



**LITERARY REVIEW ON WOUND HEALING AND ANTI-  
INFLAMMATORY ACTIVITY OF ALOE VERA IN AYURVEDA &  
MODERN WAY.**

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**ABSTRACT**

*Aloe vera is one of the most important medicinal plant in the world with applications in cosmetic industry in tonic and herbal applications or health drink product in current market, which is grown in Sri Lanka perfectly. Different varieties of Aloe vera are available in Sri Lanka. Different parts of Aloe ferox and Aloe marlothii are used as traditional medicines for different applications, although wound healing has been shown for certain aloe gel materials. Here gathered data from ancient Ayurvedic text books, Science Direct and Scholar Google articles on Aloe vera on its wound healing and anti-inflammatory activity. In vitro wound healing assay suggested that all the aloe gel and whole-leaf materials examined, exhibited faster wound healing activity than the untreated control group. After 48 h, all the aloe gel and whole-leaf materials almost completely caused full wound closure, displaying 98.07% (A. marlothii whole-leaf), 98.00% (A. vera gel), 97.20% (A. marlothii gel), 96.00% (A. vera whole-leaf), 94.00% (A. ferox gel) and 81.30% (A. ferox whole-leaf) wound closure, respectively. It was noteworthy that the gel materials of all the three aloe species exhibited significantly faster ( $p < 0.05$ ) wound healing actions when compared to their respective whole-leaf materials at 32 h. So, this article will help to fill the gap of knowledge on Aloe vera, about its contribution in wound healing & anti-inflammatory action not only on superficial skin but also in Gastric mucosa, specially on Gastric ulcers. Key words: Aloe vera, Wound healing, Gastric ulcers, Anti-Inflammatory action*



## INTRODUCTION

Aloe vera (*Aloe barbadensis* Miller) which included in Liliaceae family, is well known for its valuable medicinal properties. The chemistry of the plant has revealed the presence of more than 200 different biologically active substances. Many biological properties associated with Aloe species are contributed by inner gel of the leaves. Many research described on anti-bacterial and antimicrobial activities of the non-volatile constituents of the leaf gel. Aloe species are widely distributed in the African and Eastern European countries, spread almost throughout the world. Aloe has more than 400 species but few, such as Aloe vera, Aloe ferox and Aloe arborescens are globally used for trade. Aloe vera has various medicinal properties such as antitumor, anti-arthritic, anti-rheumatoid, anti-cancer, and anti-diabetic. In addition, A. vera has also been promoted for constipation, gastrointestinal disorders and for immune system deficiencies. The present review focuses on the detailed composition of Aloe gel, its various phyto-components having various biological properties that help to improve health and prevent disease condition.

### Plant anatomy of Aloe vera

The plant has triangular, fleshy leaves with serrated edges, yellow tubular flowers and fruits that contain numerous seeds. Each leaf is composed of three layers: An inner clear gel that contains 99% water and rest is made of glucomannans, amino acids, lipids, sterols and vitamins. The middle layer of latex which is the bitter yellow sap and contains anthrax quinones and glycosides. The outer thick layer of 15–20

cells called as rind which has protective function and synthesizes carbohydrates and proteins. Inside the rind are vascular bundles responsible for transportation of substances such as water (xylem) and starch.

### Chemical composition of Aloe vera gel

Aloe vera plant is its high water content, ranging from 99.5%. The remaining 0.5 - 1.0% solid materials include water- and fat-soluble vitamins, minerals, enzymes, simple/complex polysaccharides, phenolic compounds, and organic acids. On a dry weight basis, the percentages of the pulp represented as lipids (2.7% and 4.2%) and that as proteins (6.3% and 7.3%) only accounted for amino fraction. Non starch polysaccharides and lignin represented the bulk of each leaf fraction and were found to be 62.3% and 57.6% of the dry weight of the rind and pulp, respectively.

