T_{\lambda} \Delta\lambda}$

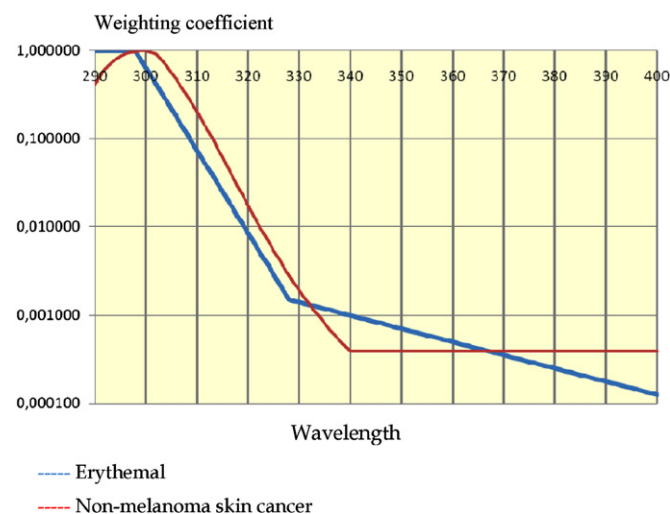
With  $E_{\text{e}\lambda}$ , CIE erythema spectral effectiveness,  $E_{\text{nmsc}\lambda}$  non-melanoma skin cancer spectral effectiveness,  $S_{\lambda}$  solar spectral irradiance and  $T_{\lambda}$  spectral transmittance of the sample.

### 3. Results and discussion

The products all comply with the recommendations published in the EUOJ of 26 September 2009 (Table 3). We have calculated a

**Table 3**  
Conformity of marketed products tested.

No.	SPF M ± DS	PF-UVA M ± DS	<i>R</i>	Critical wavelength $\lambda_c$ (nm)
1	74 ± 9	27 ± 3	2.76	378
2	76 ± 5	53 ± 3	1.43	382
3	76 ± 4	53 ± 3	1.44	382
4	58 ± 7	20 ± 2	2.93	375
5	82 ± 6	38 ± 2	2.16	380
6	18 ± 2	12 ± 1	1.46	381
7	59 ± 4	33 ± 3	1.75	381
8	41 ± 6	21 ± 3	1.96	381
9	36 ± 3	12 ± 1	2.93	376
10	49 ± 3	18 ± 1	2.75	374
11	104 ± 11	39 ± 4	2.69	380



**Fig. 1.** Variations of weighting coefficients for each wavelength concerning erythema and non-melanoma skin cancer (Norme CEI 60335-2-27, 2002).

Download English Version:

<https://daneshyari.com/en/article/2503532>

Download Persian Version:

<https://daneshyari.com/article/2503532>

[Daneshyari.com](https://daneshyari.com)