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# An updated review of aloe vera

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Throughout history, stories of aloe vera, the "cure-all" of many diseases, ailments, or afflictions, have caused some concern as to where, when, and how this plant works. The purpose of this paper is to update what is happening with the aloe vera plant in respect to history, current findings of the medical industry, identification of some of the compounds, commercial applications of extracts, safety data, and efficacy of extracts in cosmetics.

## Medicinal values of aloe

Grosourdy states that Lemaire found that when the crude crushed leaves were applied to common burns severe pain immediately stopped and the usual lesion did not develop.<sup>1</sup> Asenjo briefly summarized the value of the aloe plant in the treatment of diseases of the chest, wounds, ringworm, roundworm, and as a purgative.<sup>2</sup> In South America, it was used in the treatment of common burns. In more recent history, Barnes indicated that the rate of healing of abrasions of human skin was definitely improved by the application of the fresh aloe vera leaf.<sup>3</sup> Bovik described aloe vera extract as a yellowish, viscous, watery gel secreted from the leaves of the aloe vera plant.<sup>4</sup> He also reported that in South and Central America the Indians have used aloe vera gel for centuries for treating burns, kidney and bladder infections, prostatitis, dysentery, stomach and intestinal disorders, and for increasing longevity and sexual prowess. He concluded by describing the use of aloe vera following periodontal surgery and suggested that aloe vera gel may have more use in dental therapeutics. Berner described the use of aloe vera by natives in tropical areas for treatment of skin diseases, wounds, burns, eye afflictions, and internal disorders.<sup>5</sup> Chopia reported the use

of aloe vera in India, under the name of Aloe Vera Musabar, as an anti-inflammatory agent.<sup>6</sup> Stuart and Cole and Chen described the use of aloe vera in China for treatment of such things as sinusitis, high fever, skin eruptions, dental disorders, and convulsions.<sup>7,8</sup>

In the medicinal literature available from the United States, the use of aloe has been described mainly in the treatment of burns following radiation therapy. Collins and Collins presented the first reported case of the use of aloe vera in the treatment of a patient suffering from severe x-ray dermatitis of the forehead.<sup>9</sup> At the end of five weeks the dermatitis had completely healed. The area showed complete regeneration of the skin on the scalp and forehead, new hair growth, restoration of sensation, and no scarring. Wright, Loverman, and Fine and Brown published clinical reports on the use of aloe vera gel in the treatment of sequelae to radiation therapy.<sup>10-12</sup> In all cases, the results favored the use of aloe vera gel. From a cosmetic point of view it must be noted that Wright found the texture of the skin to be improved in all cases—a smoothing and softening of the affected skin. Mandeville's study involved an osteoradionecrosis following radiation therapy for squamous cell epithelioma of the tongue. When fresh aloe vera gel was applied, relief from pain was immediate and the ulcer grew smaller. Rowe individually and Rowe and coworkers used aloe vera gel in experimentally produced third-degree x-ray reactions on the skin of white rats. Treatment showed a definite increase in healing. Crewe used aloes as both ointments and powders to treat conditions such as palmar eczema, ulcers on amputation stumps, ulcers of advanced mammary carcinoma, poison ivy, and burns.<sup>13-16</sup> Excellent results were obtained in all

cases. Crewe reported that the use of fresh aloe relieved pain, burning, and itching, had antiseptic action, and stimulated rapid granulation and formation of new tissue so that denuded areas seemed to heal faster than when other agents were used. Lushbaugh and Hale, in treating artificially produced acute radiodermatitis with aloe vera, showed that healing occurred in half the time required for the untreated control lesions.<sup>17</sup>

Around the world, various applications have been found that show great promise. Blitz and coworkers treated 18 patients for Duodenal ulcers with 17 recovering completely and only one showing no improvement.<sup>18</sup> Mortada and coworkers at the Cairo University, treated corneal ulcers with aloe extracts and found the treated eyes showed more healing, less cellular reaction, and fewer signs of irritation.<sup>19</sup> Logai used subcutaneous injections of aloe extract along with other treatments for traumatic hemorrhages into the vitreous body.<sup>20</sup> The aloe gave better therapeutic effect in cases where other methods of treatment were ineffective. Fujita and coworkers found, as pharmacological evidence for the anti-inflammatory action of aloe, evidence indicating that aloe extract contains bradykininase activity.<sup>21</sup> Brasher and coworkers studied the effects of three therapeutic agents on monolayers of epithelial and fibroblast cell cultures.<sup>22</sup> The three drugs used were prednisolone (a corticosteroid), indomethacin (a non-steroid anti-inflammatory drug), and aloe vera. The three drugs were applied on tissue culture cells in various dilutions for periods of 24, 48, and 72 hours. There was complete toxicity of all the cells when the most concentrated solutions of the test agents were used, but aloe vera, at lower dilutions, was associated with higher cell counts than the other drugs.

