Tapping Into the Sun's Energy – Ultraviolet Light Activated Powders Influencing Extracellular Matrix Proteins

Authors: Vito Cataldo, James V. Gruber Ph.D., Francesca Muia, Arch Personal Care Products, L.P, New Jersey, USA

Abstract

Light holds energy that has been shown to interact with the skin, influencing its appearance and its physiochemical composition. From the ultraviolet (UV) region of the electromagnetic spectrum, light penetrates the skin with high enough energy to cause damage, leading to short term erythema and longer term cellular DNA damage and destruction of the dermal protein matrix, leading to photoageing. But light of longer wavelengths, in the visible region, for example, has less energy and can influence the skin in a positive way, leading to improved wound and acne healing and helping to reverse the visible signs of ageing.

Although light therapy is popular in the dermatological market with the use of high intensity lasers, there is a market need to develop a product that captures light therapy and incorporates it directly into skin care formulations. This concept has led our company to develop a new breakthrough technology based on the production of an Ultraviolet Light Activated Powder (ULAP) – a two-component system that (1) generates fluorescent light energy and (2) combines with essential amino acids to influence the physical and physiochemical properties of the skin. The initial developed ULAP will be discussed. It uses polyphenols extracted from a *morinda citrifolia* extract, bound to a Tricalcium phosphate carrier to generate red light fluorescence upon excitation with ultraviolet light. This photoresponsive powder is then combined with an active blend of yeast amino acids and the entire mixture, ULAP, is used to elicit positive skin benefits.

These benefits were investigated using a MatTek® full thickness skin tissue model *in vitro* to measure how ULAP helps with the upregulation of elastin upon photoactivation with UV light. The results were further studied *in vivo*, examining how the skin elasticity and visible appearance of human panelists improved with its application.

Introduction

Every day, our skin is exposed to different forms of radiation of varying wavelengths, ranging from high energy ultraviolet (UV) light mainly from the sun, to lower energy visible and infrared (IR) light from various sources. As we have studied it extensively in the past, we have become more aware of the detrimental effects of UV light, leading to sunburns and various skin cancers. The most studied form of UV light is UVB, with wavelengths in the range of 290-320nm. UVB is most responsible for the more immediate visible damage of the skin, such as tanning and sunburns. It has high energy and causes damage quickly. But it has also been linked with damage to cellular DNA, damage to the enzymes that repair DNA, and free radical production causing damage to cells, which eventually all lead to skin hyperplasia and photocarcinogenesis – precursors to cancer.

For this reason, sunscreens were developed to absorb this harmful energy and dissipate it in the form of heat, thus removing the danger.

There is also another type of UV light that can cause harm: UVA. With a wavelength range of 320-400nm, UVA has slightly less energy and a longer wavelength which allows it to penetrate into the skin much deeper, well into the dermis. Until recently, the damage from UVA was unknown and thought to be safe because of the lack of immediate visible damage like UVB. However, its effects are more long term and can build with time as the body cannot properly repair against the damage as it can with UVB damage. Some of this damage includes the breakdown of the collagen and elastin fibres that make up the dermal matrix. Further damage is the activation of signaling pathways that mediate the up-regulation of matrix metalloproteinase (MMP) expression leading to decreased collagen/elastin production and also causing hyperactive melanocytes leading to dark or light spots on the skin. These results are most responsible for the long term visible effects of,