How Safe are Sun Protection Products?

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Abstract

Sun protection preparations (sunscreens) are classified differently internationally. The Sun Protection Factor (SPF) determination methods as well as the UV filter substances are not yet harmonised. According to all available scientific studies, the UV filters sold in the EU are effective and safe. Further research is necessary to implement sun protection filters in the nano sector. According to the current legislation in Europe, one cannot expect the development of new and better biodegradable UV filter substances, because the necessary animal testing is prohibited and alternative methods are not predictable.

Introduction

Solar radiation is essential to all life on earth. In terms of how this concerns humans, it has major advantages and disadvantages. Sunlight increases the joy of life – most people can agree on that. Scientifically this can be proved by showing that bright light has an antidepressant effect[1]. Moreover, solar radiation exposure is essential for the generation of Vitamin D in humans, which has a positive effect on health[2,3]. More subjective and possible objective effects of sunlight on humans could be added. The major disadvantages of solar radiation exposure are the ageing effect and, of course, the carcinogenic potential.

Solar radiation is composed of electromagnetic radiation in a frequency spectrum that partly reaches the earth's surface: infrared radiation (IR), visible light (VL), ultraviolet A (UVA) and ultraviolet B (UVB) radiation. Figure 1 (see next page) gives an overview of this.

Sun protective cosmetics (sunscreens) are designed to reduce the negative features of solar radiation on the human skin to a minimum. Chemical and physical filters are used in sunscreens to increase the SPF.

Solar Radiation and its Effect on Human Skin

For a long time it has been believed that by the age of 18 humans have received 80% of their lifetime dosage of UV radiation. Recent studies cast reasonable doubt on this view. The linear approach is consistent here: up to the age of 18 about 23%, by 40 about 46% and at 59 about 74% of the lifetime dosage is reached. This is validated by a variety of American population studies[4], stating that UV exposure shows a uniform increase over one's lifetime. Therefore sun protection efforts are reasonable for all ages.

Reviewing the effects of solar radiation on human skin means separating it into its different components, as detailed below.

UV: Wavelength 200-400nm

This is divided into UVA (320–400 nm), UVB (280–320 nm) and UVC (200–280 nm). UVA and UVB reach the surface of the earth, whilst UVC is blocked by the atmosphere. UVA and UVB radiation are known to damage collagen fibres which results in accelerated skin ageing[5]. Moreover, both UV radiation types cause degradation of vitamin A[6]. While UVA is capable of producing short-term tanning by means of conformational changes of melanin in the skin (direct pigmentation), UVB exposure results in the synthesis of melanin and thus long-term tanning (indirect pigmentation). UVA has a carcinogenic effect by generating free radicals in the skin and thereby potentially damaging DNA indirectly, while UVB radiation is absorbed by DNA and can cause damage directly[5,7]. Erythema (sunburn) is caused mainly by UVB.

Visible Light: Wavelength 400-700nm

Visible light and its effects on human skin have been ignored for quite some time but recent studies have shown that its effect is comparable to that of UV regarding free radical generation (Reactive Oxygen Species, ROS) inside the skin. Furthermore, this increases the production of proinflammatory cytokines and Matrix Metalloproteinase 1 (MMP 1) expression[8].

Infrared Radiation: Wavelength 760–1440 nm

Just like visible light, the influence of infrared radiation on the skin has been ignored. But here recent studies also show an effect on regulatory processes in the skin[9]. Infrared A radiation (IRA) seems to regulate about 600 gene transcripts in skin fibroblasts. As expected, they are also jointly responsible for the skin ageing process. In addition, these gene transcripts are suspected of causing additional damage[9].