

# TODAY's Aloe vera

## Aloe Vera's Place in Anti-Pollution Skincare Products

- ✓ How pollutants affect the skin
- ✓ Fight back with Aloe!
- ✓ The one-two punch: Aloe and Fruits/Veggies

Over the past two decades, skincare 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 skincare products to simply cleanse, tone and moisturize. Those days are long gone. As baby boomers started showing the first signs of aging two decades ago, they demanded more of their skincare products. They insisted on multi-tasking formulas that could reduce their fine lines and wrinkles, firm their sagging skin, and make their dull complexions lustrous again.

Recently, the cosmetics performance bar has been raised even further. 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 skincare 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 that Aloe also deserves a place in pollution-fighting skin care products because it acts as an effective barrier to pollutants, reduces the oxidative stress created by environmentally-generated free radicals, activates the body's detoxification system, and restores immune suppression caused by UV-B rays. Best of all, Aloe works both topically and internally—making it ideal for both cosmetics, beauty foods, cosmeceuticals and dietary supplements positioned for their anti-pollution and detoxifying benefits.





## Skin: The body's 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.”<sup>1</sup>

Surprisingly, the skin often surpasses inhalation or ingestion as a route of toxin exposure. A study of crude oil refinery workers, for example, found that 75 percent of their daily dose of the toxin pyrene was absorbed through the skin.<sup>2</sup> 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.<sup>3,4</sup>

As the largest organ in the body, 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 our body's canary in a coalmine.

## How pollutants affect the skin

What do pollutants do, exactly, 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.<sup>5</sup> Second, they can increase the incidence of skin diseases. A 14-year study in Athens, Greece, for example, found that for every additional unit (mgr/m<sup>3</sup>) of carbon monoxide in the air, the number of diseases of the skin and subcutaneous tissue increased by up to 3.3 percent.<sup>6</sup> And third, 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 our bodies are equipped to neutralize a certain amount of these rogue molecules, sometimes our antioxidant reserves are depleted faster than they can be replenished. For example, a 1997 study found that 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 the E was working hard to neutralize the pollution-generated free radicals and then 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. Aloe vera, on the other hand, has been found by Chithra et al to activate the biosynthesis of collagen and connective tissue whether used topically or taken internally as a food, beverage or dietary supplement.

Collagen and elastin are not free radicals' only victims, however. Another study, this time conducted by L'Oreal, found that air

pollutants such as ozone and nitric oxide increase the oxidation of sebum, the skin's built-in moisturizer. According to the company, that affects the smoothness and brightness of the skin, but even more distressing, it compromises the skin's natural defenses and may enhance irritation and allergic reactions.<sup>7</sup>

There's one last skin problem caused by air pollution, albeit indirectly. Because pollutants like chlorofluorocarbons have eaten a hole in the ozone layer, people are exposed to higher levels of UV-B rays than they were in the past, which puts them at greater danger for skin cancer. For every percentage decrease in ozone, there's a two percentage increase in UV-B radiation, and a predicted two percentage increase in skin cancer.<sup>8</sup>

## Aloe vera: Ancient botanical for modern times

So how can consumers deal with these affronts to their skin that are being waged daily by pollution? By using topical and internal products featuring Aloe vera. What's remarkable about Aloe vera is that it works in so many different ways to fight the effects of pollutants.

### 1. Acts as a barrier to pollutants

One of the skin's main purposes is to protect us from pathogens and toxins by acting as a barrier to the outside world. Applied topically, Aloe gel reinforces that barrier. How? The polysaccharides contained within Aloe vera form chemical bonds with water, giving the gel that characteristic thick, sticky consistency. By creating a gelatinous shield over the skin, Aloe gel helps keep pollutants out and water in. (Incidentally, that's also what makes it such a good moisturizer.)

