Importance of Broad Spectrum Inorganic Sunscreens in Preventing UV and Near-UV Induced Free Radical Damage to the Skin

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Abstract

Consumers are becoming more aware of the effects of the sun such as erythema, premature ageing and even skin cancer, so it is important to formulate suncare products that offer full UV spectral coverage. Whilst many people have protected themselves against UVB radiation (290 – 320nm) and therefore burning for many years, the damaging potential of UVA radiation is now coming to light. Furthermore, the potential of near-UV, or High Energy Visible (HEV) light, is fast becoming realised and this has been linked to premature ageing, the formation of wrinkles and, more recently, to DNA damage.

Electron Spin Resonance Spectroscopy (ESR) has been used to investigate the formation of radicals in skin substitutes under the action of UV-visible and near-UV radiation. Crucially, protecting the skin substitutes with organic and inorganic UV sunscreens has been proven to reduce the number of radicals formed in the samples, thus highlighting the importance of a broad spectrum physical shield in preventing both UV and near-UV (HEV) induced radical damage.

Introduction

Exposure to sunlight is of the utmost importance in vitamin D3 formation and has the additional cosmetically desirable effect of imparting a bronzed, tanned glow to our skin in the summer months. Indeed, when people sunbathe their bodies produce endorphins, which contribute to a 'feel-good factor' and enhance a person's mood. However, it is now completely indisputable that the sun's rays can damage the skin.

The short-term damaging effects of overexposure to UV radiation to the skin are well recognised by consumers, including skin reddening, blistering and burning. Furthermore, consumers are currently becoming more aware of the associated longer-term adverse effects and it has been widely reported and well documented that excessive exposure to UV radiation can cause sun burn, photoageing, photoimmunosuppression and photocarcinogenesis[1-4]. Table 1 summarises how light can be categorised according to its wavelength range and the potentially dangerous effects on the skin.

Whilst many people have protected themselves with sunscreens against UVB radiation and therefore burning for many years, this only comprises 5% of the total UV radiation that reaches the earth's surface. 95% of the total UV radiation reaching the earth is made up from UVA radiation, therefore it is important when formulating anti-ageing skin and sun care products that full UV spectral coverage is attained.

Region	UVB	UVA	HEV (Near-UV)
Wavelength Range (nm)	280–320	320–400	380–500
	Decreasing Energy →		
	Increasing Penetration →		
Penetration	Epidermis to Basal Cell	Dermis	Dermis to Blood Cells
Damage Caused to Skin	• Reddening • Blistering • Skin Cancer	• Free Radical Formation • Skin Ageing • Vascular and Lymphatic Damage • DNA Damage	• Degrades Elastin and Collagen • Formation of Glycation Wrinkles • Premature Ageing

Table 1. Summary of How UV Light can be Categorised According to Wavelength and the Corresponding Potential Damaging Effects to the Skin