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A review on phytochemicals composition and medicinal properties of *Aloe vera* plant

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Abstract
Aloe vera is the most widely used medicinal plant in the world and the oldest known medicinal plant. The healing plant or silent healer, *Aloe vera* is a perennial succulent that is a member of the Asphodelaceae family. It is an important component in the food, drug, and cosmetic industries. It is commonly used in the traditional herbal medicine of many nations and is known as kathalai in ayurveda treatment. *Aloe vera* has been shown to have a number of positive effects, including the ability to modulate the immune system, speed up the healing of wounds and burns, fight cancer, and reduce inflammation. Additionally, it possesses immune-stimulating and antiviral qualities.
Aloe vera contains over 110 potentially active substances that fall into six categories: flavonoids, phenylpropanoids, coumarins, chromone and its glycoside derivatives, anthraquinone and its glycoside derivatives, phenylephrine and its phenol derivatives, phytosterols, and others. Mexico, India, South and Central America, Africa, Australia, the Caribbean, and Iran are all home to *Aloe vera* plantations. Therefore, the current study aims to provide a thorough overview of the literature on its traditional, phytochemical, and therapeutic qualities.

Keywords: *Aloe vera*, traditional medicine, bioactive components, medicinal plants

Introduction
For its numerous therapeutic benefits, *Aloe vera* is a medicinal plant that has been used for centuries. Up to 80% of the population, according to WHO estimates, still uses traditional medications today. Aloe is a perennial, succulent xerophyte that is grown around the world in temperate and subtropical climates. It was developed in Africa. There are more than 360 recognised species in the Asphodelaceae family, which includes *Aloe vera* and Aloe barbadensis.
Aloe vera, Aloe barbadensis, Aloe ferox, Aloe Chinensis, Aloe Indica, Aloe peyrii, and other species have all been classified as members of the genus Aloe. One of these is *Aloe vera* Linn. All agree that Aloe's true botanical origins is *Aloe barbadensis* Miller. It is also known as elephant's gall, burn plant, lily of the desert, and aloe. It is a green, cactus-like plant with fleshy, tapering, spiky, marginated leaves that are formed like daggers and filled with a viscous, clear gel. Numerous biological characteristics are connected to the inner gel of the *Aloe vera* leaf.
The biological properties of the numerous species of aloe, such as their antibacterial and antimicrobial properties, have been the subject of much investigation. Important medical characteristics of *Aloe vera* include its ability to combat diabetes, cancer, rheumatoid arthritis, and cancer. *Aloe vera* is used topically to treat a variety of skin ailments such as cuts, burns, and dermatitis. It has also been marketed for gastrointestinal disorders, constipation, and immune system inadequacies.
For the purpose of the current review two major search engines: Scopus and Google Scholar were used.

Synonyms
Aloe barbadensis Mill., *Aloe Chinensis* Bak., *Aloe elongate* Murray, *Aloe Indica* Royle, *Aloe Officinalis* Forsk., *Aloe perfoliata* L., *Aloe rubescens* DC, *Aloe vera L.* var. *littoralis König* ex Bak., *Aloe vera L.* var. *Chinensis Berger*, *Aloe Vulgaris Lam.*

Taxonomic classification
Kingdom: Plantae
Phylum: Magnoliophyta
Class: Liliopsida
Order: Asparagales
Family: Asphodelaceae
Genus: Aloe
Subject: *Aloe vera (L.)* Burm. f.

Description
It is an 80-100 cm tall, stemless or extremely short-stemmed succulent plant that spreads through offsets and root sprouts. The oblong, thick, meaty leaves have a serrated edge and range in colour from green to grey-green. Each flower on the spike, which can reach a height of 90 cm, is pendulous and has a yellow tubular corolla that is 2 to 3 cm long.

Geographical Source
Aloe vera is native to East and South Africa, but it has also been introduced to the West Indies and other modern countries. It even grows well in areas that are close to the Mediterranean. It is present in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, the United Kingdom, Himachal Pradesh, and Tamil Nadu in India. Aruba, Bonaire, Haiti, India, South Africa, the United States, and Venezuela are among the countries where it is economically established. For many purposes, it has evolved into a typical family solution.