Aloe vera gel polysaccharides consist of linear chains Vitamins. It contains vitamins A (beta-carotene), C and E, which are antioxidants. It also contains vitamin B12, folic acid, and choline. Antioxidant neutralizes free radicals.

Enzymes: It contains 8 enzymes, aliase, alkaline phosphatase, amylase, bradykinase, carboxy peptidase, catalase, cellulase, lipase, and peroxidase. Bradykinase helps to reduce excessive inflammation when applied to the skin topically, while others help in the breakdown of sugars and fats.

Minerals: It provides calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium and zinc. They are essential for the proper functioning of



various enzyme systems in different metabolic pathways and few are antioxidants.

**Sugars:** It provides mono saccharides (glucose and fructose) and polysaccharides: (glucomannans/poly mannose). These are derived from the mucilage layer of the plant and are known as mucopolysaccharides. The most prominent monosaccharide is mannose-6-phosphate, and the most common polysaccharides are called glucomannans [ $\beta$ -(1,4)-acetylated mannan]. Acemannan, a prominent glucomannan has also been found. Recently, a glycoprotein with anti-allergic properties, called alprogen and novel anti-inflammatory compound, C-glucosyl chromone, has been isolated from Aloe vera gel.

**Anthraquinones:** It provides 12 anthraquinones, which are phenolic compounds traditionally known as laxatives. Aloin and emodin act as analgesics, antibacterials and antivirals.

**Fatty acids:** It provides 4 plant steroids; cholesterol, campesterol,  $\beta$ -sisosterol and lupeol. All these have anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties.

**Hormones:** Auxins and gibberellins that help in wound healing and have anti-inflammatory action.

**Others:** It provides 20 of the 22 human required amino acids and 7 of the 8 essential amino acids. It also contains salicylic acid that possesses anti-inflammatory and antibacterial properties. Lignin, an inert substance, when included in topical preparations, enhances

penetrative effect of the other ingredients into the skin. Saponins that are the soapy substances form about 3% of the gel and have cleansing and antiseptic properties of glucose molecules.

### **Dosage forms**

At present no commercial preparation has been proved to be stable. Because many of the active ingredients in the gel appear to deteriorate on storage, the use of fresh gel is recommended. Preparation process of fresh gel is harvest leaves and wash them with water and a mild chlorine solution. Remove the outer layers of the leaf including the peri-cyclic cells, leaving a "fillet" of gel. Care should be taken not to tear the green rind which can contaminate the fillet with leaf exudate. The gel may be stabilized by pasteurization at 75–80°C for less than 3 minutes. Higher temperatures held for longer times may alter the chemical composition of the gel.

### **The rapeutic benefits of Aloe vera**

Many investigators have endeavored to establish the active principles in Aloe vera gel. It has been used for many centuries for its curative and therapeutic properties and although over 75 active ingredients from the inner gel has been identified, therapeutic effects have not been correlated well with each individual component. Many of the medicinal effects of Aloe leaf extracts have been attributed to the polysaccharides found in the inner leaf parenchymatous tissue. However, it is believed that these biological activities should be assigned to a synergistic action of the compounds contained.



Various extracts of these Aloe species are traditionally used and their application used to cure arthritis, skin cancer, burns, eczema, psoriasis, digestive problems, high blood pressure, and diabetes. Aloe species would have varying phytochemical contents due to interspecies variation and varying climate and soil conditions, direct correlation of biological activity would be inaccurate.

Many beneficial effects of this plant have been attributed to the polysaccharides present in the pulp. The clear pulp which is also known as gel is widely used in various medical, cosmetic, and neutral ceutical applications. Studies have noted higher anti oxidative activities present in its rind. Aloe vera has been used externally to treat various skin conditions such as cuts, burns and eczema.

