

PHARMACOGNOSTIC AND PHYTOCHEMICAL PROPERTIES OF ALOE VERA LINN –AN OVERVIEW

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ABSTRACT

Aloe vera is a perennial, drought-resisting, 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, unani and homoeopathy. Clinical evaluations have revealed that the pharmacological active ingredients are concentrated in both the gel and rind of the aloe vera leaves. Bioactive compounds from aloe vera are very effective in various treatments, such as burns, allergic reactions, rheumatoid arthritis, rheumatic fever, acid indigestion, ulcers, diabetes, skin diseases, dysentery, diarrhoea, piles and inflammatory conditions of the digestive system and other internal organs, including the stomach, small intestine, liver, kidney, and pancreas. The active ingredients have been shown to have analgesic, anti-inflammatory, antioxidant and anticancer agent. The present review is therefore, an effort to give a detailed survey of the literature on its traditional, phytochemical and pharmacological properties.

Keywords: pharmacological, laxative, antioxidant, anticancer, antidiuretic, tannin, Aloe vera.

INTRODUCTION

Natural products are known to play an important role in Pharmaceutical biology. Plants have been an important source of medicine for thousands of years. Even today, the World Health Organization estimates that up to 80 percent 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 motifs¹. Natural antimicrobials can be derived from barks, stems, leaves, flowers and fruits of plants, various animal tissues or from microorganisms². Genus *Aloe* is a perennial succulent herb have grown in temperate and subtropical parts of the world. This plant genus is originated in Africa. The genus includes 200 or more species. Some of them are cultivated for the resinous latex contained in their thick, fleshy leaves. Since biblical times, aloe plants have figured among folkloric remedies as purgatives and as treatments for skin disorders. *Aloe vera* is a member of liliaceae family. It is commonly called aloe, burn plant, lily of the desert, elephant's gall. *Alove vera* (L.) in synonym *A. brobadensis* is a cactus (leaves) like plant with green, dagger- shaped leaves that are fleshy, tapering, spiny, marginated and filled with a clear viscous gel³. The name, aloe, is derived from the Arabic "alloeh" or Hebrew "halal" meaning bitter shiny substance. Two types of exudates are secreted by aloe leaves. One is a bitter reddish-yellow juice contained in the pericyclic cells located under the strongly cutinized epidermis of the leaves. This "juice" has been generally used for laxative purposes and in dried form. Its bitterness is due to the presence of aloin, aloe-emodin and related compounds. The other exudate is a transparent, slippery mucilage or gel produced by the thin-walled tubular cells in the inner central zone (parenchyma) of the leaf. The raw "gel" resembles colorless gelatin with hair-like connective matrices and is also sometimes called "juice." In antiquity, this mucilage was applied to inflamed skin and during the

20th century it was used on radiation burns. The bio active compounds are used as astringent, haemostatic, antidiabetic^{4,5}, antiulcer, anti-septic⁶, antibacterial⁷, antiinflammatory, 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 nutraceuticals⁸. In the present study we focus on some of the phytochemical, pharmacological and traditional properties of Aloe vera.



Aloe Vera

Taxonomy:

Kingdom: Plantae
Order : Asparagales
Family : Asphodelaceae
Genus : *Aloe*
Species : *Aloe vera*



Chemical properties of Aloe Vera:

Vitamins:

The plant contains many vitamins, including the important antioxidant vitamins A, C and F. Vitamins B (thiamine), niacin, vitamin B₂ (riboflavin), vitamin B₁₂, choline and folic acid⁹.

Enzymes:

Biochemical catalysts, such as amylase and lipase, can aid digestion by breaking down fats and sugars. Carboxypeptidase, inactivates bradykinins and produces an anti-inflammatory effect. During the inflammatory process, bradykinin produces pain associated with vasodilation and, therefore, its hydrolysis reduces these two components and produces an analgesic effect^{10,11}.

Minerals:

Sodium, potassium, calcium, magnesium, manganese, copper, zinc, chromium and iron are all found in the aloe plant. Magnesium lactate inhibits histidine decarboxylase and prevents the formation of histamine from the amino acid, histidine. Histamine is released in many allergic reactions and causes intense itching and pain. The prevention of its formation may explain the antipruritic effect of aloe vera.

