Review article

Unfolding the gift of nature: aloevera in dentistry

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Abstract

Plants have been an important source of medicine for thousands of years. One of the ancient medicinal plant is aloevera. It has been described as a portable Nature’s first aid kit that is an effective, inexpensive first-aid solution for all minor burns and scalds. Aloevera is known for its many health benefits. Over the past decade, interest in drugs derived from medicinal plants has markedly increased to maintain oral health. In dentistry aloevera has been found to be therapeutically effective. This update focuses on various therapeutic application and possible mechanisms of interactions when aloevera is used as phytomedicine. However, further researches combining the invivo and invitro research studies need to be carried to establish the tremendous potential of the aloevera plant in dentistry.

Introduction

Natural products are known to play an important role in Pharmaceutical biology. One of the earliest books on the subject of natural medicine was the Rig Veda, compiled in India between B.C.E. 4500 and B.C.E. 1600. It lists hundreds of plants deemed useful in medicine and is considered as the pioneer for alternative medicine. Natural antimicrobials can be derived from barks, stems, leaves, flowers and fruits of plants, various animal tissues or from microorganisms. The first detailed discussion of Aloe's medicinal value was found in the Papyrus ebers, an Egyptian document written around B.C.E. 1550. This document gives twelve formulas for mixing Aloe with other agents to treat both internal and external human disorders. The first milestone in Western man's detailed understanding of medicinal plants was the work of Hippocrates (460B.C-375B.C.), the father of modern medicine.

Even today, the World Health Organization estimates that up to 80% of people still rely mainly on traditional medicines. In fact, many of the current drugs either mimic naturally occurring molecules or have structures that are fully or in part derived from natural motives. Aloevera is one of the ancient medicinal plant. It is a perennial, drought-resistant, succulent plant belonging to the Asphodelaceae family which, historically has been used for a variety of medicinal purposes. It has a vast traditional role in indigenous system of medicine like ayurveda, siddha, umani and homoeopathy. Clinical evaluations have revealed that the pharmacological active ingredients are concentrated in both the gel and rind of the aloevera leaves. The bioactive compounds are used as astringent, haemostatic, antidiabetic, antiulcer, anti-septic, antimicrobial, antioxidant and anticancer agent and also, effective in treating stomach ailments, gastrointestinal problems, skin diseases, constipation,
radiation injury, wound healing, burns, dysentery, diarrhoea and in the treatment of skin diseases. Currently the plant is widely used in skin care, cosmetics and as nutraceuticals.

In the field of dentistry the uses of aloevera are innumerable. The use of aloevera in dentistry dates back to 1982 when it was used to cure periodontitis. It plays a pivotal role to combat periodontal diseases and enhances the defence mechanism. The pharmacologic actions of aloevera have been mentioned in many studies including its anti-inflammatory, anti-bacterial, anti-viral and anti-fungal properties. Due to its anti bacterial properties it is effective in preventing halitosis, gingivitis, stomatitis and periodontitis. Acute oral lesions are improved by topical application of aloevera gel on aphthous ulcers and angular cheilitis. Reports of successful changes in root sensitivity containing aloe toothpastes have been confirmed. Hence the aim of the present review is a footstep to enlighten about the literature available on aloevera and its various application in the field of dentistry.

**Active constituents of Aloevera**

Aloe vera contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and aminoacids. There are more than 200 compounds found in Aloe barbadensis, about 75 of which have biological activity. The prominent components are anthraquinones, Aloin, Aloeemodine polysaccharides, enzymes, reducing sugars, organic acids, metallic cations.

**Uses of aloevera in dentistry**

Aloevera in dental caries

The use of aloevera for dental caries dates back between 1700 and 3700 BC and is mentioned in the papyri of ancient Egypt the *Ebers*, which throws light on medical practices. There exists a strong bactericidal activity of aloevera gel against cariogenic bacteria. This activity is attributed to a number of pharmacologically active compounds including anthraquinones, aloin, aloe-emodin, aloetic acid, anthracine, aloe mannan, aloeride, antranol, chrysophanic acid, resistanol, and saponin. Aloin and aloe-emodin possess strong antibacterial and antiviral activities. Aloin and aloe-emodin have polyphenolic structures, which can inhibit protein synthesis by bacterial cells, thus explaining their antimicrobial activity. This characteristic may also explain the anti-inflammatory activity of aloevera gel. Acemannan promotes dentin formation by stimulating primary human dental pulp cell proliferation, differentiation, extracellular matrix formation, and mineralization. The antimicrobial effect of a dentifrice containing aloevera has been demonstrated in an in vitro study, in which aloevera inhibited the growth of diverse oral microorganisms.

