A comparison of two physical light blocking agents for sunscreen lotions

UV-56
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Introduction

Traditionally sunscreen lotions have employed organic chemicals to provide solar UV protection (290-400 nm). More recently, physical light blocking agents such as microfine titanium dioxide have been used to great effect in sunscreen lotions. Physical light blocking agents add substantially to the protection afforded by sunscreens for three main reasons.

1. They extend the protection over a broader wavelength range. This is a function of their high refractive index which gives excellent light scattering properties[1].
2. They work synergistically with chemical absorbers to boost the Sun Protection Factor (SPF)[2].
3. They are protective and soothing to the skin and therefore reduce the irritant and allergic potential of conventional sunscreens.[3]

Microfine titanium dioxide was first used in a cosmetically acceptable sunscreen by Ego Pharmaceuticals Pty Ltd in 1988. Since this time it has gained popularity as a sunscreening agent and has been incorporated into many other brands of sunscreens. Recently microfine zinc oxide has been introduced as an alternative physical blocking agent.
We report here a rapid *in vitro* comparison of the absorption properties of microfine zinc oxide and microfine titanium dioxide.

Experimental

The absorbance in the region 290-400 nm of pigment dispersions (24 micron films) was measured using a Cary 5 UV-vis-NIR spectrophotemeter fitted with a Cary Diffuse Reflectance Accessory (DRA). A baseline was recorded on the dispersion base.
Pigment dispersions were prepared in castor oil/ isopropyl myristate using a Silverson Homogeniser (series L4R) in a glass beaker. The percentage pigment corresponds with typical levels used in sunscreens (Table 1).

TiO_2* (g)	ZnO**(g)	Castor oil (g)	Isopropyl Myristate (g)	Homogenizer Setting:	time (min)
3	0	85	12	5.5	3.0
0	3	85	12	5.5	3.0
3	3	85	9	5.5	3.0
0	0	85	15	-	-

* TiOveil IPM; Tioxide UK
** UFZO; Cosmo Trends, Japan

Table 1: Pigment dispersions: composition

Thin films (24 micron) of the dispersions were prepared on spectrophotometrically matched quartz slides using a wire wound metering rod (Sandmar products, Australia). A line of pigment dispersion (0.05-0.15 g) was applied to the top of the slide as shown in Figure 1. A 24 micron wire wound metering rod was placed on the slide and using an even, steady pressure, the rod was drawn along the length of the slide, without rotation, to produce a uniform film. The film was then secured over the sample port of the DRA and the absorption of the film was measured.

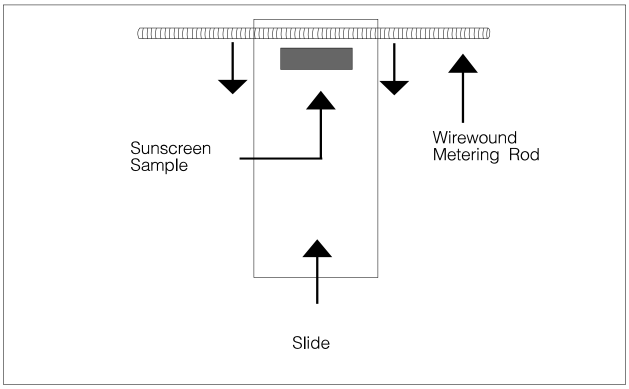

Figure 1: Preparation of films

Results and Discussions

As shown in Figure 2, the reproducibility of this method is adequate for a general comparison of absorption characteristics. Titanium dioxide exhibits a much stronger absorption of UV light than zinc oxide, however, between 390-370 nm the zinc oxide absorbance rises more sharply than titanium dioxide. When the two pigments are combined there is a general antagonistic effect on the absorbance.

When the pigments were combined (3% TiO_2 + 3% ZnO), there was an apparent antagonistic effect on the UV absorbance which suggests that in a sunscreen, such a combination would provide less UV protection than titanium dioxide (3%) alone.

