



**A REVIEW ON TRADITIONAL MEDICINAL HERB: ALOE VERA**

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**ABSTRACT**

The traditional herbal plant aloe vera finds widespread application in the fields of cosmetics and medicine. This herb has both internal and external uses in various parts of the world. Externally, it is used to treat sunburns, burns, small cuts, skin cancer, acne, and glowing skin. Internally, it is used to treat most digestive issues, such as constipation, colitis, poor appetite, irritable bowel syndrome, asthma, diabetes, immune system enhancement, peptic ulcers, and periodontal diseases. It has been possible to separate phytochemical components such as anthraquinones, sugars, lignin, sterols, hormones, minerals, enzymes, and saponins. This review provides a thorough analysis of the literature on the therapeutic uses and diverse phytochemical components of the aloe vera plant.

**KEYWORDS:** Aloe vera, phytochemical components, therapeutic uses.

**INTRODUCTION**

In medicinal biology, plants have been utilized as a major source of medication for thousands of years. According to WHO estimates, up to 80% of people still use traditional medications today.<sup>[1]</sup> Grown throughout temperate and subtropical regions of the world, the genus Aloe is a perennial succulent xerophyte. This striking plant is native to tropical and semi-tropical regions of Africa and the Mediterranean. There are more than 360 identified species in the Asphodelaceae family, which includes aloe vera or aloe barbadensis. The genus Aloe has a number of species, such as Aloe vera, Aloe barbadensis, Aloe ferox, Aloe chinensis, Aloe indica, Aloe peyrii, etc. All of these include Aloe vera Linn syn. The proper botanical source of aloe is universally acknowledged to be Aloe barbadensis Miller.<sup>[2]</sup> For millennia, people have been aware of and utilized the health, aesthetic, medical, and skin-care benefits of aloe vera. The Latin word "vera" means "true," while the Arabic word "Alloeh" means "shining bitter substance" and is the source of the name Aloe vera. Aloe vera was considered the all-purpose cure by Greek scientists 2,000 years ago. Aloe was considered "the plant of immortality" by the ancient Egyptians. Aloe vera is a plant that is used in cosmetics and medicine for a variety of applications.<sup>[3]</sup> Due to its great demand in the industrial, cosmetic, and medicinal sectors, aloe vera is grown in vast quantities. Aloe vera has pharmacological properties that include hypoglycaemic, antimicrobial,

and anti-inflammatory and anti-arthritis activity. Because of its ability to cure burns and wounds, this plant is also known as the silent healer or the healing plant.<sup>[4]</sup> Many nations, including Greece, Egypt, India, Mexico, Japan, and China, have been using aloe vera as medicine for millennia.<sup>[5]</sup>

**Synonyms**

The common names in India are Sanskrit (Kumarirasambhava, Sahasara), Assamese (Musabhar, Machambar), Bengali (Ghritakalmi), English (Indian Aloe), Nepali (Gheekumari), Gujarati (Eliyo, Eariyo), Hindi (Musabhar, Elva), Kannada (Karibola, Lolesara satva, Lovalsara, Lolesara), Kashmiri (Musabbar, Siber), Malayalam (Chenninayakam), Marathi (Korphad), Oriya (Musabara), Punjabi (Kalasohaga, Mussabar, Aлуу), Tamil (Kattazhi, Sothukkathazhai), Telugu (Musambaram), Urdu (Musabbar, Ailiva, Siber).<sup>[6]</sup>

**Distribution**

Aloe vera is indigenous to the Canary Islands, the Mediterranean region of southern Europe, and North Africa. Common growing regions for it include southern Europe, the southern USA, Mexico, Aruba, Bonaire, Bermuda, the Bahamas, the West Indies, Central America, and Asia (India, Nepal, Bangladesh, Bhutan, and Pakistan).<sup>[7]</sup>

