

Quenching Free Radicals with Aloe Vera

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 PRINT

Over the past two decades, skin care has advanced at a rate rivaling that of technology. Just as it used to be enough for cell phones to simply make phone calls, it used to be enough for skin care products to simply cleanse, tone and moisturize. Those days are long gone. As baby boomers started showing the first signs of aging, they demanded more of their skin care products. They insisted on multi-tasking formulas that could reduce fine lines and wrinkles, firm sagging skin and make dull complexions lustrous again.

Recently, the cosmetics performance bar has been raised. Now, it's not enough to simply minimize the signs of aging. Today's savvy customers want to prevent one of its main causes—skin-degrading pollutants—before it takes its toll. That trend is evidenced by the flood of mass market and natural anti-pollution skin care products hitting the shelves in recent years. Unfortunately, in the rush to incorporate the latest new fad ingredients into their formulas, many manufacturers have overlooked one of the simplest and most effective anti-pollution agents available: *Aloe vera*.



Aloe vera has been known since antiquity as an effective burn and wound healer and a soothing moisturizer, properties that have been verified by modern scientific investigation. However, recent research has revealed aloe deserves a place in pollution-fighting skin care products because it acts as an effective barrier to pollutants, reduces oxidative stress created by pollution-generated free radicals, activates the body's detoxification system, and restores immune suppression caused by ultraviolet B (UVB) rays. Best of all, aloe works both topically and internally, making it ideal for both cosmetics and dietary supplements positioned for anti-pollution and detoxifying benefits.

CANARY IN A COALMINE

Remarkable in design, the skin forms an almost impermeable barrier between the inside of the body and the outside world. That barrier keeps unwanted guests—such as pathogens—out, while locking necessary nutrients—such as water—in. Unfortunately, sometimes marauding molecules penetrate the barrier. In fact, according to researcher Lowell A. Goldsmith, the skin is “a target organ for pollution and allows the penetration of exogenous agents into the body.”¹

Surprisingly, the skin often surpasses inhalation or ingestion as a route of toxin exposure. A study of crude oil refinery workers found 75 percent of their daily dose of the toxin pyrene was absorbed through the skin.² Likewise, greater quantities of chloroform, a probable carcinogen formed when chlorine reacts with organic matter, are absorbed through the skin during showering than from drinking chlorinated water.^{3,4}

As the body's largest organ, and the one with the most direct contact with the environment, the skin may be the first place to show signs of damage from indoor and outdoor air pollution. In other words, it acts as the body's canary in a coalmine.

POLLUTANTS & THE SKIN

What exactly do pollutants do to the skin? First, they can aggravate existing skin problems, including atopic dermatitis, psoriasis and scaly skin, as discovered by researchers who found these diseases are more severe in urban populations.⁵ Second, they can increase the incidence of skin diseases. A 14-year study in Athens, Greece found for every additional unit (mgr/m³) of carbon monoxide in the air, the number of diseases of the skin and

subcutaneous tissue increased by up to 3.3 percent.⁶ And finally, pollutants such as volatile organic compounds (VOCs) can cause skin rashes.

But a more far-reaching problem is that pollutants generate free radicals, those unstable molecules that have been implicated in the aging process, including the aging of the skin. While the body is equipped to neutralize a certain amount of these rogue molecules, sometimes its antioxidant reserves are depleted faster than can be replenished. For example, a 1997 study found in highly polluted cities such as Mexico City and Los Angeles, ground-level ozone depleted the antioxidant vitamin E from the outermost layer of the skin at a rate of 25 percent every two hours, most likely because vitamin E was working hard to neutralize pollution-generated free radicals and quickly became "spent." Without the protection of vitamin E, skin becomes more vulnerable to free radicals, which attack and degrade collagen and elastin, skin's supporting structures.

Collagen and elastin are not free radicals' only victims. Another study, conducted by L'Oreal, found air pollutants such as ozone and nitric oxide increase the oxidation of sebum, the skin's built-in moisturizer.⁷ The researchers noted that pollutants affect the smoothness and brightness of the skin, compromises the skin's natural defenses and may enhance irritation and allergic reactions.