Sugars:

Sugars are derived from the mucilage layer of the plant under the rind, surrounding the inner parenchyma or gel. They form 25 per cent of the solid fraction and comprise both mono- and polysaccharides. The most important are the long chain polysaccharides, comprising glucose and mannose, known as the gluco-mannans. The polysaccharides are absorbed complete and appear in the blood stream unchanged hence they act as immunomodulators¹²⁻¹⁴.

Anthraquinones:

The bitter aloes consist of free anthraquinones and their derivatives, Barbaloin, aloe-emodin-9-anthrone, Isobarbaloin, Anthrone-C-glycosides and chromones. In large amounts these compounds exert a powerful purgative effect, but when smaller they appear to aid absorption from the gut, are potent antimicrobial agents^{15,16} and possess powerful analgesic effects. They also reduce the formation of melanin and any tendency to hyper-pigmentation^{17,18}. Lignin with their penetrative ability to carry other active ingredients deep into the skin to nourish the dermis⁹.

Sterols: These include Campesterol, Sitosterol and Lupeol⁹.

Salicylic acid:

This is an aspirin-like compound possessing anti-inflammatory and antibacterial properties. It has a kerolytic effect which helps to debride a wound of necrotic tissue.

Aminoacids:

These are the building blocks of proteins. Aloe vera gel provides 20 of the 22 necessary amino acids required by

the human body and seven of the eight essential amino acids which the body cannot synthesize.

Traditional properties:

The healing properties of the succulent plant aloe vera have been known for thousands of years. Belonging to the lily family and related to the onion, garlic and asparagus, evidence supporting the early use of aloe was discovered on a Mesopotamian clay tablet dating from 2100 BC. Aloe vera was well known not only to the Egyptians, but also the Roman, Greek, Arab and Indian cultures. In fact, many famous physicians of those times, including Dioscorides, Pliny the Elder and Galen considered to be the father of modern medicine, included aloe vera in their therapeutic armouries. Myths and legends surrounding the use of aloe vera in ancient times suggest that it was an important part of the beauty regime of the Egyptian queens, Nefertiti and Cleopatra. Legend has it that, in 333 BC, Alexander the Great was persuaded by his mentor Aristotle to capture the island of Socotra in the Indian Ocean, famed for its supply of aloe which he needed to heal his wounded soldiers. Aloe vera has been one of the most important plants used in folk medicine. The Egyptians referred to aloe as the "plant of immortality" and included it among the funerary gifts buried with the pharaohs. The healing benefits of aloe were recognized in the ancient Indian, Chinese, Greek, and Roman civilizations. It is traditionally used to heal wounds, relieve itching and swelling, and is known for its anti-inflammatory and antibacterial properties. Aloe Vera, or Ghrit Kumari in Sanskrit, is a member of the lily family and is very cactus-like in its characteristics. It is one to two feet tall; and its leaves are succulent, broad at the base and pointed at the tips, with spines along the edges. These fat leaves contain the clear healing gel that is 96% water. The other four percent contains 75 known substances including Vitamins A, B, C, E, calcium, amino acids for protein building, and enzymes used in the digestive system. Ghritkumari is described as multi functional herb in Ayurveda as blood purifier, anti-inflammatory, diuretic, uterine tonic, spermatogenic, laxative and fever reliver. It is used in ayurvedic formulations for appetite-stimulant, purgative, emmenagogue and anthelmintic, cough, colds, piles, debility, dyspnoea, asthma and jaundice. It is widely used in ayurvedic formulations for liver protection and general debility. Hair oil made from Ghrit kumari helps to prevent premature graying of hair and makes them strong and free from dandruff. Ayurvedic formulation made of juice from Aloe vera helps to improve immunity and protects heart, brain and other vital organs of body. The healing effect of aloe results from its ability to prevent injury to epithelial tissues, and promote healing of injured tissues. Aloe vera is used in variety of skin ailments such as mild cuts, insect stings, bruises, poison ivy and eczema. It also has antibacterial and antifungal qualities, and increases blood flow to wounded areas. It stimulates fibroblasts, the skin cells responsible for wound healing and the manufacture of collagen, the protein that controls the