## Description

The aloe vera plant features yellow tubular flowers, fruits with many seeds, and triangular, fleshy leaves with serrated edges. The main structure of a leaf is composed of three layers. The clear gel that makes up the inner layer is made up of 99% water, while the remaining components are vitamins, sterols, amino acids, glucomannans, and lipids. The bitter yellow sap known as latex, along with other phytoconstituents such as anthraquinones and glycosides, is found in the intermediate layer. The outermost thick layer of aloe vera leaves is called the rind, and it serves as a protective layer in addition to being a place where proteins and carbohydrates are synthesized. The vascular bundles found within the rind are in charge of moving materials like starch (phloem) and water (xylem).<sup>[8]</sup>

## Chemical constituents

The aloe vera gel has a complicated chemical makeup. 75 potentially active ingredients can be found in aloe vera, including vitamins, enzymes, minerals, carbohydrates, lignin, saponins, amino acids, and salicylic acids. The specifics are as follows:

### Vitamins

Antioxidant vitamins A, C, and E are among the many vitamins found in the plant. It also includes folic acid, choline, vitamin B12, niacin, riboflavin, and thiamine.<sup>[9]</sup> Antioxidants prevent free radical damage.

### Enzyme

The eight enzymes found in aloe vera are lipase, cellulase, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, and peroxidase. When administered topically, bradykinase helps to lessen excessive inflammation, and other enzymes aid in the breakdown of fats and sugars.<sup>[10]</sup>

### Minerals

The aloe plant contains the following elements: manganese, copper, zinc, chromium, iron, sodium, potassium, calcium, magnesium, and selenium. These minerals are crucial for the proper operation of enzymes that are engaged in a number of metabolic processes. Not many of these function as antioxidants.<sup>[11]</sup>

### Sugars

Under the leaf rind, in the mucilaginous layer of the plant, are sugars. It contains polysaccharides like glucomannose and polymannose, as well as monosaccharides like glucose and fructose. The immune system is modulated by the polysaccharides.<sup>[12,13]</sup> Glucomannan is a useful moisturizer that is included in makeup.

### Anthraquinones

Beneath the exterior green rind are bitter reddish yellow exudates that are rich in anthraquinones and their derivatives, as well as barbaloin, aloe-emodin-9-anthrone, sobarbaloin, anthrone-C-glycosides, and chromones. These substances are phenolics, which have

historically been used as laxatives. When present in large quantities, these chemicals have a strong purgative impact; nevertheless, when present in lesser amounts, they seem to facilitate absorption from the gut and are strong antibacterial agents with strong analgesic properties.<sup>[14]</sup>

### Others

It has seven of the eight essential amino acids and twenty of the twenty-two amino acids that humans require. Salicylic acid, which has antibacterial and anti-inflammatory qualities, is another ingredient in it. When added to topical medicines, the inert component lignin improves the other chemicals' ability to penetrate the skin. About 3% of the gel is made up of soapy chemicals called saponins, which have antibacterial and cleaning qualities.<sup>[15,16]</sup>

## Pharmacological actions

### Anti-ulcer activity

This investigation looked at how aloe vera affected the ulcers that indomethacin caused in albino rats. Comparable to the common medication Omeprazole, aloe vera extract has shown statistically significant anti-ulcer efficacy. Two medicines are found to have statistically significant mean ulcer indices. Thus, the findings pointed to Aloe vera's potential anti-ulcerogenic properties. Nevertheless, it is still unknown what biological pathways underlie the anti-ulcerogenic effects.<sup>[17]</sup>

### Anti-tumour activity

Aloe vera 50% ethanol extract (100 mg/kg) was tested for its antitumor properties against Ehrlich ascites carcinoma (EAC) tumours in mice. The studies underlying the impact of Aloe vera on the growth of transplantable ascites tumours, the body weight of EAC-bearing hosts, and concurrent changes in the liver biochemical parameters (lipid peroxidation, GSH, and antioxidant enzymes), serum proteins (ALT, AST, LDH, ALP, and glucose), and haematological profile. In EAC-bearing mice, the 50% ethanol extract of Aloe vera showed anticancer action by regulating lipid peroxidation and enhancing the antioxidant defence system.<sup>[18]</sup>

