



***Aloe vera* – A miracle plant for dentistry**

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Abstract

The plant *Aloe vera* (*Aloe barbadensis*) belongs to the Liliaceae family. Aloe is derived from the Arabic term “Alloeh,” which means “shining bitter substance,” and “vera,” which means “truth” in Latin. It is high in minerals and vitamins. It is a medicinal plant that is been around for a long time. *A. vera*'s health advantages are well-known, and the plant's dental applications are numerous. Researchers are becoming more interested in the utilization of this plant. *A. vera* has been shown to have antiseptic, anti-inflammatory, antiviral, and antifungal effects in studies, and its use has been proven to be beneficial. This plant has been shown to be non-allergic and beneficial to the immune system. *A. vera* is gaining favor in dentistry since it is 100% natural and has no recorded negative effects. The aim of this paper is to provide a review of the usage of this miraculous plant, as well as its applications in dentistry.

Introduction

Natural products are increasingly being used in the prevention and treatment of oral diseases, which may assist low-income people in both urban and rural areas.^[1] *Aloe vera* is the most popular and is currently gaining a lot of scientific interest among the different herbal agents currently available. *A. vera* gets its name from the Arabic word “Alloeh,” which means “shiny.” The term *A. vera* comes from the Arabic word “Alloeh,” which means “shining bitter substance,” and “vera,” which means “truth” in Latin. *A. vera* has a long and illustrious history reaching back to biblical times. It is a perennial succulent xerophyte that produces water-storage tissue in its leaves to enable it survives in dry, low-rainfall situations. The plant has lance-shaped stiff grey-green leaves with a mucilaginous pulp core that holds a translucent gel. *A. vera* gel contains polysaccharides, which have been related to its health benefits.^[2] Around 250 different types of aloe are grown all over the world. *A. vera* is grown in approximately 250 different varieties all over the world. *Aloe barbadensis* Miller and *Aloe arborescens* are the two commercially accessible species. The Aloe plant thrives in hot, humid climates and is unable to withstand freezing conditions, such as those experienced during the winter. Mexico, the Pacific Rim countries, India, South America, Central America, the Caribbean, Australia, and Africa are all home to aloe.^[3] Over the years, this plant has been dubbed “the wand of heaven,” “heaven's benediction,” and “the silent healer.”

Aloe-plant Description

A 15-cell thick hard rind forms the uppermost layer. This rind is crucial since it is here that all 75 nutrients found in the plant are synthesized. The sap is beneath this lawyer. This is a circulatory system that essentially transfers resources from the roots to the leaves. Anthraquinones, which are potent laxatives, are abundant in the sap. The mucilage layer is responsible for keeping the plant together. It also serves as a barrier, ensuring that the interior gel remains sterile. Polysaccharides, particularly the immunological modulator acemannan, are abundant in the mucilage layer. The parenchyma gel, which lies beneath this, is where the leaf stores all of its nutrients. At the mucilage layer, the gel is filed out. This keeps all of the nutrients in the sterile gel, the important polysaccharides in the mucilage layer, and just the proper amount of anthraquinones in the sap layer. The laxative effect would be amplified if there was too much sap in the final product.

Contents of *A. vera* gel

In stabilized *A. vera* gel, 75 nutrients have been found thus far.

The most essential are the following: lignin is a cellulose-based component found in the gel that has no known therapeutic properties. Despite the fact that its presence in topical aloe therapies is thought to give it the ability to permeate

human skin, lignin is a cellulose-based component contained in the gel that has no known medicinal properties. Saponins are glycosides that are thought to account for around 3% of *A. vera* gel. They are antibacterial and soapy compounds that can be used to clean.

Vitamins

Vitamins A, C, E, B1, B2, B3 (niacin), B6, choline, folic acid, alpha-tocopherol, and beta-carotene are all found in *A. vera*.

Vitamin B12 is only found in a few plants, including *A. vera*.

Vitamins A, C, and E are crucial antioxidant vitamins that help the body battle free-radical damage.