This study has only looked at the *in vitro* properties of these agents and further work using an *in vivo* assay would be required to confirm these results.

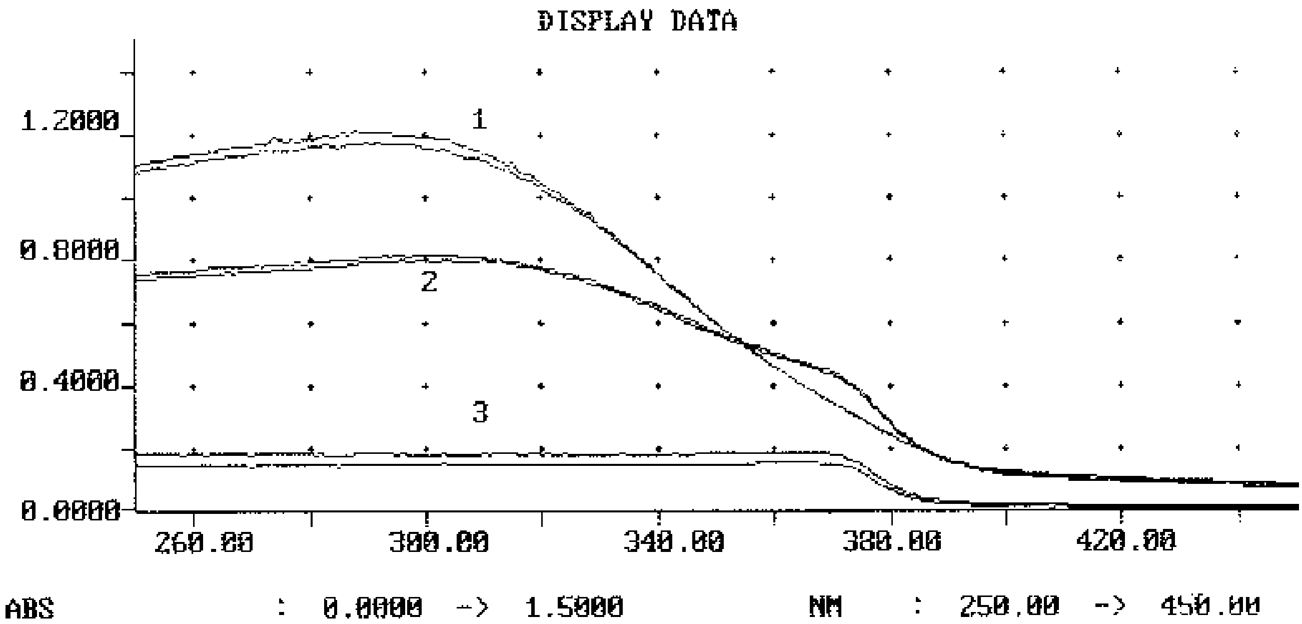

Figure 2: Absorbance spectra of pigments

Trace 1 = TiO_2 (3%) duplicates

Trace 2 = TiO_2 (3%) + ZnO (3%) duplicates

Trace 3 = ZnO (3%) duplicates

This result suggests that a combination of TiO_2 (3%) and ZnO (3%) in a sunscreen would provide less protection from UV radiation than TiO_2 (3%) alone. This behaviour is the reverse of organic UV absorbers where combinations produce an additive effect on absorbance. The antagonistic effect may be due to variations in the nature of the pigment dispersion leading to a reduced absorbance. Such variations could exist in sunscreens containing these physical blocking agents. It should be noted, however, that this is an *in vitro* study and that the results would need to be substantiated by an *in vivo* assay.

Conclusion

Using an *in vitro* technique, the general UV absorption characteristics (250-400 nm) of microfine titanium dioxide and microfine zinc oxide have been compared. Microfine titanium dioxide shows much greater absorption of UV radiation than microfine zinc oxide.

References

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3. Martindale (**1982**). The Extra Pharmacopoeia (The Pharmaceutical Press) London p507.