### Anti-viral activity

Studies have been conducted on the antiviral properties of the crude hot glycerine extract of Aloe vera gel that was grown in Bushehr, southwest Iran, against HSV-2 replication in the Vero cell line. The extract demonstrated antiviral action against HSV-2 at both the pre-attachment and post-attachment phases of virus replication, in addition to the virus's entry and attachment into the Vero cells. Consequently, Bushehr aloe vera chemicals may be a promising option for antiviral action.<sup>[19]</sup>

### **Anxiolytic activity**

Aloe vera's effects on the central nervous system in mice were assessed, and various behavioral tests for depression and anxiety were conducted, including the inclined plane test, the open field test, the swimming-induced depression test, the stationary rod test, and the cage crossing test. When aloe vera was given orally to mice of both sexes, it was discovered to significantly reduce both overall and exploratory behavioural patterns. The findings demonstrated that aloe vera extract significantly reduced traction in an inclined plane test and reduced exploratory and locomotor activity. The findings imply that aloe vera may have sedative and anxiolytic properties.<sup>[20]</sup> Aloe vera was also tested for its effects on the nervous system in mice as well as on other behavioural measures for sadness and anxiety. Oral aloe vera administration was reported to significantly lower exploratory behavioral patterns and overall depression. The findings imply that aloe vera may have sedative and anxiolytic properties.<sup>[21]</sup>

### **Antidepressant activity**

Using forced swimming, FST, and open box, OFT tests, the antidepressant effects of Aloe vera hydro-alcoholic extract at various doses were compared with the mice in the fluoxetine-treated and control groups. Aloe vera extract, at varying doses, exhibits positive antidepressant effects on mice in comparison to the fluoxetine-treated and control groups, according to the findings of the OFT and FST tests. These benefits were enhanced by increasing the dosage and duration of drug usage.<sup>[22]</sup>

### **Hypolipidemic effect**

In rats with diabetes induced by streptozotocin (STZ), the ethanolic extract from Aloe vera leaf gel demonstrated a significant improvement in plasma insulin and a significant decrease in fasting blood glucose, hepatic transaminases (aspartate aminotransferase and alanine aminotransferase), plasma and tissue (liver and kidney) cholesterol, triglycerides, free fatty acids, and phospholipids. Furthermore, after receiving the extract, the plasma levels of LDH, VLDL-cholesterol, and HDL-cholesterol in diabetic rats were raised and returned to almost normal levels.<sup>[23]</sup>

### **Hypoglycaemic effect**

The purpose of the study was to compare the antidiabetic effects of an ethanolic extract of Aloe vera in rats that were both normal and hyperglycaemic. The group that received 500 mg/kg body weight of Aloe vera ethanolic extract had a highly substantial ( $P < 0.01$ ) decrease in plasma glucose levels, according to the results of the hyperglycemic experiment. Nonetheless, it was discovered that the reduction in the blood glucose level caused by glibenclamide and aloe vera extract at a dose of 100 mg/kg body weight was comparable.<sup>[24]</sup>

### **Hypoglycemic and anti-atherogenic effect**

In alloxan-induced diabetic rabbits, oral administration of Aloe vera leaf extract for 21 days resulted in a

considerable reduction in Hb1Ac and fasting blood glucose levels. Additionally, the diabetic rabbit treated with aloe vera showed a significant drop in serum levels of triglycerides, total cholesterol, and LDL with a concurrent increase in HDL, suggesting the plant's potential as an anti-diabetic medication. The noteworthy reduction in the "Atherogenic Index" within the group administered aloe vera indicates its potential to prevent cardiovascular ailments.<sup>[25]</sup> After 30 days of Aloe vera treatment, the blood glucose levels of treated groups of rats both normal and alloxan-induced diabetic rats showed a considerable drop. Aloe vera water extract was discovered to have anti-diabetic effects in both normal and alloxan-induced diabetic rats through statistical analysis of the results.<sup>[26]</sup>