Aloe vera is also known for useful secondary metabolites. Anthra quinones, tricyclic aromatic quinines are the major secondary metabolites that are abundantly present. Among the naturally occurring anthrax quinone derivatives, Aloe emodin and chrysophanol are the major compounds. These novel plant enzymes might potentially be associated with biosynthesis of natural tricyclic aromatic quinines in Aloe, but it remains unclear whether these enzymes produce end products such as Aloe-emodin and chrysophanol in vivo. Aloesin, aloin and Aloe-emodin (oxidative product of aloin) are the most important secondary metabolites found in A. vera gel. Many secondary metabolites in plants have reported potent anti-inflammatory, lipid lowering, and antioxidant activities. However, no reports have

elucidated complete entire secondary metabolites present in the plant species.

### Wound healing effect

Aloe is known as the healing plant. A. vera has been used for traditional medical purposes in several cultures. In vitro extracts of A. vera stimulate the proliferation of several cell types. Many studies have shown that treatment with whole A. vera gel extracts resulted in faster healing of wounds. A. vera may have a direct effect on the wound healing process as a whole, which is manifested by increase in rate of contraction of wound area and has confirmed the effect of A. vera on increasing wound contraction and collagen synthesis. This property is attributed to the mannose-6-phosphate known to be present in A. vera gel. Polysaccharides from Aloe promote both the proliferation of fibroblasts and the production of hyaluronic acid and hydroxyproline in fibro blasts, which play important roles in extracellular matrix remodeling during wound healing. Acemannan, significantly increases periodontal ligament cell proliferation, up regulation of growth/differentiation factor 5, type I collagen and alkaline phosphatase activity in primary human periodontal ligament cells. In a clinical study, to check the efficacy of A. vera gel compared with 1% silver sulfadiazine cream as a burn dressing for the treatment of superficial and partial thickness burns, healing of burn wounds were remarkably early in A. vera treated patients than those patients treated with 1% silver sulfadiazine. Polysaccharides isolated from Aloe vera induce matrix metalloproteinase (MMP)-3 and metalloproteinase inhibitor-2 gene



expression during the skin wound repair of rat, which directly helps to regulate the wound healing activity of Aloe vera gel.

Effects on skin exposure to UV and gamma radiation:

Aloe vera gel has been reported to have a protective effect against radiation damage to the skin.<sup>12,13</sup> Exact role is not known, but following the administration of aloe vera gel, an antioxidant protein, metallothionein, is generated in the skin, which scavenges hydroxyl radicals and prevents suppression of superoxide dismutase and glutathione peroxidase in the skin. It reduces the production and release of skin keratinocyte-derived immunosuppressive cytokines such as interleukin-10 (IL-10) and hence prevents UV-induced suppression of delayed type hypersensitivity.

### **Immuno-modulatory effect**

Aloe vera gel has strong immuno-modulatory activity wherein it down regulates lipopolysaccharide-induced inflammatory cytokine production and expression of NLRP3 (NACHT, LRR, and PYD domain-containing protein 3) inflammation in human macrophages. Aloe vera could inhibit the inflammatory process following burn injury, as characterized by the reduction of leukocyte adhesion, as well as pro-inflammatory cytokines. Aloe polysaccharides pre-treatment can attenuate the cerebral ischemia and reperfusion injury in severe traumatic hemorrhage rats by first entering high altitude through inhibiting systemic inflammatory response and leukocyte aggregation and lipid peroxidation in the

brain. Administration of Aloe vera has been universally.

demonstrated to result in marked increase in phagocytic and proliferative activity of the reticulo endothelial system. A. vera directly inhibits the cyclooxygenase pathway and reduces prostaglandin E2 production,<sup>35</sup> which plays an important role in inflammation. Aloe also contains anthraquinones and chromone in the inner gel, which possess strong anti-inflammatory effects as shown in murine macrophages. This report suggests that Aloe as a whole has anthraquinones (aloin) and chromone (aloesin) components, and Aloe gel has pharmacological activity to alleviate inflammatory responses in inflammatory bowel disease. A recent report of a clinical study evaluated the therapeutic effect of A. vera gel wherein 2% oral gel is not only effective in decreasing the pain score and wound size in recurrent aphthous stomatitis patients but also decreasing the aphthous wound healing period.

