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The validation of sun protection factor（SPF）measurement for sunscreen products

（化粧品防曬係數測定之確效研究）

Abstract

The testing of sun protection factor（SPF）for sunscreen product is important in order to provide correct information to consumers against the risks of skin diseases related to sun exposure. Both in-vivo and in-vitro methods used nowadays have their drawbacks. This study is intended to find another way to provide effective and accurate way for measuring sun protection factor（SPF）of sunscreen product. The results show that by improving the sample application method to give more uniform film can have more precise results of sun protection factor（SPF）. However, the substrate for application still need to be examined according to the formulation of the sunscreen products.

Objective

The objective of this research is to evaluate the influence of the factors which effect the measurement of SPF of sunscreen products.

Introduction

The labeling of sun protection factor（SPF）has got tremendous attention in recent years accomplished by the increasing awareness of the risks of skin diseases related to sun exposure by consumers. The testing of sun protection factor（SPF）is then a work which need extra caution to prevent the misleading or provide false information to the consumers.

An effective sunscreen, whether organic or inorganic, must block the ultraviolet (UV) radiation in the spectral region of 400 - 290 nm（the UV-A and UV-B region）for reaching the skin. The active ingredient that shields the skin works by either reflecting or absorbing the ultraviolet (UV) radiation, it must be present in sufficient quantity and uniformity for the protection of skin.

The traditional method for sunscreen analysis is based on the quantitative analysis of samples using spectrophotometric method which is obeying the Beer's Law, A = abc. Where, A = the absorbance of analyte; a = the absorptivity coefficient of the analyte - a constant; b = the light path length - generally considered as a constant; and c = the concentration of analyte. diluted. A series of standards of the active ingredient with different concentrations have to be prepared for the measurements. However, the measurement does not reflect the real situation of sun protection properties of sunscreen applied on skin.

Beside the above method, both in-vivo and in-vitro methods have therefore been developed for the measurement of SPF for sunscreens. The Sun Protection Factor (SPF) determined in-vivo is now a universal indicator of the efficacy of sunscreen products against sunburn. The sun protection factors（SPF）of sunscreen is determined in a cohort of volunteers. The conventional approach is to administer each subject to a series of exposures (normally between five and seven) on their sunscreen-protected skin. It can be time-consuming particularly on products designed to provide high levels of protection.

By contrast, the in-vitro method developed by Diffey and Robson[1] uses a UV transparent substrate, 3M Transpore surgical tape, to examine the final sunscreen formulation. The quantity and uniformity for the application are the major difficulties in this method which cause great variation during the measurement. However, no

dilution and no standard preparation is necessary. Therefore, in-vitro method can be more time saving but have to be handled with greater care.

In this study, the main research point is to improve the sunscreen's application method to provide more uniform film with definite thickness. No literature was found in this approach till now. The method is planned to compare with conventional in-vitro method.

Materials and method

Materials and Instruments

sunscreens（with various formulation）
SPF 4 Standard Lotion（Labsphere, New Hampshire, USA）
3M Transpore surgical tape
Quartz plate（2×5 cm^2）
UV-1000 Ultraviolet Transmittance Analyzer（Labsphere, New Hampshire, USA）
Film Applicator（ZUA 2000, Zehntner, Switzerland）

Methods

1. Conventional in-vitro measurements：
   3M Transpore surgical tape is first cutted to fit the size of the Quartz plate and then taped on the top surface of the Quartz plate.
   Standard Lotion is applied on the surface of the Quartz plate with 3M Transpore surgical tape.
   Sunscreens with different formulation are applied to the surface of individual Quartz plate with 3M Transpore surgical tape with the same weight of the Standard Lotion.
   Measuring the SPF value using UV-1000 Ultraviolet Transmittance Analyzer.
2. The proposed measurement method：
   Standard Lotion is applied on the surface of the Quartz plate without 3M Transpore surgical tape using Film Applicator with different thickness.
   Sunscreens with different formulation are applied on the surface of the Quartz plate without 3M Transpore surgical tape using Film Applicator with different thickness.
   Measuring the SPF value using UV-1000 Ultraviolet Transmittance Analyzer.