### **Antifungal activity**

The agar-well diffusion method was used to measure the antifungal activity against human and plant fungal infections. Compared to the ethyl acetate fraction, the methanol and ethanol sections of the extracts under study were more bioactive. Additionally, it was noted that, with the exception of *Candida albicans*, the activity was more noticeable on plant pathogens than human pathogens. This suggests that the extract may be able to treat fungal diseases in plants.<sup>[27]</sup> A concentration of 0.15%, 0.25%, and 0.35% of aloe vera gel was tested for its antifungal effectiveness against five plant pathogenic fungi, namely *Aspergillus niger*, *Aspergillus flavus*, *Alternaria alternata*, *Drechslera hawaiiensis*, and *Penicillium digitatum*. At concentration of 0.35% the growth of *Alternaria alternative* and *Drechslera hawaiiensis* was totally suppressed by aloe vera gel.<sup>[28]</sup>

### **Wound healing activity**

The purpose of the study was to evaluate the effects of topical application of Aloe vera leaf pulp on the excision wound model's ability to heal. Povidone-iodine ointment, a typical medication, was used to compare the activity (5% w/w). On an excision wound model, aloe vera leaf pulp was discovered to have a better and faster wound healing effect than the conventional medication Povidone Iodine Ointment.<sup>[29]</sup>

### **Antibacterial activity**

Using gel filtration chromatography and the agar diffusion assay, the antibacterial activity of Aloe barbadensis Miller (Aloe vera) was assessed for the work. *Salmonella typhi*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas*, *Klebsiella pneumoniae*, and *Staphylococcus epidermidis* were the strains of bacteria used in this study. The leaves and gel of the aloe vera plant were macerated in ethanol, methanol, and distilled water, among other organic solvents. The agar diffusion assay was then used to determine antibacterial activity. When compared to other solvent extracts, the methanol extract of aloe vera exhibited the strongest antibacterial activity.<sup>[30]</sup> Using the agar diffusion method, *in-vitro* tests of aqueous and methanolic extracts of Aloe vera roots demonstrate antibacterial efficacy against *Bacillus*

cereus, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Enterobacter aerogens*. The extracts contain flavonoids, terpenoids, tannins, saponins, reducing sugars, and anthraquinones, according to preliminary phytochemical tests.<sup>[31]</sup>

Ethanol, methanol, and distilled water were among the organic solvents used to macerate the leaves and gel of the aloe vera plant. The agar diffusion assay was then used to determine the antibacterial activity. When compared to other solvent extracts, the methanol extract of Aloe Vera exhibited the highest level of antibacterial activity.<sup>[32]</sup>

#### Antioxidant property

The study assessed the effects of an aqueous extract of Aloe vera on oxidative damage and the expression of Anion Exchanger 1 (AE1, sometimes referred to as Band 3) in human erythrocytes subjected to the water-soluble free radical initiator 2,2-azobis-2-amidinopropanodihydrochloride (AAPH). Furthermore, the extracts total phenolic components were quantified as catechin equivalents, and the extracts varied antioxidant properties were contrasted with those of typical synthetic and natural antioxidants like ascorbic acid and BHA. When aloe vera extract was directly incubated with glutathione (GSH) in a basic aerated aqueous solution, it did not result in the consumption of the cytosolic antioxidant; this suggests that aloe vera extract does not proceed with autooxidation under these experimental conditions.<sup>[33]</sup> ORAC and FRAP analyses support the strong antioxidant capacity observed in *in-vivo* Aloe vera leaf gel, which can be attributed to the presence of antioxidant polyphenols, indoles, and alkaloids.<sup>[34]</sup>

#### Nephroprotective Activity

Single oral 100–200 mg/kg/day of the leaf aqueous extract of Aloe *Barbadensis* was studied for their protective effects in gentamicin and cisplatin-induced Nephrotoxic wistar rats for 7 days and 5 days respectively. In the gentamicin nephrotoxic rats, 100–200 mg/kg/day significantly attenuated elevations in the serum creatinine, total protein and blood urea nitrogen levels in dose related fashion and no treatment related effect on uric Acid and ions, as well as, attenuation of gentamicin-induced tubulonephrosis. Similar effects were also recorded in the cisplatin model of acute renal injury. Results suggest that the Nephroprotective effect of Aloe *barbadensis* could be due to the inherent antioxidant and free radical-scavenging principle(s) contained in the extract.<sup>[35]</sup>

