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DERMAL DEFENSE WITH **CAFFEINE**

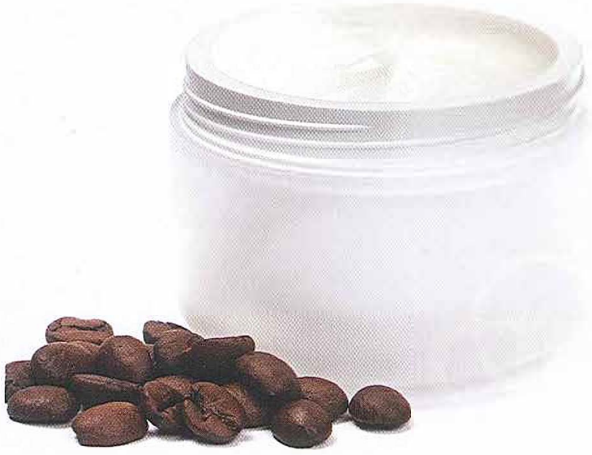
TAKING PROTECTION TO THE NEXT LEVEL

UV RADIATION IS A WELL DOCUMENTED cause of oxidative stress on the skin and cellular DNA mutation. The human body uses several internal mechanisms designed to mitigate the possible damage UV radiation can inflict on the skin. Melanogenesis, endogenous antioxidants and limiting cell replication are all internal processes designed to protect cells and prevent the copying of cells with damaged DNA. Even with these and other biological safeguards, some cells with damaged or compromised DNA do slip through. Topically applied caffeine has demonstrated an unprecedented ability to increase cutaneous protection against the negative effects of UV exposure. The potential of this ingredient is extraordinary.

BY IVANA VELJKOVIC

Dermal defenses

One of the biological processes designed to protect cells from UV exposure is pigment deposit. Through the process of melanogenesis, melanin is deposited in a parasol formation over the nucleus of a cell to protect the DNA from damage due to UV exposure. The result of this is a tanned appearance of the skin. This is clearly an indication that the skin is stressed and working diligently to protect itself from DNA damage. A "healthy tan" is the ultimate oxymoron.



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Additionally, the skin has its own endogenous (native) antioxidant defense system. This system works to fight off oxidative stress and damage to the skin. Some of the most important antioxidants in this system are superoxide dismutase (SOD), glutathione peroxidase and catalase. SOD disarms some of the most dangerous of reactive oxygen species (ROS) and turns them into hydrogen peroxide. Then, glutathione peroxidase and catalase break hydrogen peroxide into oxygen and water, rendering the ROS harmless. UV radiation challenges this internal antioxidant defense system in many ways. Not only does UV exposure produce free radicals in the skin, but it also renders the skin's own antioxidant system less effective. This is a dangerous combination. Supplementing the skin with additional antioxidants can help to bolster this protection and minimize potential UV-induced damage. Some important antioxidants to add to a patient's regimen are glutathione, vitamins C and E (which work in concert with glutathione to recycle and support one another), green tea, coffea arabica extract, ergothioneine and silybin.

The all-important DNA

Robust, healthy skin is dependent on the replication of keratinocytes with intact DNA. DNA damage is possible from environmental insults, as well as errors that can occur during replication. Because of this, there are biological processes that act as checkpoints during various parts of the cell cycle to be certain DNA is intact prior to additional cell division and replication. If damage is detected, these cells can, in some circumstances, be kept alive but unable to reproduce, or they can be targeted for apoptosis (cell death). Of course, sun avoidance, broad-spectrum sun protection and topical antioxidants can help minimize the chances of cell damage, but even the most powerful sunscreen is just that—a screen. Some radiation will get by and some cells will ultimately be damaged. Although this is highly unavoidable, topically applied caffeine adds a level of protection previously unattainable.

Caffeine: a new frontier

Until now, caffeine has primarily been used as an addition to formulations designed to reduce the appearance of cellulite. As a vasoconstrictor, caffeine leads to a temporary constriction of the blood vessels and a decrease in the leakage of serum from blood vessels. This overall reduction of dermal edema is likely the reasoning behind chemists using it in successful cellulite-fighting and under eye puffiness-reducing formulations. These purported benefits require many more peer reviewed studies to be substantiated. Caffeine's scientifically proven inhibition of tumorigenesis and resultant skin cancer is currently the most impressive of caffeine's known benefits.

Topically applied caffeine has demonstrated multi-functionality in its work against cutaneous UV damage. Its UVB-absorbing capability reduces the production of sunburn cells, as well as the formation and activity of UV-induced free radicals. And, although caffeine is not a polyphenol itself, a study measuring the antioxidant component in caffeinated and decaffeinated beverages demonstrated a dramatically higher level of antioxidant activity in the beverages containing caffeine. Caffeine clearly increases the antioxidant effect of some of the previously mentioned polyphenols, such as coffee and tea.

More compelling than its antioxidant value is caffeine's ability to facilitate the demise of

continues

damaged skin cells. The process of cell death is called apoptosis. Apoptosis is a complex chain of events comprised of an array of chemical reactions, ultimately leading to damaged cells being overtaken and recycled. This process occurs throughout the body thousands of times every day. In regards to skin cancer prevention, caffeine increases the skin's ability to identify and rid itself of damaged cells that could lead to the formation of cancer. Cells called "killer T cells" communicate with damaged keratinocytes, and call on other proteins and biomolecules to instigate cell death. The fact that topical caffeine can add this increased level of protection against the replication of damaged cells is inspiring. We understand that even with diligent use of sun protection, at least some UV radiation always reaches into the skin and potentially causes damage. The addition of topical antioxidants certainly helps, but some DNA damage is likely to occur, despite our diligence. Caffeine's ability to help the skin terminate damaged cells prior to tumorigenesis opens a whole new frontier of formulating products for healthy, protected skin.

Formulations on the frontier

The unveiling of the exciting science around caffeine's unique topical functions is likely to make this ingredient a more popular addition to skin care products in the future. Because of its unique combination of benefits, the most compelling product category to explore is sun protection. The knowledge of the cascade of damage that is caused by UV exposure in conjunction with the science of product advancement will lead to the development of highly effective and well-rounded protective products. Look for those that incorporate broad-spectrum UVA/UVB protection containing zinc oxide, titanium dioxide, avobenzone or encamsule. Next, look for the addition of polyphenol antioxidants in the formulation. Additionally, always select a product that provides skin with the unparalleled activity of topical caffeine. This new horizon for UV protection products is just the beginning for chemists looking to provide the very best for skin health. ■

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