All three have a positive effect on the immune system, with Vitamin C aiding wound healing in particular. Collagen is also produced, which aids in the stiffness and strength of bones, skin, and joints. Normal night vision necessitates Vitamin A. Vitamin E helps the body use oxygen more efficiently, as well as prevent blood clots, thrombosis, and atherosclerosis. It also aids in the healing of wounds and increases fertility.

Anti-inflammatories

Aside from vitamins and minerals, anti-inflammatory compounds are found in *A. vera*.

Bradykinase is an enzyme found in *A. vera* that helps to alleviate skin inflammation.

Antraquinones, widely known as laxatives, are found in abundance in *A. vera*. It contains fatty acids, salicylic acid, and auxins and gibberellin hormones, all of which help to reduce inflammation. Anti-inflammatories act through increasing immune system function and collagen development, as well as blocking irritating pathways.

Amino acids

For proper health, the human body requires 20 amino acids, of which all but eight can be produced by the body. The necessary amino acids, on the other hand, must be consumed through diet. They combine to generate the building blocks of proteins, which humans need to make and repair muscles. *A. vera* includes 19 out of the 20 essential amino acids as well as seven out of the 20 required amino acids. Despite the fact that tryptophan is the missing amino acid, Bill Coates, an American pharmacist and Aloe expert, believes it is present. Although the proof is not conclusive yet, providing seven of the required eight is a good start.

Enzymes

A. vera has a variety of enzymes that can be grouped into two categories: Digestive enzymes and anti-inflammatory enzymes. Some, such as amylase, improve digestion by breaking down starch and sugar, while others, such as lipase, aid digestion by breaking down fats.

Sugars

A. vera includes two types of sugars: Monosaccharides, such as glucose and fructose, and polysaccharides, the most important of which is glucomannose, also known as Acemannan.

Acemannan has been proven to have a variety of effects, including:

- Immuno-modulating characteristics – it aids in the restoration of normal immunity by increasing antibody levels
- Antiviral – especially against viruses that cause tumors, such as feline leukemia
- Reduces the occurrence of subsequent infections
- T-lymphocyte activity can be increased by up to 50%
- Increased wound healing due to increased activity of big white blood cells (macrophages).

Sterols

- Plant sterols are powerful anti-inflammatory compounds. Lupeol is the antibacterial and analgesic agent among the three.

Salicylic acid

It is also found in *A. vera*, and it is converted in the body into an aspirin-like molecule that, along with lupeol, gives it some painkilling qualities.

Biological and Pharmacological Actions of *A. vera* Gel

Several studies have sought to link the chemical components of the gel to specific biological effects.

Wound-healing effects

The wound-healing properties of Aloe gel have been attributed to a variety of mechanisms, including keeping the site wet, promoting epithelial cell migration, faster collagen maturation, and reduced inflammation.^[4] In a 1996 study, the high molecular weight polypeptide component of the gel was found to have a healing effect on excisional wounds in rats.^[5] Glucomannan, a mannose-rich polysaccharide, and gibberellin, a growth hormone, interact with the growth factor receptor on the fibroblast after topical and oral administration, boosting fibroblast activity and proliferation and encouraging collagen synthesis. Angiogenesis, or the formation of new blood capillaries, is a process that occurs during tissue regeneration. Despite the absence of specific components, topical use of *A. vera* gel improved vascularity of burn tissue in a guinea pig in a 1993 study. The polysaccharide acemannan, which is contained in *A. vera* gel, stimulated macrophages in a rat model, encouraging wound healing. Davis *et al.* reported 2 years later that a low molecular weight component of freeze-dried *A. vera* gel enhanced blood vessel development in the chorioallantoic membrane of a chick (a vascular membrane formed from hatching chicken eggs). In addition, in an *in vitro* study, a methanol-soluble fraction of the gel containing a glycoprotein with primarily cell proliferation-promoting activity stimulated artery endothelial cells to proliferate and penetrate a collagen substrate.^[5]