#### Arthritis, joint and muscle pain

Regular consumption of aloe vera has been shown in studies to both prevent and induce arthritis to regress. Aloe gel also lessens the discomfort associated with injuries like tendinitis. Aloe vera penetrates the skin when applied directly to the painful area, relieving pain. Functioning as a biological vehicle, it facilitates the entry

and absorption of additional bioactive compounds into the deep tissue.<sup>[36]</sup>

#### Effect of gastric secretion and ulcer

Gel made from aloe vera has the power to treat stomach ulcers and shield humans and animals against developing new ones. A. Vera's anti-ulcer capabilities have been linked to a number of potential processes, such as its anti-inflammatory qualities, healing effects, mucus-stimulatory effects, control over gastric secretions, and lectin content.<sup>[37]</sup> The uptake of aminopyrine by parietal cells is inhibited by the lectins. Therefore, the extract's unusual capacity to reduce stomach acid production may be the consequence of its direct effect on the cells that produce acid.<sup>[38]</sup>

#### CONCLUSION

Traditional medicinal herbs like aloe vera can be used to treat a variety of internal and exterior illnesses in a safe and efficient manner. The majority of digestive issues, such as constipation, colitis, poor appetite, irritable bowel syndrome, asthma, diabetes, immune system stimulation, peptic ulcers, and periodontal diseases, can be helped by the phytochemical components of this herb. Here, we have made an effort to gather all the data available on the chemical makeup and therapeutic applications of aloe vera from both traditional and published scientific literatures. The knowledge will be useful to researchers in the future. This will present a plethora of options for organizing and carrying out study on different facets of this medicinal plant.

#### REFERENCE

1. Yates A, Yates Garden Guide, Harper Collins Australia, Australia, 2002.
2. Chandegara VK, Varshney AK, Aloe vera L. Processing and products: A review. *International Journal of Medicinal and Aromatic Plants*, 2013; 3(4): 492-506.
3. Surjushe A, Vasan R, Saple DG. Aloe vera: A short review. *Indian J Dermatol*, 2008; 53(4): 163-66.
4. Choi S, Chung M H, A review on the relationship between Aloe vera components and their biologic effects, *Seminars in Integrative Medicine*, 2003; 1: 53-62.
5. M Marshall JM, Aloe vera gel: What is the evidence?, *The Pharmaceutical Journal*, 1990; 24: 360-362.
6. The Ayurvedic Pharmacopoeia of India. In: Ayush Do, editor.: Government of India Ministry of Health and Family Welfare. P. 104.
7. Morton JF. *Major Medicinal Plants*, Charles C. Thomas – Publisher: Springfield, Illinois, USA 1977.
8. Tyler V. *The honest herbal: A sensible guide to the use of herbs and related remedies*. Binghamton, New York: Pharmaceutical Products Press, 1993.
9. Coats BC, *The Silent Healer, A Modern Study of Aloe vera*, Texas, Garland, 1979.

