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Photostability of UVA/UVB Sunscreens Under Extreme Tropical Sun Exposure

TECHNICAL BULLETIN

Neutrogena Dermatologics

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Introduction

With increasing evidence of the damaging potential of UVA on the skin comes the awareness for the importance of broad-spectrum UVA/UVB sun protection.[1,2] Avobenzone (butyl methoxydibenzoyl-methane) provides the broadest UVA absorbance than any other chemical or physical sunscreens. However, avobenzone can be chemically unstable upon UV irradiation if not properly formulated (**Figure 1**). It has also been reported that avobenzone can enhance the degradation of UVB protection agents in sunscreens.[3]

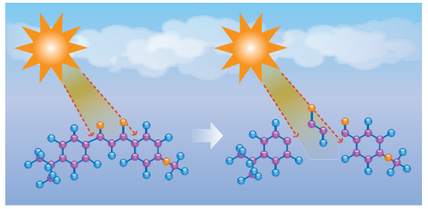


Figure 1. Breakdown of Avobenzone by UV irradiation

A sunscreen system combining avobenzone and oxybenzone and containing diethylhexyl 2,6-naphthalate has been developed to provide maximum broad spectrum UVA/UVB protection that is photostable.[4] In this study, the stability of this patented photostable sunscreen system (PSS), when exposed to direct tropical sunlight in an in-life environment, was evaluated by benchmarking to two other broad-spectrum UVA/UVB sunscreens.

Objective

To evaluate the in-life photostability of sunscreen products under extreme tropical sun exposure.

Materials and Methods

Test Products

Sunscreen Product	Label SPF	Active Ingredients
Test Product (PSS)	55	Avobenzone, Homosalate, Oxybenzone, Octocrylene
Benchmark 1*	60+	Avobenzone, Terephthalylidene Dicamphor Sulfonic Acid, Drometrizole Trisiloxane, Octocrylene, Cyclopentasiloxane, Titanium Dioxide.
Benchmark 2**	50	Homosalate, Octinoxate, Octocrylene, Oxybenzone, Zinc Oxide

* Marketed in Europe.

** Commercially available in the U.S.

In-Life Sun Exposure Photostability Evaluation

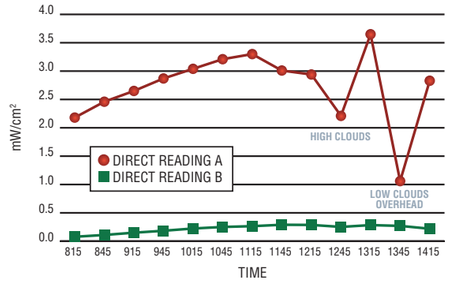
Study was performed in Kona, Hawaii (Latitude 21 degrees N) on a sunny July day using a modified method of Lebwohl, *et. al.* (1995).[3]

Kona, Hawaii, July 12, 2005

- Sunscreens were applied as an even film (2 mg/cm^2) onto clear polymethacrylate (PMMA) plates (25cm^2).[5, 6]
- Transmittance of UVA and UVB through the PMMA plates with and without sunscreens, and direct irradiances of UVA and UVB were measured at 30-minute intervals for 6 hours from 8 AM to 2 PM, using a radiometer.
- Transmittance through a clear PMMA plate without sunscreens was used as 100% control. The relative transmittance values were calculated and plotted as a function of sun exposure time for each sunscreen.

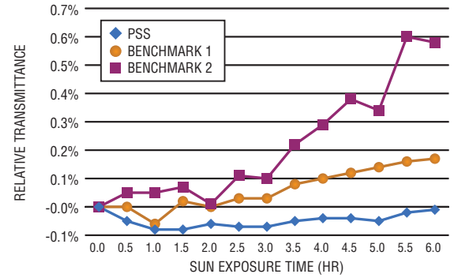
Results

Figure 2. UV Irradiances From The Sun Over Time



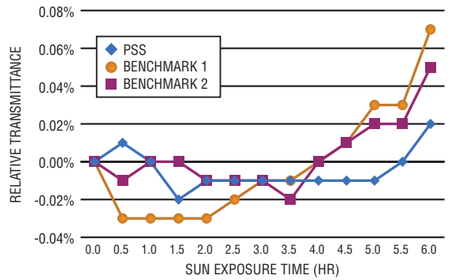
UV Irradiances From The Sun During The Study. UVB intensities were 2.18 to 3.3 mW/cm^2 for UVA and 0.08 to 0.28 mW/cm^2 for UVB. The latter correlated with direct exposure times for 1 MED of 21 to 8 minutes of unprotected exposure for people with Fitzpatrick type II skin.

Figure 3. UVA Penetration Through Sunscreens As a Function of Sun Exposure Time



Changes in UVA Penetration Through Sunscreens As A Function of Sun Exposure Time. UVA transmittance was measured at the indicated time intervals as described in the Materials and Methods. Benchmark 2 is the least stable in UVA protection, showing the greatest rise in UVA transmittance. Benchmark 1 is quite stable showing a slight, gradual rise in UVA transmittance over the course of sun exposure. PSS is the most stable in UVA protection, showing no increase in UVA transmittance over time. There is a statistical difference ($p<0.001$, t-test) between PSS and both Benchmarks.

Figure 4. UVB Penetration Through Sunscreens As a Function of Sun Exposure Time



Time Course of UVB Transmittance of Sunscreen Formulations under direct tropical sun exposure. In ***Figure 4,*** all three sunscreens are stable with respect to UVB.

Conclusions

- The test product containing the patented photostable sunscreen system with avobenzone was shown to be stable in screening out UVA and UVB under the study conditions.
- All three sunscreens tested are stable with respect to UVB protection.
- Under the in-life conditions tested in the study, the sunscreens were subjected to direct tropical sunlight which contains the entire UV spectrum and other types of sun radiation (e.g.: IR, visible). Thus the PSS sunscreen was proven to provide stable UVA/UVB screening protection under this acid test condition.