Skin hydration effect

It was suggested that greater concentrations of *A. vera* gel (0.25% w/w and 0.5% w/w) increased skin hydration, possibly

through a humectant mechanism. The Aloe gel functions as a humectant, which means it attracts water from the dermis below and helps to retain it bound in the stratum corneum.^[6]

Anti-aging effect

Davis *et al.* discovered that aloe had a strong anti-aging effect on mouse ears by producing collagen and elastin fibers, which made the skin more elastic and wrinkle-free. Fibroblast cells reside in the dermis of the skin and are responsible for the production of collagen, the skin's support protein that keeps it tight, supple, and youthful. *A. vera* has been demonstrated to increase fibroblast cell shape and speed up collagen production.^[7] One of the primary reasons for this is the plant's unique ability to enhance the synthesis of human fibroblast cells 5–8 times faster than normal cell creation.

Anti-inflammatory effects

It decreases prostaglandin E2 by inhibiting the cyclooxygenase pathway. C-glucosyl chromone, a new anti-inflammatory molecule, was recently isolated from gel extracts. Furthermore, the peptidase bradykinase was isolated from Aloe and demonstrated to break down bradykinin, a pain-inducing inflammatory molecule.^[8]

Antibacterial property

Several approaches have been used to demonstrate the activity of *A. vera* inner gel against Gram-positive and Gram-negative bacteria. *A. vera* gel has been shown to inhibit *Streptococcus pyogenes* and *Streptococcus faecalis* bacteria. *Pseudomonas aeruginosa* was observed to be bactericidal in *A. vera* gel, and acemannan inhibited it from adhering to human lung epithelial cells in a monolayer culture.^[9]

Antifungal property

Candida albicans growth was apparently reduced by a processed *A. vera* gel formulation.^[9]

Antiviral property

This activity can be direct or indirect, with direct activity due to aloe emodin and indirect activity due to immune system stimulation. Aloe emodin, which can be found in *A. vera*, is a viral inhibitor. *A. vera* is virucidal against Herpes simplex virus types 1 and 2, Varicella zoster virus, pseudorabies virus, and influenza virus, according to Thomson's research. Virucidal activity was discovered in anthraquinones derived from the inner leaf of Aloe and the roots, bark, or leaves of a variety of other anthraquinone-containing plants during these experiments. According to the results, aloe emodin had a direct effect on both DNA- and RNA-containing encased viruses, but had no effect on bare (unenveloped) viruses. Under the conditions studied, the anthraquinones worked directly on the envelopes of anthraquinone-sensitive viruses, preventing adsorption, and subsequent multiplication.^[10]

Immunomodulating effects

The polysaccharide acemannan found in *A. vera* includes 90% rhodium and iridium (trace minerals), which stimulate white blood cells such as macrophages and T cells. When macrophage cells are activated, they create nitric oxide, secrete cytokines (tumor necrosis factor, interleukin-1, interleukin-6, and interferon-), and exhibit cell surface markers, all of which have immunomodulatory effects.^[11] It aids in the thymus gland's 40% enlargement. T cells are produced in the thymus by the immune system.

Antioxidant property

Antioxidants abound in *A. vera*. The antioxidant benefits of *A. vera* gel may be due to glutathione peroxidase activity, superoxide dismutase enzymes, and a phenolic antioxidant. In addition to these, it contains Vitamins A, C, and E. The toxins and carcinogenic properties that have built up in our systems as a result of pollution and poor dietary quality are removed by these free-radical components. These free radicals enter our bodies via being absorbed through our skin and digested.^[12]

Antitumor effect

Glycoproteins (lectins) and polysaccharides, two Aloe components with anticancer effects, are believed to exist. In investigations involving lower tumor burden, tumor shrinkage, tumor necrosis, and longer survival rates, *A. vera* gel was found to have anticancer properties. Aloe gel has been demonstrated to increase glutathione S-transferase and block the tumor-promoting effects of phorbol myristic acetate, implying that it could be used in cancer chemoprevention. The immunological response is stimulated, which has an indirect anticancer impact.^[13]