Aloevera in periodontitis

Aloevera is a natural product contained in herbal dentifrices for plaque control and gingivitis. Clinical effects of aloevera showed a significant reduction of gingivitis and plaque accumulation after use of a mouthrinse containing aloevera. The microcirculation of wound is enhanced by aloe, increasing oxygenation. Aloe blocks action of catecholamines, thus increases epithelisation. Aloevera increases cross linking of collagen. The Type I/ Type III collagen ratio of aloe treated wounds is low, indicating increased Type III collagen. The levels of hyaluronic acid and dermatan sulphate, the main constituents of ground substance are high in aloe treated wounds. Acemannan acts as a macrophage stimulator. In a study conducted by Fujita *et al*, stated that carboxypeptidase in aloevera inactivates
bradykinin by about 67% and relieves pain. Aloevera contains magnesium salicylate, lactate decarboxylase, which is known to inhibit histidine, thereby preventing the formation of histamine from histidine in mast cells. The decrease in gingival index can be attributed to presence of sterols as anti-inflammatory agents and lupeol as an antiseptic analgesic. Existing evidence indicates that aloevera used in variety of concentrations is effective in shortening the duration of wound healing. Aloevera penetrates and dilates capillaries to an injured site, which improves healing.

Aloevera in lichen planus

Aloe vera gel contains bradykininase, an anti-inflammatory agent, magnesium lactate, which helps prevent itching, and salicylic acid and other antiprostaglandin compounds which relieve inflammation. Choonkaran et al carried out a double blind study to explore the efficacy of aloevera gel in management of OLP and found that aloevera gel is more effective than placebo.

Aloevera in osmf

Aloevera reduces the burning sensation and improves mouth opening thereby enhanced the patient’s compliance. Aloevera penetrates and dilates capillaries to an injured site, which improves healing. A study conducted on aloevera group showed a better treatment response as compared to the antioxidants group.

Aloevera in endodontics

Elimination of the microorganisms and prevention of re-infection within the pulp canal are the main objectives of the pulp space therapy. Aloevera is recommended in its application in root canals as a sedative dressing and as a file lubricant. It contains aloins and barbaloins as main chemical constituents. Its bactericidal activity is found to be less than Ca(OH)₂. The average zone of inhibition with methanol extract of aloe vera against E. faecalis was found to be 12mm. These results were in agreement with the studies done by Agaoglu S et al, and Agarry OO et al.

Aloevera in gloves

Dental health-care personnel frequently suffer from occupationally-related dermatitis due to frequent use of gloves and hand hygiene. An innovative dry-coating technology has produced a new concept - an examination glove that gradually delivers aloevera gel to the skin of the gloved hand. Extensive research indicates that aloe helps reduce inflammation, enhance skin hydration and moisturizes the skin. Aloevera contains saponins which are soapy substances that have both cleansing and antiseptic properties.

Aloevera in toothpaste and toothgel

Aloe Vera is added to toothpaste as an essential ingredient. It is known to be a whitening agent for the teeth. It is also rich in Vitamin K and provides natural protection for those susceptible teeth and gums. Studies using aloevera in toothpastes have shown that aloe vera tooth gel and the toothpastes were equally effective against C.albicans, S.mutans, L. acidophilus, E. faecalis, P. intermedia, and P. anaerobius. Aloevera tooth gel demonstrated enhanced antibacterial effect against S. mitis. Also the saponin present in aloe has a soapy and cleansing action which acts as a foaming agent in toothpaste. A study conducted on the relative abrasiveness of various compounds on tooth enamel showed that
Aloevera toothpaste contains mainly hydrated silica as abrasive as compared to other toothpastes which have calcium carbonate and pumice as abrasive. The lesser the abrasive index, lesser is the surface loss of enamel. Aloevera toothpaste was able to achieve equal or better results without the addition of fluoride. 