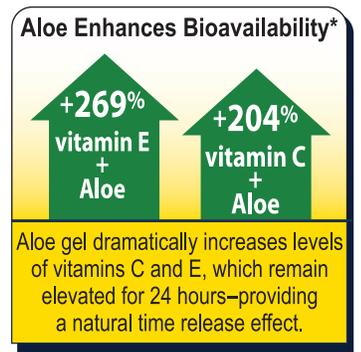
### 2. Neutralizes oxidative stress

The skin is constantly being hit with reactive free radical molecules created both by pollution and UV-B rays. Free radicals, which can degrade skin's supporting structures, are considered one of the causative effects of premature skin aging. Aloe vera neutralizes this oxidative stress in three distinct ways, thereby supporting a youthful appearance.

**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.<sup>9</sup>

**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 has shown internal administration of the gel elevates liver levels of three out of five cellular antioxidant enzyme families: the glutathione family, the superoxide dismutase family, and the catalase family.<sup>10</sup>

**Third**, Aloe has the unique and remarkable ability to increase the absorption of vitamins E and C. A crossover study in normal human subjects found that taking Aloe vera gel in combination with vitamin E increased plasma levels of the vitamin by 269 percent compared to controls, while taking it with vitamin C increased plasma levels by 204 percent compared to controls!<sup>11</sup> Considering that ground-level ozone rapidly depletes vitamin E from the outermost layer of the skin, any substance that can increase E's absorption is a must for urban dwellers.



\*Study sponsored and funded by IASC.

### 3. Activates phase II metabolism

Another way that Aloe vera gel protects the skin is that it activates Phase II metabolism, which is responsible for inactivating, detoxifying, and eliminating environmental pollutants, including free radicals. That's a crucial function, because whether or not 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 vera gel elevates liver levels of cellular antioxidant enzymes additionally discovered it induces two important Phase II detoxifying enzymes: glutathione-S-transferase and DT-diaphorase.<sup>12</sup>

### 4. Restores immune suppression caused by UV-B rays

When UV-B rays hit the skin, they not only create free radicals, they also suppress immunity. In fact, chronic UV-B-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 UV-B radiation as it used to. Therefore people are more at risk of skin cancer today than they were just a few decades ago.

One of the most interesting discoveries about Aloe vera gel is that it can restore the immune suppression caused by UV-B rays. Or, more specifically, an intermediate molecular weight polysaccharide fraction from Aloe vera gel, called Modified Aloe Polysaccharide (MAP) can. 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 UV-B radiation, then treated either with MAP or water, and then challenged with dinitrofluorobenzene (DNFB), a highly toxic liquid. MAP completely restored the immune suppression induced by UV-B exposure compared to controls<sup>13,14</sup> making it a perfect addition to sunscreens and after-sun lotions.

So now that you're convinced you should be formulating your anti-pollution skincare products with Aloe vera, you should beware: not all Aloe vera is alike.

### Variation among Aloe preparations

Unfortunately, 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 the quality of the leaves used, and whether or not the gel is exposed to excessive heat, UV light or poor quality controls during processing—all of which can degrade the active polysaccharide constituents.

Another, more malevolent, factor that can affect Aloe efficacy is purposeful adulteration, which is regrettably widespread. It's not uncommon for Aloe to be spiked with maltodextrin, for example, 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 vera quality is to look for the seal the International Aloe Science Council (IASC, [www.iasc.org](http://www.iasc.org)), which was created in 1981 to establish standards for content and purity of Aloe materials. Aloecorp, one of the largest producers of Aloe vera products, has been a supporter of the IASC since 1988.