aging process of the skin and wrinkling. The skin absorbs aloe vera up to four times faster than water; it appears to help the pores of the skin open and receive the moisture and nutrients of the plant. Due to its soothing and cooling qualities, Maharishi ayurveda recommends aloe vera for a number of skin conditions. The leaf gel is applied several times a day for light burns and wounds, for mild sun burn apply the paste on affected areas and wash it off after 15 minutes. In addition to the skin, other epitheliums in our body include the lining of the gut, the bronchial tubes and the genital tract, which also benefit from the healing effect of aloe vera. When taken internally, aloe vera juice aids the digestion and absorption of nutrients, helps control blood sugar, increases energy production, promotes cardiovascular health, improves liver function, and boosts the immune system. The pulp is used extensively in Siddha medicines for treating constipation, enlargement of spleen, zymotic disease and chengamaari (a type of venereal infection)¹⁹. **For balancing digestion and elimination** take 1 tablespoon aloe vera gel in the morning on an empty stomach. Aloe helps clear the toxins out of the digestive system, facilitates digestion and improves the functioning of the kidneys, liver and gall bladder. The anti-inflammatory fatty acids in aloe alkalize the digestive juices and prevent acidity—a common cause of indigestion. These fatty acids benefit not only the stomach but the small intestine and the colon as well. Since aloe vera purifies the body and aids liver function, it is beneficial for the skin when taken internally. Take 1-2 teaspoons fresh aloe gel daily for young and healthy skin. Aloe vera has six antiseptic agents (sulphur, lupeol, salicylic acid, cinnamic acid, urea nitrogen and phenol) which act as a team to provide antimicrobial activity thus eliminating many internal and external infections. The pain relieving action is due to the effective analgesics in salicylic acid, magnesium and lupeol. Fatty acids also have a pain reducing, allergy and inflammation relieving effect, and work to lower harmful cholesterol levels.

Phyto chemical composition:

The plant contains flavonoids, terpenoids, lectins²⁰⁻²², fattyacids, cholesterol, anthraquinones, Chromones (8-C-glucosyl-7-O-methylaloediol, 8-C-glucosyl-noreugenin, Isoaloeresin D, iso rabaichromone, neoaloesin A)^{23,24}, mono and polysaccharides (pectins, hemicelluloses, glucomannan, acemannan, and mannose derivatives)^{25,26}, tannins, sterols (lupeol, campesterol, and β sitosterol), salicylic acid, organic acids, enzymes, saponins, vitamins, minerals²⁷, aloin, anthrone, aloe emodin (3-hydroxymethyl-chrysozin), aloetic acid, choline and choline salicylate, complex mucopolysaccharides similar to hyaluronic acid, sapogenins and enzymes such as catalase, amylase, cellulase and alliinase. Minerals such as calcium, magnesium, potassium, sodium, aluminum, iron and zinc. Aminoacids such as arginine, asparagine, glutamic acid, aspartic acid and serine²⁸. Vitamins such as B1, B2, B6, C, β -carotene, choline, folic acid, α -tocopherol are present. Free monosaccharides consisted of D-mannose and D-glucose in a molar ratio of 5:4 and trace amounts of xylose, rhamnose, galactose, and either

arabinose or fucose were found. Mannose 6phosphate is a major sugar component in aloe vera.

Phytopharmacological properties:

Antitumor and antioxidant activity:

The active principles of A. vera exhibited significant inhibition on Ehrlich ascite carcinoma cell (EACC) number, when compared to control group, in the order barbaloin > aloe-emodin > octapeptide > aloesin. In trypan blue cell viability assay a significant concentration-dependent cytotoxicity against acute myeloid leukemia (AML) and acute lymphocytes leukemia (ALL) cancerous cells. In MTT cell viability test, aloe-emodin was found to be active against two human colon cancer cell lines (i.e. DLD-1 and HT2), with IC(50) values of 8.94 and 10.78 microM,. Treatments of human AML leukemic cells with active principles (100 microg ml(-1)) resulted in varying intensities of internucleosomal DNA fragmentation, hallmark of cells undergoing apoptosis. Treatment of EACC tumors with active principles resulted in a significant elevation activity of key antioxidant enzymes (SOD, GST, tGPx, and LDH). This results proves the antitumor and antioxidant properties of Aloe vera²⁹.