Cultivation and Collection
There are more than 250 species of aloe mature around the over in the world. Be that as it may, just two species are developed today industrially, with *Aloe barbadensis* Miller and Aloe arborescent being the most prevalent. The *Aloe vera* plant is grown in warm tropical territories and cannot survive solidifying temperatures. It is an evergreen perpetual developing to 0.8 m by 1 m at a slow rate. The plants incline toward the light (sandy) and medium (loamy) soil requires all around depleted soil can develop in healthfully poor soil. The plant inclines toward corrosive, nonpartisan and essential (basic) soil. It can't develop in shade. It requires dry or clammy soil and can endure dry spells.
These plants are xerophytic. It can spread through seeds. The seedlings are traded in for containers with drastically decreased soil. For their first two winters, they are at least allowed to grow in sunny areas. The counterweight will primarily be available in the spring. The plants can be isolated at any time of the year as long as the temperature is warm enough to encourage new attachment growth and allow plant repair. After the swirling season, lines of young equalization are formed at a detachment of 60 meters and planted in the ground.
Due to the difficult manner of take-off, locals amass leaves in the second year by holding onto their hands. The leaves are taken from an aloe arrangement's focal point and cut just above the light fuel tins. Aloe juice can be found in the sticky parenchymatous cells of the pericycle. Adhesive cells are present at a single-entry point.

Table 1: Chemical composition of *Aloe vera*

Class	Compounds	Properties
Anthraquinones/anthrones	Aloe-emodin, aloetic-acid, anthranol, barbaloin, isobarbaloin, emodin, ester of cinnamic acid.	Aloin and emodin act as analgesics, antibacterials and antivirals.
Chromones	8-C-glusoly-(2'-O-cinnamoyl) -7-O-methlyaloediol A, 8-C-glucosyl-(S)-aloesol, 8-C-glucosyl-7-O-methylaloediol A, 8-C-glucosyl-7-0-methylaloediol, 8-C-glucosyl-noreugenin, isoaloeresin D, isorabaichromone, neoalosin A	The novel anti-inflammatory commands.
Enzymes	Alkaline phosphatase, amylase, bradykinesia, carboxypeptidase, catalase,cyclooxidase, cyclooxygenase, lipase, oxidase, phosphoenolpyruvate, carboxylase, superoxide dismutase	Bradykinase helps to reduce excessive inflammation when applied to the skin topically, while others help in the breakdown of sugars and fats.
Miscellaneous including organic compounds and lipids	Arachidonic acid, Y-linolenic acid, steroids (campesterol, cholesterol, Bsitosterol), triglycerides, triterpenoid, gibberellin, lignins, potassium sorbate, salicylic acid, uric acid	
Carbohydrates	Pure mannan, acetylated mannan, acetylated glucomannan, glucogalactomannan, galactan, galactogalacturan, arabinogalactan, galactoglucoarabinomannan, pectic substance, xylan, cellulose	A glycoprotein with antiallergic properties called alprogen and a novel anti-inflammatory compound.
Inorganic compounds	Calcium, chlorine, chromium, copper,iron, magnesium, manganese, potassium, phosphorous, sodium, Zinc	They are essential for the proper functioning of various enzymes systems in different metabolic pathways and few are antioxidants
Proteins	Lectins, lectin-like substance	It also contains salicylic acid which possesses anti-inflammatory and antibacterial properties. Lignin, an inert substance, when included in topical preparations, enhances the penetrative effect of the other ingredients into the skin. Saponins are soapy substances from about 3% of the gel and have cleansing and antiseptic properties.
Saccharides	Mannose, glucose, L-rhamnose, aldopentose	
Vitamins	Vitamin A, B12, C, E, choline and folic acid	Vitamins A, C and E are antioxidants and antioxidants neutralize free radicals.
Hormones	Auxins and gibberellins	That helps in wound healing and has anti-inflammatory action.

Medicinal properties of *Aloe vera*

Wound Healing Activity

Aloe vera gel hastens the healing of wounds. In mice given 100 mg/kg/day orally, it decreased wound diameter (inflicted on both sides of the spinal column) by 62.5%, and in animals given 25% *Aloe vera* topically, it reduced wound diameter by 50.80%. Numerous studies have demonstrated that aloe helps wounds from burns, frostbite, electrical injuries, caustic chemicals, and surgery heal more quickly. It promoted fibroblast and macrophage activity, which increases the production of collagen and proteoglycans and aids in tissue healing. Compared to topical antibiotics, it also increased collagen deposition and cross-linking in granulation tissue in wounds and improved scar strength. Acemannan also reduced skin responses brought on by radiation exposure and sped up wound healing.