Aloevera in tooth gel is used to cleanse teeth and gingiva as effectively as toothpaste. The aloevera tooth gel does not contain the abrasives found in most tooth pastes and it is less harsh on teeth. It is a great alternative for people with sensitive teeth or gums. The aloevera tooth gel used in the study had no added fluoride content but still exerted almost an equal amount of antimicrobial activity.

Aloevera in mouthwash

Mechanical plaque control is the most effective method of controlling plaque and gingivitis. Aloevera in mouthwash is made using natural ingredients and is free from alcohol and saccharin. The antimicrobial effect of mouthwash containing aloevera has been demonstrated in an in vitro study, in which this phytotherapeutic agent inhibited the growth of diverse oral microorganisms, such as *S. mutans*, *S. sanguis*, *A. viscosus* and *C. albicans*. Also, aloevera acts as a natural remedy for halitosis that is caused by pathogenic bacteria and fungi as well as halitosis caused due to digestive problems. This is due to the antimicrobial effect of aloevera. Aloevera contains six antimicrobial agents such as lupeol, salicylic acid, urea, nitrogen, cinnamonic acid, phenols and sulfur which have inhibitory action on fungi, bacteria and viruses. It also helps protect the soft tissues of the oral cavity, reducing the likelihood of halitosis. A randomised double-blinded clinical trial conducted on the comparison of aloevera containing mouthwash with 0.1% Triamcinolone acetonide evaluated that the clinical effects of aloevera showed a significant reduction of gingivitis and plaque accumulation after use as a mouthrinse.

Aloevera in dental floss

Dental floss acts as an interdental mechanical aid to promote plaque removal. The aloevera containing eco floss helps remove plaque from interdental areas that the toothbrush cannot reach, and thus helps prevent periodontal disease and dental caries. Also the antimicrobial and healing properties adds to the flossing effect. The aloevera containing floss has a smoother finish and is gentle as compared to the organic (beeswax) and synthetic floss (nylon). The commercial studies conducted on the product efficacy have shown better results with aloevera floss.

Aloevera and HSV

Topical administration of aloevera has been widely used for wound healing. Aloevera has direct antiviral activity against HIV1 by inhibiting glycosylation of glycoproteins. It acts synergistically with AZT or acyclovir by inhibiting the replication of HIV and HSV1. Aloe emodin, an anthraquinone prepared from aloevera, was shown in vitro to inactivate HSV-2. In another study, acemannan was reported to act synergistically with acyclovir against HSV invitro. Acemannan reduced herpes simplex infection in two cultured target cell lines. These results showed that anthraquinones extracted from aloevera are directly virucidal to enveloped viruses and can be used for the treatment of herpetic lesions.

**Aloevera in healing extraction socket**

Extraction sites heal properly and dry socket formation is prevented when aloevera is applied on extraction site. Aloevera consists of glucomannnan and giberrelins which function to stimulate fibroblast
to proliferate faster in wound area and to accelerate wound healing with epithelial cell proliferation as well as to prevent infection which could inhibit wound healing. Clinical studies have shown its efficacy in acceleration of wound healing in postderm-abrasion, partial thickness of wounds, and pressure ulcers. Freeze-dried acemannan was also shown to be effective against painful dry socket treatment as a result of dental procedure complications. 36

**Aloevera in aphthous ulcer**

Aphthous stomatitis is a chronic self limiting condition of the oral cavity. Aloevera inhibits acute inflammation but unlike steroids it stimulates fibroblast growth to improve wound healing. Acute mouth lesions are improved by direct application in gel form on aphthous ulcers. 37 Aloevera activates collagen production by way of mannose-6-PO_4 binding to receptors of fibroblasts. Also acemanan present in aloevera accelerates the collagen synthesis. It has been reported that acemannan hydrogel present in aloegel accelerates the healing of aphthous ulcers and reduces the pain associated with them. Garnick et al. 38 evaluated a gel that combined allantoin, aloevera, and silicon dioxide and its effects on aphthous ulcers.