### **Contraindications of Aloe vera:**

Pregnancy and breastfeeding: Oral aloe is not recommended during pregnancy due to theoretical stimulation of uterine contractions, and in breastfeeding mothers, it may sometime causes gastrointestinal distress in the nursing infant.

### **CONCLUSION**

The positive influence of Aloe vera on the healing of full-thickness wounds is well explained by the article. Wound granulation tissues were removed on various days and the collagen, hexosamine,



total protein and DNA contents were determined, in addition to the rates of wound contraction and period of epithelialization. Measurements of tensile strength were made on treated/untreated incision wounds. The results of many research indicated that Aloe vera treatment of wounds may enhance the process of wound healing by influencing phases such as inflammation, fibroplasia, collagen synthesis and maturation, and wound contraction. These effects may be due to the reported hypoglycemic effects of the aloe gel.

The occurrence of flavones-C-glycosides, heptaketides (e.g.5-methylchromones) and octaketides (e.g. 1,8-dihydroxy-9-anthrone) in Aloe species is known. The results obtained from research showed that these species possess different chemical composition, justifying the importance of studies aiming for the chemical characterization of different Aloe species. The anti-inflammatory and wound healing activity of the Aloe species has been attributed to poly phenolic compounds. Some research are showed that highest effect in reducing the wounds area in ten days which is rich in Aloenin . Among the species presented in this paper, flavonoids are foundas main constituents specially lucienin II, vicienin II, orientin andisovitexin in A. vera.

## REFERENCES

1. Reynolds T, Dweck AC. Aloe vera gel leaf: a review update. J Ethnopharmacol.1999
2. Eshun K, Qian H. Aloe vera: a valuable ingredient for the food, pharmaceutical and cosmetic industriesda review. Crit Rev Food Sci Nutr. 2004
3. Foster M, Hunter D, Samman S. Evaluation of the nutritional and metabolic effects of Aloe vera. In: Benzie IFF, Wachtel-Galor S, eds. Herbal Medicine: Biomolecular and Clinical Aspects. 2nd ed. Boca Raton: CRC; 2011.
4. Hamman JH. Composition and applications of Aloe vera leaf gel. Molecules.2008
5. Femenia A, Sanchez ES, Simal S, Rossello C. Compositional features of polysaccharides from Aloe vera (Aloe barbadensis Miller) plant tissues. CarbohydrPolym. 1999
6. Ni Y, Turner D, Yates KM, Tizard I. Isolation and characterization of structural components of Aloe vera L. leaf pulp. Int Immunopharmacol. 2004
7. Hutter JA, Salman M, Stavinoha WB, et al. Antiinflammatory C-glucosyl chromone from Aloe barbadensis. J Nat Prod. 1996
8. Chow JT-N, Williamson DA, Yates KM, Goux WJ. Chemical characterization of the immunomodulating polysaccharide of Aloe vera L. Carbohydr Res. 2005
9. Lee KY, Weintraub ST, Yu BP. Isolation and identification of a phenolic antioxidant from Aloe barbadensis. Free Radic Biol Med. 2000
10. Habeeb F, Shakir E, Bradbury F, et al. Screening methods used to determine

## International Conference on Ayurveda Traditional Medicine and Medicinal Plant



the anti-microbial properties of Aloe vera inner gel. *Methods*. 2007

11. Avijgan M, Mahboubi M, Moheb Nasab M, Ahmadi Nia E, Yousefi H. Synergistic activity between *Echinophora platyloba* DC ethanolic extract andazole drugs against clinical isolates of *Candida albicans* from women suffering chronic recurrent vaginitis. *J Mycol Med*. 2014