There's one last skin problem caused by air pollution, albeit indirectly. Because pollutants such as chlorofluorocarbons have eaten a hole in the ozone layer, people are exposed to higher levels of UVB rays than they were in the past, putting them at greater danger of skin cancer. For every percentage decrease in ozone, there is a 2 percent increase in UVB radiation, and a predicted 2 percent increase in skin cancer.⁸

ANCIENT BOTANICAL FOR MODERN TIMES

At a basic level, aloe acts as a barrier to pollutants. One of the skin's main purposes is to protect the body from pathogens and toxins by acting as a barrier. Applied topically, aloe gel reinforces that barrier. How? The mucopolysaccharides contained within *Aloe vera* form chemical bonds with water, giving the gel its characteristic thick, sticky consistency. By creating a gelatinous shield over the skin, aloe helps keep pollutants out and water in.

Aloe also neutralizes oxidative stress in three distinct ways. First, aloe naturally contains a variety of antioxidants—including vitamins, phenolic compounds and peroxidases—that directly quench free radicals on the skin and in the body. In fact, a recent investigation of the antioxidant potential of an *Aloe vera* extract found it exhibited a radical scavenging activity of 72 percent, compared with only 65 percent for alpha-tocopherol.⁹

Second, in addition to containing its own stores of antioxidants, *Aloe vera* gel may also activate the body's endogenous antioxidant enzyme systems. Research in mice found internal administration of the gel elevates liver levels of three out of five cellular antioxidant enzyme families: the glutathione family, the superoxide dismutase (SOD) family and the catalase family.¹⁰

Finally, aloe has the unique and remarkable ability to increase the absorption of vitamins E and C. A crossover study in normal human subjects found taking *Aloe vera* gel in combination with vitamin E increased plasma levels of the vitamin by 369 percent compared to controls, while taking it with vitamin C increased plasma levels by 304 percent compared to controls.¹¹ Considering ground-level ozone rapidly depletes vitamin E from the outermost layer of the skin, any substance that can increase vitamin E's absorption is a must for urban dwellers.

Another way *Aloe vera* gel protects the skin is that it activates Phase II metabolism, which is responsible for inactivating, detoxifying and eliminating pollutants, including free radicals. This is a crucial function because whether a toxin ultimately causes harm is largely determined by how well the body is able to detoxify it. The same mouse study that found aloe gel elevates liver levels of cellular antioxidant enzymes additionally discovered it induces two important Phase II detoxifying enzymes: glutathione-S-transferase and DT-diaphorase.¹²

Aloe also restores immune suppression caused by UVB rays. When UVB rays hit the skin, they not only create free radicals, they also suppress immunity. In fact, chronic UVB-induced suppression of T-cell mediated immunity is a proposed mechanism behind the development of skin cancer. Unfortunately, due to the release of ozone-depleting pollutants into the atmosphere, the ozone layer does not absorb as much UVB radiation as it used to.

An intermediate molecular weight polysaccharide fraction from aloe gel, called Modified Aloe Polysaccharide (MAP), can restore immune function suppressed by UVB radiation. An impressive in vivo study used the contact hypersensitivity (CHS) test to measure the degree of immune suppression in mice that were first exposed to UVB radiation, then treated either with MAP or water, and then challenged with dinitrofluorobenzene (DNFB), a highly toxic liquid.¹³ MAP completely restored the immune suppression induced by UVB exposure compared to controls, making it a perfect addition to sunscreens and after-sun lotions.

QUALITY CONSIDERATIONS

While the health benefits seem apparent, the composition and efficacy of commercial aloe preparations varies wildly. The most obvious variable is the manufacturing method employed. The composition of aloe gel produced through the “fillet method,” for example, wherein the rind containing the laxative anthraquinones is separated from the pulp and mucilage layer mechanically, differs considerably from aloe produced through the “whole leaf method,” wherein the entire leaf is ground, and the rind particles and anthraquinones are removed through filtration. Other variables that may affect the composition of the gel include whether it was exposed to heat, UV light or enzymes during processing—all of which can degrade the active polysaccharide constituents.