Laxative effect

Anthraquinones enhance intestinal peristalsis through increasing the amount of water in the colon, inducing water secretion, and increasing the amount of water in the colon. The pericyclic tubules, which are positioned just under the leaf's outer green ring, produce an exudate consisting of a bitter yellow latex with laxative-like properties, as previously indicated.^[14]

Dental Uses

Lichen planus

Lichen planus is a chronic inflammatory condition that affects the skin and the mucosa of the mouth. Because of the disease's chronic nature, no definitive cure has been established. Topical *A. vera* use 3 times a day relieves discomfort, improves oral lesions, and improves quality of life in individuals with oral lichen planus. The use of *A. vera* juice and topical application of *A. vera* helps reduce pain and burning (oral lichen planus) and skin pruritus (skin lesions). In the case of lichen planus, steroids have remained the major treatment

method; nevertheless, long-term steroids therapy is linked to a number of systemic issues, giving *A. vera* an edge due to its fewer adverse effects.^[15]

Antifungal

Several researches on *A. vera*'s antibacterial efficacy against *C. albicans* have been conducted. *C. albicans* growth and germ tube formation are both inhibited by *A. vera* leaf extracts. Antifungal activity of pure Aloe protein against *Candida parapsilosis*, *Candida krusei*, and *C. albicans* has been discovered.^[16]

Aphthous stomatitis

A. vera oral gel not only reduces the pain score and wound size in recurrent aphthous stomatitis patients, but it also reduces the time it takes for the aphthous wound to heal. Topical therapy of minor recurring aphthous stomatitis with the newly prepared Aloe and Myrrh-based gels found to be helpful. Aloe was found to be superior to Myrrh in terms of reducing ulcer size, erythema, and exudation, whereas Myrrh provided more pain relief. Acemannan, one of the polysaccharide components of *A. vera*, has been utilized to treat oral aphthous ulceration in people who do not want to use steroid medication.^[17]

Oral submucous fibrosis (OSMF)

The use of *A. vera* gel as an adjuvant in the treatment of OSMF was discovered to be successful. When compared to an antioxidant (lycopene), there was a greater improvement in mouth opening and a decrease in burning symptoms. The mouth opening in the *A. vera*-treated group was 5.1 mm, 3.4 mm in the antioxidant-treated group, and 4.6 mm in the antioxidant-steroid-treated group. As a result, the use of *A. vera* in the treatment of OSMF may have a future function, potentially minimizing the need for surgical intervention in severe cases of OSMF.^[18]

Pulpotomy of primary teeth

A. vera has been used successfully in primary tooth Pulpotomy. Pulpotomy entails the removal of coronal pulp with a spoon excavator, followed by saline irrigation and bleeding control with moist cotton pellets. After that, *A. vera* gel was found to be beneficial in relieving symptoms and preventing re-infection when applied to the remaining pulp stumps, followed by non-eugenol cement and permanent restoration. To assess the viability of the teeth, a follow-up was done at 30 days and 60 days. After that time, no signs of abscess, movement, pain, or edema were discovered.^[19]

Prevention of dry sockets (alveolar osteitis)

A. vera is a plant that has been used for centuries to cure wounds. Acemannan has been discovered to aid in the mending of bones. When compared to Clindamycin-soaked Gelfoam, the SaliCept Patch (a freeze-dried pledget containing acemannan hydrogel

derived from the transparent inner gel of *A. vera* leaf) significantly reduces the occurrence of Alveolar osteitis.^[20]

Obturation of primary teeth

A. vera has been discovered to be an efficient primary tooth obturator. *A. vera*, sterile water with zinc oxide and eugenol, zinc oxide eugenol with *A. vera*, calcium hydroxide, and sterile water, calcium hydroxide with sterile water and *A. vera*, calcium hydroxide and iodoform (Metapex), calcium hydroxide and iodoform (Metapex), calcium hydroxide and iodoform (Metapex), and Vaseline (Control). *A. vera* with sterile water was found to have the highest antibacterial action against the majority of germs, followed by ZOE+ *A. vera*, Calcium hydroxide + *A. vera*, ZOE, Calcium hydroxide, Metapex, and Vaseline in that order.^[21]