**Aloevera and throat infection**

Throat infections are mostly caused by gram negative bacteria especially Streptococcus. Aloevera activator spray, which is used for certain throat infections like palatine tonsillitis. It has the capacity to prevent not only fungal but viral infections of wisdom tooth and joint pains associated with it. 69% extract of aloevera is bactericidal against Pseudomonas, Klebsiella, Serratia, Citrobacter, Enterobacter, S. pyogenes and Agalactiae. 19 About 77% extract is bactericidal against S. aureus. 80% for E. coli, 90% for S.fragilis and C. albicans. Aloevera contains anthraquinones have an antiseptic effect against a number of bacteria and fungi. 23 It has even been suggested that administration of aloevera could be a potential therapeutic agent for the clinical treatment of sepsis. 37 Aloevera in denture stomatitis

Stomatitis can occur from leaving dentures in the mouth while sleeping as well as from smoking or vitamin A deficiencies. Although there are several causes of this disorder, a common cause is due to the fungus Candida Albicans. The antimicrobial effects of aloevera have been attributed to the plant’s natural anthraquinones: aloe emodin, aloetic acid, aloin, anthracine, anthranol, barbaloin, chrysophanic acid, ethereal oil, ester of cinnamonic acid, isobarbaloin, and resistannol. 22 Hanley et al reported that an aloe vera extract decreased inflammation by 48% in a rat adjuvant-induced arthritic inflammatory model. More recently, the peptidase bradykinase was isolated from aloe and shown to break down the bradykinin, an inflammatory substance that induces pain. 25

Aloevera and denture adhesive

Acemannan, a complex mannose carbohydrate derived from the aloevera plant, has an inherent viscosity, which makes it ideal for denture adhesive formulations. It was found that the bonding effect provides an extremely strong and long lasting hold which prevents dentures from slipping and sliding, thus preventing irritations of the mucosa. 39 AloeVera – strengthens the gingiva, soothes and alleviates irritations like denture sores.

Aloevera in denture cleaner

Aloevera gel reportedly was bactericidal against Pseudomonas aeruginosa while acemannan prevented it from adhering to human lung epithelial cells in a monolayer culture. 19 A processed aloevera gel preparation reportedly inhibited the growth of
Candida albicans. It acts as an antifungal agent. This can also be used along with soft liners. The saponins which contain glycosides, are soapy substances that have both cleansing and antiseptic properties.31

Aloe vera in dental implants

The aloegel can be used to stimulate bone growth both around and onto the surface of endosseous dental implants placed in sites with extended peri-implant osseous defects. Aloe vera can be used around dental implants to control inflammation from bacterial contamination. As it has antimicrobial and healing properties it helps to improve bone-implant interphase and in preventing periimplantitis. Aloe vera inhibits the cyclooxygenase pathway and reduces prostaglandin production from arachidonic acid. Recently, the novel anti-inflammatory compound called C-glucosyl chromone was isolated from gel extracts.39 Using a rat model, Heggers et al23 suggested that the antibacterial effect of the aloevera gel in vivo could enhance the wound healing process by eliminating the bacteria that contributed to inflammation.

Conclusion

Public interest in aloe has developed, and now there is a considerable amount of research into the various components of aloe to find out more about their properties and to characterize these components so that more specific research can be done. We live in an era of rapidly emerging antimicrobial resistant pathogens and therefore a wide search for alternative remedies to prevent and cure infection are needed. The allopathic forms of antibacterial drugs are available since long time but they have many side effects. The combination of high amount of herbal remedies like aloevera and low amount of Allopathy drugs like Roxythromycin, Cefixime and Levofoxacin gives new path in medicinal world. It is a new concept to combine herbal and Allopathy drugs to be known as herbo-Allopathy combinations.40 Also ongoing research is focusing on aloevera’s anticancer, antileukaemic and antimutagenic effects.

The utilization for oral conditions demands better evidence and further clinical trials and research studies including the invitro and invivo studies to establish the clinical effectiveness of this popular herbal remedy in dental conditions. Also, there is need for a scientific approach for propagation of medicinal plant aloevera and to collect relevant information regarding agro technology.

References