Using natural ingredients as sunscreens in cosmetic

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Introduction

European legislation currently authorizes 26 sun filters among which, there is only one mineral filter: titanium dioxide. In front of this low number of ingredients available, we investigated new resources. A certain number of molecules such as ferulic acid ethyl ester (FAEE), flavonoids and polyphenols have been studied because of their antioxidant, cancer-control and anti-inflammatory. This work present the results obtained with 11 molecules.

Materials and Methods

The molecules studied are presented table 1. They were incorporated into an emulsion L/H (Couteau et al., 2007a), which was formulated in the laboratory using varied incorporation percentages from 2 to 10%. Effectiveness in both UVB and UVA range was then determined according to two indicators: SPF and PF-UVA by using an *in vitro* method which we developed by adapting the work of Diffey and Robson. The sunscreen cream containing the ingredient to be tested was spread across an appropriate support (PMMA plates, 25 cm², Europlast, Aubervilliers, France) (Fig. 1). 15 mg of product must remain on the plate to facilitate a good *in vivo – in vitro* correlation (Couteau et al., 2007a). SPF and PF-UVA measurements were then taken using a spectrophotometer with an integrating sphere (Laser 2000, Saint-Nom-la-Bretèche, France). The values obtained for each molecule tested were then compared to the values obtained with currently authorized filters in order to estimate the interest of each. The photostability of the formulated creams was then studied by irradiating them for 2 hours (the amount of time after which it is recommended to re-apply a sunscreen product). PMMA plates coated with cream were irradiated using a Suntest® (Suntest CPS+, Atlas, Moussy-le-Neuf, France) at 650W/m² in order to simulate the conditions of use for this type of product. A sunscreen cream is considered photostable if it retains 90% effectiveness after two hours of exposure to sunlight (Couteau et al., 2007b).

Name	Supplier
Ethylferulate	Kraeger GMBH& Co, Ellerbek, Germany
Apigenine	Daqing New Century Fine Chemicals, Daqing, China
Baicaline	Daqing New Century Fine Chemicals, Daqing, China
Luteoline	Daqing New Century Fine Chemicals, Daqing, China
Myricetine	Daqing New Century Fine Chemicals, Daqing, China
Puerarine	Daqing New Century Fine Chemicals, Daqing, China
Chlorogénic acid	MPPinc, US
Diosmine	Sigma Aldriche, St Quentin, France
Caffeic acid	Sigma Aldriche, St Quentin, France
Rutine	Fisher Bioblock, Illkirch, France
Quercetine	Fisher Bioblock, Illkirch, France

Table 1. Studied molecules

Fig.1. Spreading out on PMMA plate

Results

The results obtained for each molecule tested at 10% (w/w) are presented in Table 2.
Non-patented organic UVB filters currently available on the market and authorized by law were rated according to their effectiveness. SPF levels obtained range from 1.66 for benzylidene camphor to 20.00 for anisotriazine. Each filter was used at its maximum dose rate. It is clear then that all of the molecules presented offer an effectiveness which is largely superior to benzylidene camphor (Choquenet et al., 2008a). Ethyl ferulate or ethyl-4 hydroxy-3 methoxycinnamate proved to be the best filter tested (Choquenet et al., 2008b); its effectiveness is much higher than the authorized cinnammates (octyl methoxycinnamate and Isoamyl p-methoxycinnamate) (fig.2).
In terms of UVA activity, if we compare the molecules tested against authorized molecules, we can see that the best currently authorized UVA filter is anisotriazine (broad spectrum UVB filter) with a PF-UVA of 12.00 and the least effective is benzophenone-3 with a PF-UVA of about 2.5. Here too, all the molecules tested fit inside this range. Apigenin is almost as effective as anisotriazine (fig.3). Eight molecules can be used to create photostable sunscreen creams; only three (ethyl ferulate, caffeic acid and chlorogenic acid) are not. This photostability problem is not prohibitive since nearly 70% of commercial filters (meaning 12/18) are not photostable and therefore must be used in combination.

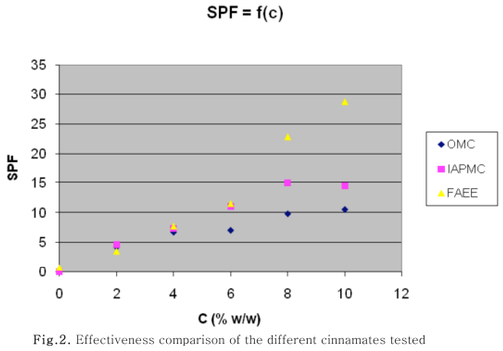

Fig.2. Effectiveness comparison of the different cinnamates tested

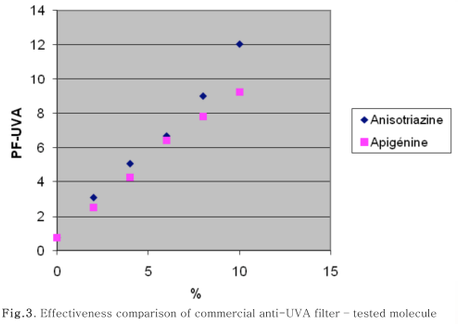

Fig.3. Effectiveness comparison of commercial anti-UVA filter – tested molecule

Molécule tested	SPF ± SD	PF-UVA ± SD
Ethylferulate	28.71 ± 3.54	7.46 ± 0.30
Rutine	4.72 ± 0.20	4.92 ± 0.20
Quercetine	4.52 ± 0.38	5.77 ± 0.55
Diosmine	3.18 ± 0.19	4.15 ± 0.28
Myricetine	3.16 ± 0.27	2.91 ± 0.24
Caffeic acid	6.20 ± 0.23	3.81 ± 0.09
Puerarine	6.23 ± 0.95	2.48 ± 0.15
Apigenine	7.34 ± 1.26	9.21 ± 1.74
Luteoline	7.66 ± 0.48	8.31 ± 0.52
Baicaline	8.49 ± 0.81	6.21 ± 0.53
Chlorogenic	10.13 ± 1.56	5.89 ± 0.47

Table 2. Antisolar efficacy of natural tested molecules

Conclusion

The natural environment seems to offer possibilities for finding new molecules with sunscreen potential. Certain chemical families like the flavonoids appear to be particular interesting. Furthermore, we discovered that all the molecules tested, with the exception of ethyl ferulate, have a broad action spectrum which is interesting with respect to the current regulatory framework.

Bibliographie

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