It was suggested that solutions of aloe vera might be incorporated into periodontal dressings. Grammer incorporated aloe vera into two commercially available periodontal dressings. The dressings were placed into cell cultivations of epithelial and fibroblast cell lines. He discovered that higher dilutions of aloe vera seemed to stimulate the growth rate of tissue culture cells when compared to the untreated controls.<sup>23</sup> Payne, in his topical use of aloe vera following periodontal flap surgery, found that post-operative pain was reduced more than with the normal saline control and swelling of tissues treated with aloe vera was not as marked as the swelling of the control tissues.<sup>24</sup> Also, the presence of a greater number of inflammatory cells and dilated vessels in the control tissue specimens, as compared to gingiva treated with aloe vera, may indicate aloe vera increases the rate of healing of periodontal surgical wounds.

In an effort to determine if certain drugs exert some of their pharmacological effects by stimulating prostaglandin synthetase, Collier and coworkers found aloe, tyramine, ethanol, and quipazine produced a dose-related increase in resting the tone of the isolated fundus of the rat

stomach.<sup>25</sup> This increase occurred at concentrations comparable to those effective in stimulating BSV prostaglandin synthetase.

Noskov treated 50 patients with first-third stages of parodontosis by means of aloe extract injections.<sup>26</sup> The results yielded a satisfactory effect only in the first-second stages of the disease. The content of calcium, elevated in the blood serum in parodontosis, normalizes in the treatment with aloe extracts. Savitsky reported that aloe and an extract of bioset manifest a regular activating effect on aspartate-aminotransferase and alanine-aminotransferase function.<sup>27</sup> The nature of this effect on the activity of each enzyme in various tissues varies both as to the degree and time of the alterations and as to their trend—i.e., there is a pronounced tissue specificity. The regular effect of both tissue preparations of the amino group transfer process is one of the central links in the mechanism of their action on the metabolism and general state of the organism.

El Zawahry and coworkers evaluated aloe vera gel in the treatment of chronic ulcers and certain other dermatoses in men.<sup>28</sup> The report deals with its uses locally in chronic leg ulcers, seborrhea, acne vulgaris, alopecia (hair fall), and alopecia areata. The results proved to have a stimulating effect on the healing of chronic leg ulcers. Aloe appears to stimulate hair growth and drying of seborrheic skin. El Zawahry believed the active principle for promoting healing is the mucopoly-saccharides which are present in high concentration in the aloe gel and this may be aided by enzymatic removal of necrotic tissue. Figure 1 shows a leg ulcer of a 16 year old girl before treatment. Figure 2 shows the



Figure 1

ulcer after 30 days of treatment with topically applied aloe vera gel, plus an internal dosage of aloe vera gel. Figure 3 shows the ulcer after 60 days of continued treatment, and figure 4 shows the result after 90 days of treatment. This is the type of response that people from around the world have been talking about for years. The



Figure 2



Figure 3

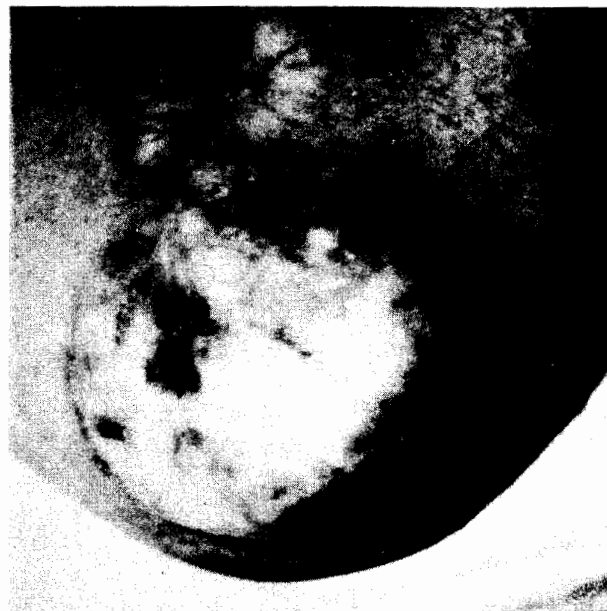


Figure 4

only conclusion that can be drawn from the evidence is that aloe works.