Results

The SPF Measurement results of SPF 4 Standard Lotion vs. time

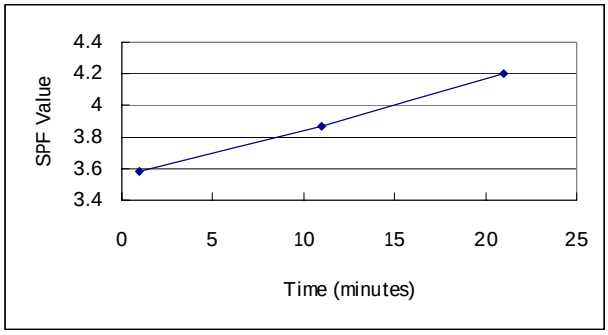

Fig. 1.

The SPF Measurement results of SPF 4 Standard Lotion vs. thickness.

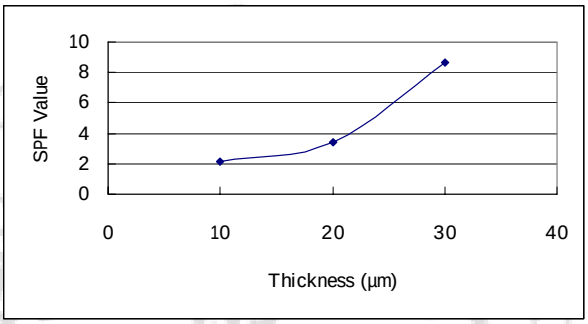

Fig. 2.

The SPF Measurement results of Sample 1 Lotion vs. time with thickness of 20μm.

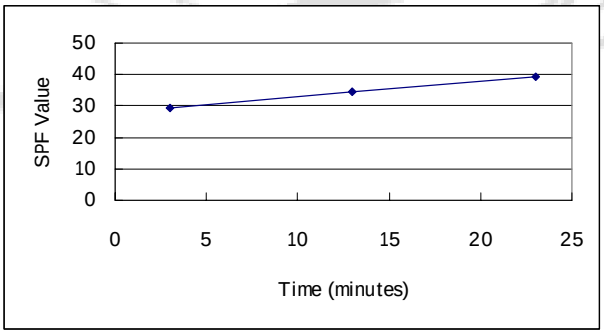

Fig. 3.

The SPF Measurement results of Sample 2 Lotion vs. time with thickness of 20μm.

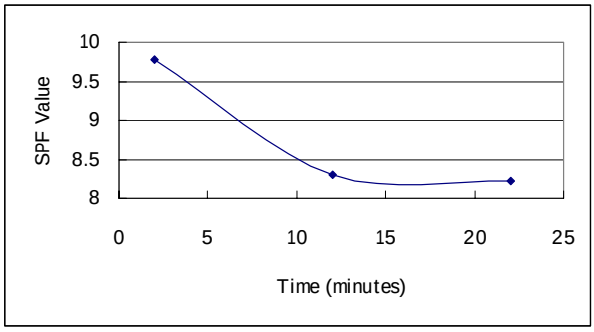

Fig. 4.

Discussion

In the measurement of SPF with conventional in-vitro method, in order for the SPF value of standard lotion to be coinciding with the measured result, the weight of the standard lotion is controlled to meet this requirement. However, under this situation, the thickness of the standards is difficult to control throughout the entire surface area. Therefore, the measurements have to be choosing on certain spots. The same situation is also happened during the application of sunscreen product with the same weight.

With the help of film applicator, both standard lotion and sunscreen product can be applied uniformly on the substrate's surface, which also give more results with higher precision.

Due to the various formulations of sunscreen products, the physical state, such as the viscosity, of the sunscreen products are different from each other. The application of sunscreen with film applicator therefore has different appearance.

Conclusion

The measurement of sun protection factor（SPF）can be influenced by the application method, applied amount, film thickness, formulation and measuring time. Therefore, it is hard to draw a standard operation procedure（SOP）for all the product with different formulations. It is recommended that the procedure for measuring SPF should be distinguished with product of different formulations. Secondly, the measurement is better to be dynamic, the variations of SPF versus time could give better pictures about the protection capabilities of the sunscreen products.

References

[1] B.L. Diffey, J. Robson, *J. Soc. Cosmet. Chem.*, 40, 127-133, 1989.