A Day at the Beach
Steve Herman
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CHEMICAL REACTION BY STEVE HERMAN

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Sun exposure is recognized universally as damaging to skin.

Cosmetic formulators have countered sun damage with sunscreens, antioxidants and—after the harm has occurred—healing agents. Starting with a hearty dose of UV and an innocent victim, it is instructive to follow the lines of attack and defense. The process, from a molecular and biochemical perspective, shows the genuine value of properly constructed skin protection and treatment products.

The skin is the largest organ and the frontline of the battle between the body and the outside world. The outer portion, the stratum corneum, is all but dead. The next layers, the epidermis and dermis, are a broth of biochemical activity and, hence, live a precarious existence. Among the components of the dermis, lipids, proteins and DNA are particularly vulnerable to assault. After years of education and marketing, consumers now routinely accept UV protection as a necessity of life.

Assume that the typical sunbather has dutifully applied some waterproof SPF 30 lotion and headed out to a blazing beach an hour before noon, ready to bask until the late afternoon. Sunscreens have real clinical value, but are not good enough for the hapless sun worshipper. This person probably has not applied the sunscreen thick enough (2 mg/cm^2) to achieve the advertised sun protection factor, so it really never was SPF 30, and after 4 hours, its effect has plummeted. As a consequence, a significant amount of UV radiation is penetrating the dermis. Enter now a complex world of radiation, free radicals, DNA repair enzymes and antioxidants. Figure 1 shows this scenario, where some UV rays are not blocked by the sunscreen, creating harmful free radicals in the dermis. Vitamin E is there scavenging some of these free radicals, limiting the damage.

The actual process is very complex. UV has a variety of components, divided for cosmetic discussions as UVA1, UVA2, UVB and UVC. The penetration, damage potential and effective sunscreens for each must be considered in a rigorous discussion. If the sunscreen formulation does not provide full-spectrum protection, selective damage will result.

During the normal course of events, DNA is mutating constantly and, fortunately, the vast majority of mutations have no effect. One reason is that 95 percent of it is "junk DNA" that does not encode genes. Cells also have DNA repair enzymes, which clip out bad sections so the correct bases can be restored. When the damage is too extensive, the repair enzymes give up and send a signal to expel the cell. This results in the skin peeling after sunburn.

UV creates free radicals, active oxygen species that generate a cascade of molecular destruction. Enter vitamins. Vitamins have many useful attributes in personal care, a key one being their antioxidant powers. If the right ones are selected, the cascade of free radical production can be halted. Vitamins have considerable chemical diversity, and can be broadly divided into two groups: lipophilic and hydrophilic. The lipophilic ones penetrate the skin readily and, one of them, vitamin E, will be the defender in this case.

Back to the beach, the sunscreen has been overwhelmed by the incoming radiation, the DNA repair enzymes have surrendered, and the vitamin E has been unable to keep up with the free radical assault. The skin now has sunburn and possible peeling. It is unsightly and painful. The victim reaches for any product containing aloe, as people have done for several thousand years. Like vitamin C, aloe can be consumed as well as applied topically. Once positioned in the domain of folklore remedies, a significant body of efficacy data on aloe has been amassed.

There is no standard legal definition of aloe. Aloe diluted with water still can be called aloe, which allows it to appear as the main ingredient on many labels where the only motivation is to mislead the consumer. Despite this marketing exaggeration, aloe remains a genuinely useful healing agent widely accepted by the public as well as formulators. Much of

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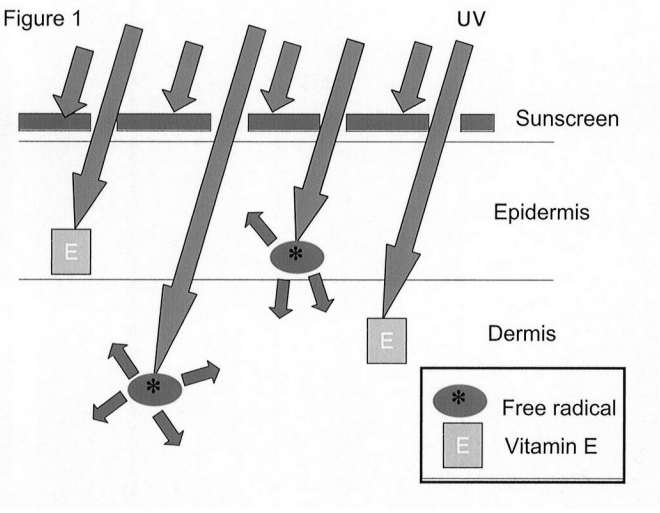
Figure 1



the beneficial activity is linked to the polysaccharide content in general and has been pinpointed to specific bioactive compounds such as acemannin. There are many other materials in aloe that may have therapeutic value: saponins, amino acids, enzymes and vitamins among them.

The solids content of the aloe is a key attribute. The industry standard 1:1 product has a minimum solids content of 0.60 percent. Concentration ultimately can yield a tan powder approaching 100 percent solids, which is particularly useful for export. The amount of 1:1 in finished products is highly variable, with 1-5 percent being a common range for products that seriously intend to offer beneficial effects.

The sunbather is the extreme case of exposure, but the environment challenges everyone constantly. Lifestyle choices have critical long-term consequences for appearance. Smoking and sun exposure are the two greatest offenders, generating an abundance of free radicals. Diet and treatment cosmetics treat appearance from the inside and outside, providing the best conditions for the body to effectively use its own biochemical maintenance program. Ultimately, it appears that common sense in daily life is the best approach to a healthy appearance. As Plato said, "The most we can teach people is what they already know." ■ GCI

Steve Herman is vice president, new technology development, at AFF International. He has more than 30 years of experience in the industry, primarily in fragrance application. He serves as an adjunct professor in the FDU Masters in Cosmetic Science program and has been active in numerous capacities with the SCC. *chemreaction@allured.com*