Another more malevolent factor that can affect aloe’s efficacy is purposeful adulteration, which is regrettably widespread. It is not uncommon for aloe to be spiked with maltodextrin to make it look like the material has higher levels of aloe polysaccharides than it actually does. One way for manufacturers to be assured of consistent aloe gel quality is to look for the seal the International Aloe Science Council (IASC), which was created in 1981 to establish standards for content and purity of aloe materials.

One final variable that can affect the efficacy of aloe is the type of extract used. For many indications, native aloe gel has proven itself efficacious. However, when it comes to immunomodulatory activity, the intermediate molecular weight polysaccharides (MAP) clearly outperform the gel. For example, MAP stimulates the release of TNF-alpha (a cytokine that activates the immune system) in cultured mouse peritoneal macrophages, while native aloe gel does not.¹⁴ It also provides about half the protection from UVB-induced immune suppression that MAP does.

As it turns out, there is a “sweet spot” of polysaccharide molecular weight—between five and 400 KDa—for modulating immunity. Research has shown that for all immune parameters measured, the MAP fraction falling in that sweet spot was responsible for virtually all of aloe’s immunomodulating activity, with higher and lower molecular weight fractions either having no effect or displaying marginal activity.¹⁵

COMBINATION FORMULAS

Clearly, with so many diverse anti-pollution roles, *Aloe vera* should be one of the top ingredient choices for manufacturers formulating skin care cosmetics and dietary supplements that protect against and detoxify pollutants. Aloe is undoubtedly strong enough to stand on its own in such products. However, forward-thinking manufacturers may want to consider pairing aloe with fruits and vegetables that have documented anti-pollution benefits to create value-added cosmeceutical drinks, capsules, or topical products.

In general, fruits and vegetables work against toxins by neutralizing pollution-induced oxidative stress and activating the body’s detoxification systems. Interestingly, it tends to be fruits that work the first way and vegetables that work the second.

One of the most antioxidant-rich fruit families are berries. They are packed with pollution-fighting antioxidants—specifically anthocyanins, protective pigments that give berries their blue and purple colors. One anthocyanin, cyanidin 3-O-alpha-D-glucoside (C3G), is documented to be more than 40 times as powerful as vitamin E at neutralizing oxidative stress caused by UV light.¹⁶

Like berries, concord grapes are also rich in anthocyanins, as evidenced by their deep purple skin. An in vitro study found that in healthy human cells exposed to the carcinogen benzo[a]pyrene, treatment with an anthocyanin-rich extract from concord grapes suppressed free radicals generated by the toxin.¹⁷

A number of vegetables are blessed with a special ability: they can induce Phase II detoxification enzymes—including both glutathione S-transferase and quinone reductase—which help to inactivate, detoxify and eliminate xenobiotics (foreign chemicals) such as pollutants from the body.

The most famous and well-studied Phase II-inducing vegetables belong to the cruciferous family. These include broccoli, Brussels sprouts, cabbage, kale, cauliflower, bok choy, collards, turnips, radishes, arugula and watercress. Crucifers are loaded with glucosinolates that are transformed into isothiocyanates in the body. Isothiocyanates—of which sulforaphane is the most famous—are well-documented to upregulate phase II detoxification.^{18,19,20,21,22,23,24}

While less famous than their cruciferous cousins, a number of other vegetables also induce phase II detoxification, including green beans, carrots, celery, asparagus and spinach.²⁵

For manufacturers interested in combining antioxidant fruits and detoxifying vegetables with *Aloe vera*, Aloecorp developed a processing technology, Qmatrix®, that enables the company to blend farm-fresh, bioactive *Aloe vera* with almost any fruit or vegetable puree and then dry the combination into a homogenous matrix. This technology opens up the possibility for a multitude of cosmeceuticals, from a detoxifying aloe and vegetable juice, to an after-sun lotion with aloe and kiwi, or an aloe berry salt scrub. The possibilities of this age-old anti-pollution agent, as they say, are endless.

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