One final variable that can affect the efficacy of Aloe is the type of extract used. For many indications, native Aloe vera gel has proven itself efficacious. However, when it comes to immunomodulatory activity, the intermediate molecular weight polysaccharides (MAP) clearly outperform the native 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. It also provides about half the protection from UV-B-induced immune suppression that MAP does.<sup>13,14</sup> (Figure 1)

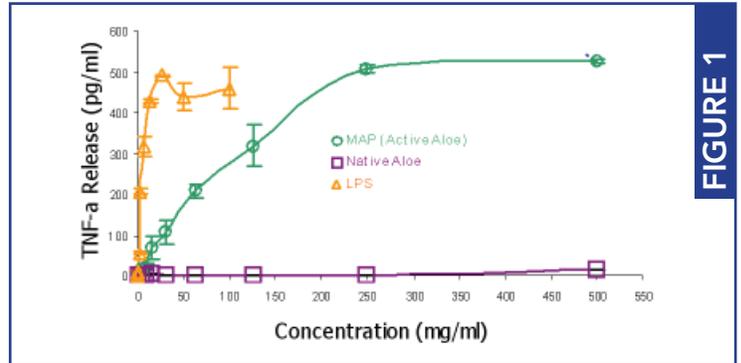


FIGURE 1

As it turns out, there is a "sweet spot" of polysaccharide molecular weight—between 5 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.<sup>14</sup> Aloecorp, which sets the bar for quality in the aloe industry, offers the only standardized Aloe vera ingredient called ACTiValoe<sup>®</sup>, which concentrates the polysaccharides that fall into the active molecular weight range, as well as Certified Plus<sup>®</sup> Aloe vera, in both gel and whole leaf form.

### The more the merrier: Aloe in combination with other anti-pollution fruits and vegetables

Clearly, with so many diverse anti-pollution roles—reinforcing the skin's barrier function, neutralizing pollution-induced oxidative stress, activating the body's detoxification systems, and protecting against skin cancer—Aloe vera should be one of the top ingredient choices for manufacturers formulating skincare cosmeceuticals, functional beauty foods and dietary supplements that protect against and detoxify environmental pollutants. Aloe is undoubtedly strong enough to stand on its own in such products. However, forward-thinking manufacturers may want to consider pairing Aloe vera 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 in two of the four ways that Aloe does: 1. They neutralize pollution-induced oxidative stress, and 2. They activate the body's detoxification systems. Interestingly, it tends to be fruits that work the first way and vegetables that work the second.

## Fruits that neutralize



### pollution-induced oxidative stress

When nutrition scientists at the USDA analyzed the antioxidant content of over 100 fruits, vegetables, nuts, and spices, berries won six out of the top 11 spots on the agency's list of the 20 most antioxidant-rich foods.<sup>15</sup> In the lead were wild blueberries, claiming the number two spot. Regular blueberries won fifth place, followed by cranberries in sixth, blackberries in eighth, raspberries in tenth, and strawberries in eleventh. No doubt about it, berries are packed with pollution-fighting antioxidants—specifically anthocyanins, protective pigments that give berries their blue and purple colors. One anthocyanin, called cyanidin 3-O-β-D-glucoside (C3G), is documented to be over 40 times as powerful as vitamin E at neutralizing the oxidative stress caused by ultra violet light<sup>16</sup>—so it may help protect against skin cancer.



Like berries, concord grapes are also rich in anthocyanins, as evidenced by their deep purple skins. 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.<sup>17</sup> But grapes don't have to be of the concord variety to protect against oxidative damage. Tests by the USDA have found that consumption of both regular grapes and kiwis boosts plasma antioxidant capacity in human subjects.<sup>18</sup>

## Vegetables that activate the body's detoxification systems

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, which are transformed into isothiocyanates in the body. Isothiocyanates—of which sulforaphane is the most famous—are well-documented to upregulate phase II detoxification.<sup>19,20,21,22,23,24,25</sup>

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.<sup>26</sup>



For manufacturers interested in combining antioxidant fruits and detoxifying vegetables with Aloe vera, Aloecorp has a patent-pending processing technology, called Qmatrix<sup>®</sup>, which 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 that easily goes into solution without separation, provides shelf stability without preservatives, and retains the nutritional profile and organoleptic qualities (smell, taste, color) of the fresh picked fruit. 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, to an Aloe Berry salt scrub. The possibilities of this age-old anti-pollution agent, as they say, are endless.



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