Immune Modulation

Anti-inflammatory and stimulant (gel). The number of circulating monocytes and macrophages significantly increased in case studies of 14 HIV-1+ patients who were given 800 mg/day of acemannan, which coincided with clinical improvements. Acemannan boosted the quantity of white blood cells and reduced symptoms in a pilot investigation on HIV-positive individuals. Adults with asthma were also given aloe extracts, which boosted phagocytosis.

Alprogen prevents calcium from entering mast cells, which prevents histamine and leukotriene from being released from mast cells through the antigen-antibody pathway. Acemannan stimulates the synthesis and release of interleukin-1 (IL-1) and tumour necrosis factor from macrophages in mice, which in turn triggers an immune attack that results in necrosis and regression of the cancerous cells, according to a study on mice that had previously received implants of murine sarcoma cells. A number of low-molecular-weight substances are also able to prevent activated human neutrophils from releasing reactive oxygen free radicals.

Moisturizing and Anti-Ageing Activity

Currently, more than 95% of dermatologically beneficial products are made using *Aloe vera*. This is due to its remarkable moisturising abilities. It enhances the skin's capacity to moisturise itself and aids in the exfoliation of dead skin cells. In order to reverse the degenerative skin changes, it does this by creating collagen and elastin fibres, which increase the skin's elasticity and reduce wrinkles. By acting cohesively on flaky, superficial epidermal cells as well as by the influence of amino acids, it softens the skin. *Aloe vera* is a perfect element in cosmetics and dermatological procedures due to its amazing qualities.

Anti-Diabetic Activity

Blood sugar levels can be decreased by using *Aloe vera* gel. However, the outcomes can differ depending on how the mucilaginous layer is separated from the anthraquinones. It also lowers hepatic transaminases, plasma and tissue cholesterol, triglycerides, free fatty acids, and phospholipids while lowering blood glucose levels. In a study by Rajasekaran *et al*., treatment with gel extract was able to return the plasma levels of high-density lipoproteins to normal after they had reduced and the levels of low-density lipoproteins had grown. The mechanism behind the lowering of blood glucose levels could be the enhancement of glucose metabolism or it could also be attributed to the anti-oxidant effect, which reduces the peroxide levels and hence oxidative damage. The level of triglycerides was dramatically reduced with *Aloe vera* gel. This clarifies its effects on blood sugar and cholesterol levels.

Anti-Viral Activity

Numerous components of *Aloe vera* have been found to have effective antiviral properties. Lectin extracted from *Aloe vera* leaf gel may disrupt protein synthesis and stop Cytomegalovirus from multiplying (Sahu *et al*. 2013) [27]. While this is going on, *Aloe vera* emodin can effectively lower the influenza virus by up-regulating galectin-3 (Li *et al*. 2014) [50]. Electron micrographs have shown that it is also effective against type I and type II herpes simplex infections as well as deactivating other viruses such as varicella zoster, influenza, and pseudorabies virus by partially destroying their envelopes (Zandi *et al*. 2007) [49].

Additionally, preliminary research indicates that consuming *Aloe vera* strengthens the immune system by raising the CD4 count, which may be advantageous for those with HIV (Olatunya *et al*. 2012) [13]. It may be possible to treat disorders brought on by viral infections like HIV and other viruses by further developing these anti-viral components from *Aloe vera* leaves.

Anti-Inflammatory Activity

The body's natural reaction to an injury is inflammation, which is characterized by heat, redness, swelling, and discomfort and delays the healing process. *Aloe vera* is a potent active ingredient in the creation of herbal medicines. The recently discovered calming substance known as C-glucosyl chromone was separated from gel extracts, which suppressed the cyclooxygenase and decreased prostaglandin E2 synthesis from arachidonic corrosive. *Aloe vera*'s anti-inflammatory properties make this plant highly helpful in treating inflammation.