Ingredient in toothpastes and mouthwashes

Streptococcus mutans contamination of toothbrush bristles was reduced by *A. vera* and propolis (bee glue) dentifrice. When compared to placebo dentifrice (similar to those achieved with toothpaste containing triclosan), *A. vera* toothpaste exhibited significant improvements in gingival and plaque index scores, as well as microbiologic counts. Aloe vera tooth gel and toothpastes destroyed *C. albicans*, *S. mutans*, *Lactobacillus acidophilus*, *Enterococcus faecalis*, *Prevotella intermedia*, and *Peptostreptococcus. S. mitis* were found to be more resistant to *A. vera* tooth gel's antibacterial effect.^[22]

Intracanal medicament

The removal of bacteria is crucial for the long-term success of root canal procedures. Endodontic infection is assumed to be caused by the retention of bacteria within the dentinal tubules. The primary organism discovered in cases of persistent root canal infection and unsuccessful root canal therapies is *E. faecalis*. Herbal extracts have recently gained popularity in dentistry, and *A. vera* has been shown to be effective against *E. faecalis* when used in root canals (due to anthraquinones).^[23]

Disinfection of irrigation units

Dental operatory waterlines are heavily contaminated with germs and might cause infection. It is critical that these tubes are disinfected properly. After collecting baseline water samples, the dental unit waterlines were treated with three disinfection solutions: *A. vera*, 10% hydrogen peroxide, and 5% sodium hypochlorite, to draw inter-comparisons. Each of the three disinfectants was tested in increasing quantities to see how effective they were at inhibiting bacteria. When disinfectants were used for 1 week, there was a considerable reduction in mean CFU/ml. The most efficient way to reduce microbial colonies was to use *A. vera* solution.

Antiviral

The effects of Aloe emodin on the infectivity of herpes simplex virus types 1 and 2, varicella-zoster virus, pseudorabies virus,

influenza virus, adenovirus, and rhinovirus were observed after a pure sample of Aloe emodin was synthesized from aloin. All of the viruses examined were inactivated by Aloe emodin, with the exception of adenovirus and rhinovirus. According to electron microscopy, the envelopes of anthraquinone-treated herpes simplex virus were partially ruptured. According to these observations, anthraquinones are directly virucidal to encapsulated viruses.

Denture adhesive formulations

When used as a denture glue, acemannan was found to have good adhesive qualities and to be less cytotoxic to gingival fibroblasts.

Bleeding and painful gums

In periodontal pockets, *A. vera* gel can be employed as a local drug delivery mechanism. The use of *A. vera* gel subgingivally has been reported to enhance periodontal and gingival disorders. Acemannan is a bioactive molecule and scaffold for periodontal tissue regeneration that stimulates both soft- and hard-tissue healing. The gel is applied directly to periodontal surgery sites in conjunction with periodontal dressing or to the gum tissues. *A. vera* has also been attempted as a mouthwash for treating plaque-induced gingivitis as an addition to mechanical therapy.^[24]

Disinfection of Gutta Percha (GP) cones

To far, no effective chemical or herbal solution for decontaminating GP cones has been discovered. Cones distort under dry and damp heat, and there is a risk of contamination with chemical agents. However, before obturation, chairside disinfection cannot be ruled out. Many chemicals have been attempted for GP decontamination, including chlorhexidine, ethyl alcohol, hydrogen peroxide, polyvinyl pyrolidone iodine, and quaternary ammonium compounds. Sterilization with an electron beam has also been attempted.