Anti-inflammatory activity:

Aloe vera gel had a dose-dependent inhibitory effect on reactive oxygen metabolite production; 50% inhibition occurred at 1 in 1000 dilution in the phycoerythrin assay and at 1 in 10-50 dilution with biopsies. Aloe vera inhibited the production of prostaglandin E2 by 30% at 1 in 50 dilution (P = 0.03), but had no effect on thromboxane B2 production. The release of interleukin-8 by CaCo2 cells fell by 20% (P < 0.05) with aloe vera. diluted at 1 in 100. The anti-inflammatory actions of aloe vera gel in vitro provide support for the effect in inflammatory bowel disease³⁰.

Hypoglycemic and hypolipidemic activity:

Processed Aloe vera gel (PAG) when administered orally for 8 weeks reduced circulating blood glucose concentrations to a normal level in diet-induced obesity mice. The antidiabetic effects of PAG were confirmed by intraperitoneal glucose tolerance testing. PAG lowered blood glucose level by decreasing insulin resistance. The administration of PAG also lowered triacylglyceride levels in liver and plasma. Histological examinations of periepididymal fat pad showed that PAG reduced the average size of adipocytes³¹. This shows the Hypoglycemic and hypolipidemic effects of processed Aloe vera gel.

Wound healing activity:

Wounds were induced on both sides of the vertebral column of ICR mice using a biopsy punch.

A 62.5% reduction in wound diameter was noted in mice receiving 100 mg/kg/day oral Aloe vera and a 50.80% reduction was recorded in animals receiving topical 25% Aloe vera. These data suggest that Aloe vera is effective in wound healing³².



Antimutagenic activity:

The antimutagenic effect of aloe vera gel was investigated using sex-linked recessive lethal test (SLRL) in 3-days-old adult *Drosophila*. One group of drosophila were mutated by ethyl methanesulfonate (EMS). The other group was first treated with EMS, and then with aloe vera gel (co-treatment). Co-treatment with aloe vera was effective in reducing genotoxicity of the direct-acting mutagen³³.

Immunomodulatory activity:

Mice, when administered with Aloe vera extract (150 mg/kg and 300 mg/kg) respectively for 5 days there was a significant increase in the total white blood cell count and macrophages with the engulfed SRBC with increase in concentration. This shows the immunomodulatory property of the extract³⁴.

Gastroprotective activity:

Ethanol extract by intraperitoneal injection on acute gastric mucosal lesions induced by 0.6 M HCl in rats, dose dependently inhibit gastric acid secretion. The plant was more active as a gastroprotective agent at lower concentration against mucosal injury³⁵.

Antifungal activity:

Antifungal activity of leaf pulp and liquid fraction of *Aloe vera* was evaluated on the mycelium development of *Rhizoctonia solani*, *Fusarium oxysporum*, and *Colletotrichum coccodes*, that showed an inhibitory effect of the pulp of *A. Vera* on *F. oxysporum* at $10^4 \mu\text{l}^{-1}$ and the liquid fraction reduced the rate of colony growth at a concentration of $10^5 \mu\text{l}^{-1}$ in *R. solani*, *F. oxysporum*, and *C. coccodes*³⁶. From this it is evident that leaf pulp and liquid fraction of *Aloe vera* act against plant pathogenic fungi.

CONCLUSION

The present study shows the traditional, pharmacological and phytochemical properties of various bioactive compounds present in Aloe vera. The plant contains many vitamins, including the important antioxidant vitamins A, C and E. Vitamins B (thiamine), niacin, vitamin B₂ (riboflavin), vitamin B₁₂, choline and folic acid. The leaf pulp and liquid fraction of *Aloe vera* act against various microorganisms. The ethanol extract also showed significant dose-dependent increases in total white blood cell count and macrophages. In acute gastric mucosal lesions, the extract dose dependently inhibits gastric acid secretion and provides gastroprotective activity. Processed aloe vera gel lowered blood glucose level by decreasing insulin resistance and also lowered triacylglyceride levels in liver and plasma of mice. Further investigations should be conducted to isolate and characterize the active components of this plant.

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