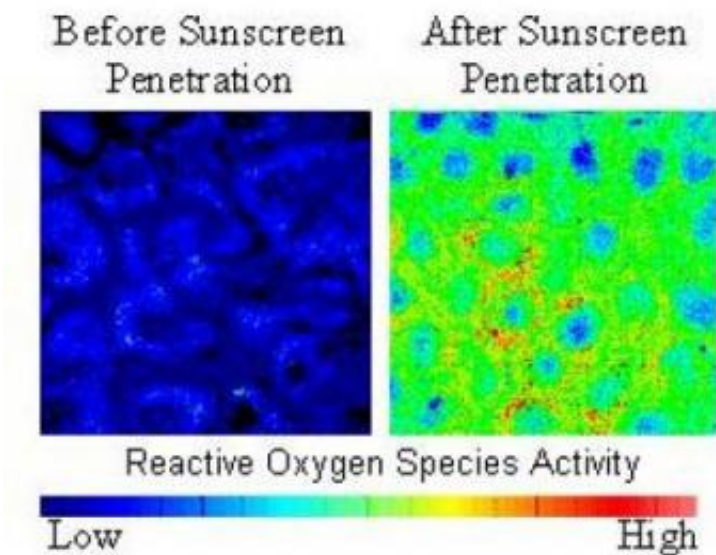


# Sunscreens can damage skin, researchers find

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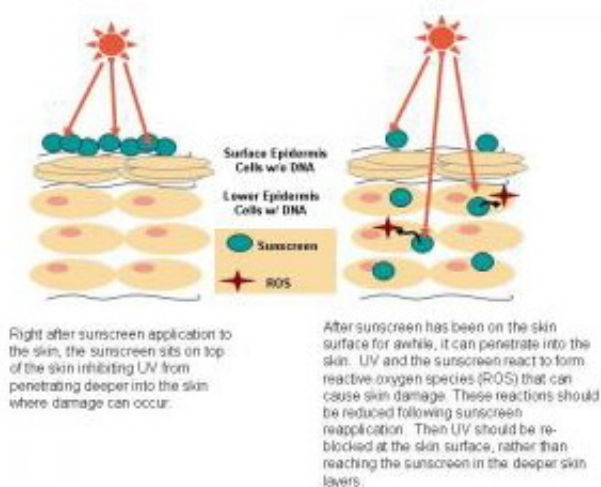


Two-photon fluorescence intensity images of cells deep in the epidermis showing reactive oxygen species activity following sunscreen application to the skin surface. Reactive oxygen species can react with cellular components, leading to skin damage and increasing the visible signs of aging. Credit: K. Hanson, UC Riverside

Are sunscreens always beneficial, or can they be detrimental to users? A research team led by UC Riverside chemists reports that unless people out in the sun apply sunscreen often, the sunscreen itself can become harmful to the skin.

When skin is exposed to sunlight, ultraviolet radiation (UV) is absorbed by skin molecules that then can generate harmful compounds, called reactive oxygen species or ROS, which are highly reactive molecules that can cause "oxidative damage." For example, ROS can react with cellular components like cell walls, lipid membranes, mitochondria and DNA, leading to skin damage and increasing the visible signs of aging.

When sunscreen is applied on the skin, however, special molecules – called UV filters – contained in the sunscreen, cut down the amount of UV radiation that can penetrate the skin. Over time, though, these filters penetrate into the skin below the surface of the epidermis, the outermost layer of skin, leaving the body vulnerable to UV radiation.



UV filters (octylmethoxycinnamate, benzophenone-3 and octocrylene) widely used in sunscreens generate reactive oxygen species (ROS) in skin when exposed to ultraviolet radiation, augmenting the ROS that is naturally produced. Credit: K. Hanson, UC Riverside

Led by Kerry M. Hanson, a senior research scientist in the Department of Chemistry at UCR, the researchers report that three UV filters

(octylmethoxycinnamate, benzophenone-3 and octocrylene), which are approved by the Food and Drug Administration and widely used in sunscreens, generate ROS in skin themselves when exposed to ultraviolet radiation, thus augmenting the ROS that is naturally produced. The researchers note that the additional ROS are generated only when the UV filters have penetrated into the skin and, at the same time, sunscreen has not been reapplied to prevent ultraviolet radiation from reaching these filters.

Study results will appear in an upcoming issue of *Free Radical Biology & Medicine*. An advance copy of the paper is available online on the journal's Website.

"Sunscreens do an excellent job protecting against sunburn when used correctly," said Hanson, who works in the laboratory of Christopher Bardeen, an assistant professor of chemistry at UCR. "This means using a sunscreen with a high sun protection factor and applying it uniformly on the skin. Our data show, however, that if coverage at the skin surface is low, the UV filters in sunscreens that have penetrated into the epidermis can potentially do more harm than good. More advanced sunscreens that ensure that the UV-filters stay on the skin surface are needed; such filters would reduce the level of UV-induced ROS. Another solution may be to mix the UV-filters with antioxidants since antioxidants have been shown to reduce UV-induced ROS levels in the skin."

In their research, Hanson and colleagues used epidermal model tissue and applied sunscreen to the surface to test the effect of sunscreen penetration on ROS levels in the deep epidermis. A two-photon fluorescence microscope allowed them to visualize ROS generation occurring below the skin surface. The ROS activity was detected using a probe molecule whose fluorescent properties change upon exposure to ROS. On comparing images taken before and after the skin was exposed

to UV radiation, they found that ROS generation in the skin increased after sunscreen penetration.

About 95 percent of the visible signs of aging are associated with UV exposure. About 90 percent of a person's total life-time UV exposure is obtained before the person is 18 years of age. Only a few UV-filters are available that block "UV-A," the wavelengths that penetrate more deeply into the skin, all the way into the dermis where collagen exists.

"For now, the best advice is to use sunscreens and re-apply them often – the Skin Cancer Foundation recommends every two hours, and especially after sweating or swimming, which can wash away sunscreen – to reduce the amount of UV radiation from getting through to filters that have penetrated the skin," Bardeen said. "This, in turn, would reduce ROS generation."

Next, the researchers plan to investigate the effect of smog on ROS generation in the skin.

Source: University of California - Riverside

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