None of these strategies, however, has been demonstrated to be completely effective. Treatment of the cones with 1% sodium hypochlorite for 1 min or 0.5% Sodium hypochlorite for 5 min is the recommended approach for decontaminating GP points. However, sodium hypochlorite has the potential to cause crystal deposition within the canals, which could obstruct obturation. In 1 min, *A. vera* gel was found to be effective in decontaminating GP cones. Some GP points were inserted in the thioglycolate broth and cultured for 24 h under sterile conditions. New GP cones were placed next to them and decontaminated in 90% *A. vera* gel for 1 min. Following that, the cones were taken from the gel, washed using sterile gauze, and incubated in thioglycolate broth for 24 h.

The development of turbidity in both tubes was then continuously watched. Turbidity formed in the GP cones that had not been decontaminated and were placed straight in the soup. Even after 24 h, the cones decontaminated with *A. vera*

and then reintroduced in the broth remained clear, indicating no microbial development.^[24]

Wound healing

The polysaccharides present in the gel of the leaves assist wound healing. In gingival fibroblasts, acemannan increased the expression of keratinocyte growth factor 1, vascular endothelial growth factor, and type 1 collagen. These findings imply that acemannan plays a role in oral wound healing. *A. vera*-derived products have been shown to help acute wounds (such as lacerations, surgical incisions, and burns) as well as chronic wounds (such as infected wounds, arterial, and venous ulcers) (such as bandages and topical gels).^[25]

Burning mouth syndrome

Burning mouth syndrome is a painful disorder caused by a variety of factors that causes a burning feeling in the tongue, lips, palate, or across the mouth. Tingling or numbness on the tip of the tongue or in the mouth, bitter or metallic taste alterations, and a dry or painful mouth are all possible symptoms. The situation is really distressing. Patients with burning mouth syndrome were separated into three groups to examine the efficacy of *A. vera* in this condition: In Group I, the Tongue Protector (The protector consisted of a transparent, low density polyethylene sheath covering the tongue from the tip to the posterior third), Group II (tongue protector and 0.5 ml AV at 70% 3 times a day), and Group III (tongue protector and 0.5 ml AV at 70% 3 times a day) (tongue protector and 0.5 ml placebo 3 times a day). Three months of treatment were required. The total clinical improvement was greater in Group II, implying that tongue protector and *A. vera* prescriptions can help patients with burning mouth syndrome.^[26]

Radiated head and neck cancer patients

Topical *A. vera* gel has been observed to suppress cariogenic and periodonto-pathogenic microorganisms in radiated head and neck cancer patients, suggesting that it could play a preventative function in these individuals. *A. vera* mouthwash, with its antifungal and immuno-modulatory properties, may help patients with head and neck radiotherapy avoid radiation-induced mucositis and oral candidiasis.^[27]

Anticancer agent

Any type of cancer treatment comes with a lot of side effects. Plant extracts are becoming more popular as cancer treatment alternatives to allopathic medications. Quinones are plant-derived secondary metabolites that have anti-proliferative and anti-metastasis properties *in vitro* and *in vivo* in several cancer types. The anti-cancer potential of plant-derived quinones, including Aloe-emodin, which is abundant in *A. vera*, is being considered.^[28]

Contraindications

A. vera, like any other pharmacological drug, has some negative effects. Contact dermatitis and hypersensitivity reactions have been reported following topical use of *A. vera* gel in some situations. Aloe should only be used under medical supervision during pregnancy and nursing. Even a single dose can cause abdominal cramps and pain. Overdosing can cause abdominal spasms, discomfort, and the development of thin, watery stools. Oral usage of *A. vera* in children under the age of 10 years is not recommended because of these negative effects. Increased hypoglycemia in diabetic patients has been reported in association with oral anti-diabetics or insulin. In combination with antidiabetic, diuretic, or laxative medications, sevoflurane, or digoxin, *A. vera* gel for systemic application is not suggested.^[29]

Conclusion

In comparison to standard medicine, *A. vera* is very cost-effective; it will significantly reduce both medical costs and invalidity. The practice of dentistry is changing as a result of the introduction of modern science. The studies that have been published are all short-term research. Long-term research with a bigger sample size is necessary. More research is needed on its healing effects, antibacterial characteristics, anti-inflammatory properties, and releasing pattern as a local drug delivery mechanism.

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