Anti-Cancer Activity

Numerous studies have demonstrated that certain elements in *Aloe vera* leaves have anti-cancer effects by controlling the development of different tumours (Unlu *et al*. 2016). An analysis revealed that using an *Aloe vera* treatment with aloin and aloe-emodin can greatly slow the growth of cells that cause Ehrlich ascites carcinoma (Kuo, Lin, and Lin 2002). Numerous cancer cell lines have been used in extensive research on aloe-ability emodin's to prevent the growth of a variety of tumour cells, including lung carcinoma (Lee *et al*. 2001), hepatoma (Kuo, Lin, and Lin 2002), and leukaemia cell lines (Chen *et al*. 2004).

Numerous studies have shown that specific components of *Aloe vera* leaves have anti-cancer properties by limiting the growth of various tumours (Unlu *et al*. 2016). The growth of cells that produce Ehrlich ascites carcinoma can be significantly slowed down by utilising an *Aloe vera* treatment that contains aloin and aloe-emodin, according to an analysis (Kuo, Lin, and Lin 2002). Numerous cancer cell lines, including as lung carcinoma (Lee *et al*. 2001), hepatoma (Kuo, Lin, and Lin 2002), and leukaemia cell lines, have been utilised in significant research on aloe-ability emodin's to inhibit the growth of a range of tumour cells (Chen *et al*. 2004).

Aloe-emodin is one of many *Aloe vera* compounds that have been identified as possible anti-cancer candidates, though. According to studies, *Aloe vera*'s glycoproteins may have anti-tumor properties (Yagi *et al*. 1997) [24], and a polysaccharide fraction of the plant may be able to stop the development of potentially cancer-causing benzopyrene-DNA adducts in primary rat hepatocytes (Kim and Lee 1997). But more study is needed to back up the clinical usage of *Aloe vera* for cancer treatment (Kim and Lee 1997). However, prior research on the anti-cancer activities of several *Aloe vera* extracts has indicated that these ingredients may alter multiple pharmacological processes linked to the development of cancer.

Antioxidant Activity

Antioxidants are substances that, through scavenging free radicals, chelating metals, and controlling enzyme activity, prevent or delay the oxidative damage that ROS cause to biomolecules. Using various in vitro techniques, Kumar *et al*. 2017 examined the potential antioxidant activity of crude methanolic extracts of *Aloe vera* from six agro-climatic zones in India (i.e., DPPH, metal chelating, and reducing power assay). In Northern India-collected species, antioxidant activity was higher than in Southern India-collected species, which is associated with a high amount of alkaloids, glycosides, phenolic compounds, flavonoids, and saponin glycosides.

Additionally, via lowering ROS production and HNE-protein adduct formation, *Aloe vera* ethanol extracts protected, in particular human microvascular endothelial cells, against hydrogen peroxide and 4-hydroxynonenal-induced toxicity. *Aloe vera*'s antioxidant properties are at least partially attributed to anthraquinones and related chemicals (10 M), which have peroxyl radical scavenging and reduction abilities.

Anti-Microbial Activity

Aloe vera contains lupeol, salicylic acid, urea nitrogen, cinnamomic acid, phenols, and sulphur, which together make up six antiseptics. They all serve as inhibitors against viruses, bacteria, and fungi. The AIDS virus and Herpes virus cannot reproduce when acemannan, azidothymidine (AZT), and acyclovir are combined. Antifungal Trichophyton mentagrophytes-infected guinea pig foot treated with aloe extracts showed a 70% reduction in growth when compared to untreated animals. Recent research has demonstrated that a polysaccharide fraction inhibits the binding of benzopyrene to primary rat hepatocytes, reducing the development of benzopyrene-DNA adducts that may initiate cancer. An advantage of utilising aloe may include the induction of glutathione S-transferase and the prevention of phorbol myristic acetate's tumor-promoting actions.

Conclusion

For its numerous therapeutic benefits, *Aloe vera* is a medicinal plant that has been used for centuries. *Aloe vera*'s chemical makeup is particularly intriguing because a number of its constituents have medicinal and pharmacological characteristics. *Aloe vera* cultivation is becoming very important commercially for cosmetics and pharmaceuticals. India's farmers frequently deal with issues like soil deterioration, low groundwater levels, and a lack of rain. *Aloe vera* can be grown in a variety of ecological environments, and it can generate consistent revenue and significant returns on investment.

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