#### Components of aloe

The voluminous medical information supporting the effectiveness of aloe in gel or various extracts that is now available to research personnel leads one to the question: "What component or components are responsible for the overall effectiveness?"

The main ingredients of aloe, as described by Chopia and Ghosh, are aloin, emodin, chrysophanic acid, resin, gum, and traces of a volatile and non-volatile oil.<sup>29</sup> Since this original work was completed, there has been much published about the components of the aloe plant.<sup>30-47</sup> The following chemical components have been reported to be present in aloe: aloin; aloe emodin; aloetic acid; homonataloin; aloesin; aloesone; emodin; chrysamminic acid; chrysophanic acid; apoise; beta barbaloin; isobarbaloin; O-glycosides; galacturonic acid; calcium oxalate; choline; choline salicylate; saponins; uronic acid; sugars, simple and hydrolyzable; complex mucopolysaccharides; 2"-O-p-coumaroylaloetin (I); 2"-O-feruloylaloetin (II); protein containing 18 amino acids; 7-hydroxchromone; 8-C-glucosyl-7 hydroxchromone; myrcene; limonene; coniferyl alcohol; O-xylotocopherol; 2-methyl-2-phytyl-6-chromanol; pteroylglutamic acid; glucosamines; hexuronic acid; casanthranol I; casanthranol II; sapogenin glycosides; hecogemins; pentahydroxyflavones; enzymes of catalase, amylase, oxidase, cellulose; and aliinase. The minerals (fig. 5) are also present. It must be pointed out that all species do not contain the same amount or the same components, and the seasonal climate causes variations in the anthraquinones present.

The work done to isolate the above components and the knowledge that none of the chemicals individually can give the results

found when using aloe tend to indicate a synergistic effect among one or more components. It has been indicated that the mucopolysaccharides are responsible for the healing effects. This relationship is backed up by reports.<sup>54,55</sup> Evidence in literature eliminates vitamins, urea, and tannins as possible agents responsible for the healing effects.<sup>15</sup> Can the benefits derived be a synergistic effect from the mucopolysaccharides, sulfur derivatives, and nitrogen compounds present? Only further research will resolve this question.

Figure 5. Metal Analysis

Chemical	PPM
Calcium	460
Magnesium	93
Potassium	85
Sodium	51
Aluminum	22
Iron	3.9
Zinc	1.0
Manganese	0.59
Copper	0.47
Lead	0.24
Chromium	0.03
Silver	0.022
Mercury	0.0007

Another area of interest to research personnel working with natural plants is determining whether the plant or its extracts have any bacterial or fungicidal properties. In the case of aloe, Gottshall tested 28 different species against *Mycobacterium tuberculosis*, *Staphylococcus aureus*, and *E. coli*.<sup>48</sup> Aloe chinensis was active against the *Mycobacterium tuberculosis*. George and Pandalai found that an aqueous extract of aloe littoralis inhibited the growth of both *Staphylococcus aureus* and *E. coli* while an alcoholic extract of the same species exhibited no measurable inhibition.<sup>49</sup> Fly, using aloe barbadensis and aloe vera against *Staphylococcus aureus* and *E. coli*, reported that neither the gel portion nor the leafy portion had any antibiotic effects.<sup>50</sup> Richards, in testing the mascerated gel of aloe vera (fig. 6), found a decrease in all cases but the *Candida albicans* which shows a 108% increase.<sup>51</sup> There is not enough evidence presented to draw any conclusions as to the effectiveness of aloe in this experiment. Further work is indicated. Sage has shown different results when using stabilized aloe gel against *Candida albicans*.<sup>52</sup> The results show a 91% decrease in the organism. In general, it seems that if aloe is to be effective against any organisms, it must be used at a concentration in excess of 90%.

Figure 6. Microbiological Testing of Aloe Gel

Organism	Initial Count	96 Hours	Effect
<i>Aerococcus viridians</i>	$2.87 \times 10^7$	$2.9 \times 10^6$	90% Decrease
<i>Pseudomonas aeruginosa</i>	$6.30 \times 10^7$	$1.0 \times 10^6$	89% Decrease
<i>Candida albicans</i>	$1.00 \times 10^6$	$1.08 \times 10^8$	108% Increase
<i>Aspergillus niger</i>	$8.33 \times 10^5$	$1.0 \times 10^5$	88% Decrease
<i>Escherichia coli</i>	$3.93 \times 10^7$	$9.0 \times 10^4$	99.8% Decrease
<i>Flavobacterium-riognese</i>	$5.5 \times 10^7$	$3.8 \times 10^6$	93.1% Decrease

#### Current cosmetic applications

There are many cosmetics on the market today which use aloe extracts in concentrations vary-

ing from 1% to 98%. The aloe extracts have found a place in certain pharmaceutical applications as well. The use of aloe in cosmetics is not new, but the acceptance of its emollient, moisturizing, and healing properties seems to be documented in reputable scientific journals.<sup>53</sup>

Safety data on the aloe vera lipo-quinone #10113 and aloe vera aqueous extract #10209 have been accumulated. The following tests were performed:

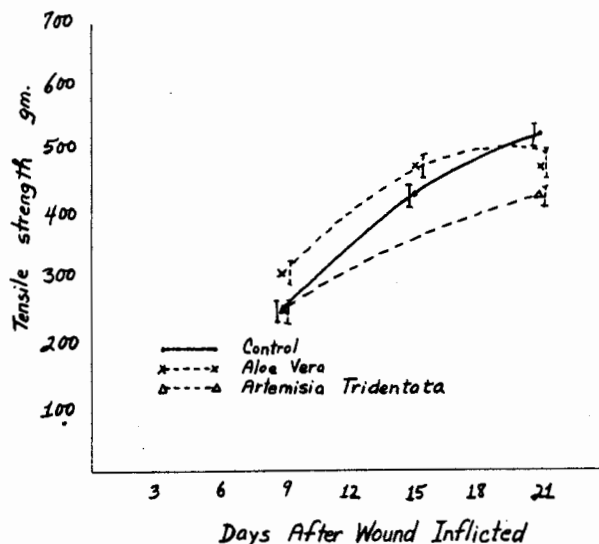
- Primary skin irritation
- Draize Eye irritation
- Single level acute LD<sub>50</sub>
- Guinea pig sensitization

The results are:

- Aloe vera lipo-quinone, according to Kay and Calandra, is practically non-irritating when applied to the eye.
- Aloe vera aqueous extract, according to Kay and Calandra, is minimally irritating when applied to the eye.
- Aloe vera lipo-quinone and aloe vera aqueous extracts, when evaluated according to Hodge and Sterner, are relatively harmless when dosed orally.
- Aloe vera lipo-quinone and aloe vera aqueous extracts, when evaluated for skin sensitization in accordance with the Draize Sensitization Test Procedure, did not exhibit any positive reactions for skin sensitization.

Aloe vera extracts can be considered safe when used near the eye, on the skin, or when ingested in a single dose.

The efficacy of aloe extracts can be shown with reference to past clinical studies as Goff and Levenstein and, later, Northway.<sup>56,57</sup> Goff used aloe vera extract, artemisa tridentata, and several other agents to determine whether the effects of topically applied preparations on the healing of skin wounds could be measured quantitatively. The comparison of the strength of the wounds treated with aloe vera extract, the artemisa oil, and controls is shown in figure 7. Statistically significant differences in favor of



Tensile strength of wounds treated with plant extracts  
Figure 7

aloe vera are seen at nine and fifteen days. However, 21 days after the wounds were inflicted, the values are essentially the same.

Northway used aloe vera gel in the treatment of 76 various animals with mixed infections. No controls were used so the results cannot lead to definite conclusions. The results ranged from "excellent" to "no response." The overall effect is one of improvement.

### Conclusions

Many different species of aloe possess healing, moisturizing, and emollient properties. Identification of aloe's components is needed to further establish what the effective component or components are. Clinical studies presented show effectiveness of aloe extracts. Aloe extracts are effective in cosmetic and pharmaceutical formulations.

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