10. Shelton RM. Aloe vera. Its chemical and therapeutic properties. *Int J Dermatol*, 1991; 30(10): 679-83.
11. Surjushe A, Vasani R, Saple DG, Aloe Vera: A short review, *Indian Journal of Dermatology*, 2008; 53(4): 163-166.
12. Kumar KPS, Bhowmik D, Chiranjib and Biswajit, Aloe vera: A Potential Herb and its Medicinal Importance, *Journal of Chemistry and Pharmaceutical Research*, 2010; 2(1): 21-29.
13. Green P, Aloe vera extracts in equine clinical practice, *Veterinary Times*, 1996; 26(9).
14. Joseph B, Raj SJ, Pharmacognostic and phytochemical Properties of Aloe vera linn –an overview, *International Journal of Pharmaceutical Sciences Review and Research*, 2010; 4(2): 106-110.
15. Atherton P. Aloe vera revisited. *Br J Phytothe*, 1998; 4: 76-83.
16. Atherton P. The essential Aloe vera: The actions and the evidence. 2<sup>nd</sup> ed, 1997.
17. Borra SK, Lagisetty RK, GR. M. Anti-ulcer effect of Aloe vera in non-steroidal anti-Inflammatory drug induced peptic ulcers in rats. *Afr J Pharm Pharmacol*, 2011; 5: 1867-71.
18. Naveena, Bharath BK, Selvasubramanian. Antitumor activity of Aloe vera against ehrlich Ascitis carcinoma (EAC) in swiss albino mice. *IJPBS*, 2011; 2(2): 400-9.
19. Zandi K, Zadeh MA, K S, Z. R. Antiviral activity of Aloe vera against herpes simplex Virus type 2: An in vitro study. *Afr J Biotechnol*, 2007; 6: 1770-73.
20. Gupta A, Sethi J, Sood S, Dahiya K, Singh G, Gupta R. Evaluation of hypoglycemic and Anti atherogenic effect of Aloe vera in diabetes mellitus. *IJCP*, 2011; 8(3): 1-4.
21. Sultana N, Najam R. Anxiolytic activity of Aloe vera (L.) Burm.F tested in rodents. *Pak J Pharmacol*, 2012; 29(1): 7-15.
22. Salehi B, Biazar E, Jahromi MH, Romani HA. Antidepressant effects of Aloe vera Hydroalcoholic extract on Mice Model. *JPS*, 2011; 2: 59-63.
23. Rajasekaran U, Ravi K, Sivagnanam K, Subramanian S. Beneficial effects of Aloe vera Leaf gel extract on lipid profile status in rats with Streptozotocin diabetes. *Clinical and Experimental Pharmacology and Physiology*, 2006; 33: 232–37.
24. Afaf I, Maha K.M, Elmahdi B. Effects of Aloe vera (Elsabar) Ethanolic Extract on Blood Glucose Level in Wistar Albino Rats. *Journal of Applied Sciences Research*, 2008; 4: 1841-45.
25. Gupta A, Sethi J, Sood S, Dahiya K, Singh G, Gupta R. Evaluation of hypoglycaemic and Anti atherogenic effect of Aloe vera in diabetes mellitus. *IJCP*, 2011; 8(3): 1-4.
26. Rehman SU, Jafri SA, Hassan S, Ahmed I, Naim M. Study on antidiabetic effect of Aloe Vera extract on alloxan induced diabetic rats. *LARCJI*, 2011; 2(1): 29-32.
27. Khaing TA. Evaluation of the Antifungal and Antioxidant Activities of the Leaf Extract Of Aloe vera (Aloe barbadensis Miller). *World Academy of Science, Engineering and Technology*, 2011; 51: 609-11.
28. Sitara U, Hassan N, NaseemJ Antifungal activity of Aloe vera gel against plant pathogenic Fungi. *Pak J Bot*, 2011; 43(4): 2231-33.
29. Purohit SK, Solanki R, Soni MK, Mathur V. Experimental evaluation of Aloe vera Leaves pulp as topical medicament on wound healing. *IJPR*, 2012; 2: 110-12.
30. Irshad S, Butt M, Younus H, Irshad S. In-Vitro antibacterial activity of Aloe Barbadensis Miller (Aloe Vera). *Intl R J of Pharmaceuticals*, 2011; 1: 59-64.
31. Krishna Kumar HN, Chandana E, Preethi SD, Chauhan JB. In vitro antimicrobial activity and phytochemical screening of Aloe ver. *IJCPR*, 2012; 4(3): 45-7.
32. Irshad S, Butt M, H Y. In-Vitro Antibacterial activity of Aloe barbadensis Miller (Aloe Vera). *Intl R J of Pharmaceuticals*, 2011; 1(2): 59-64.
33. Mazzulla S, Sesti S, Schella A, Perrotta I, Anile A, Drogo D. Protective Effect of Aloe Vera (Aloe barbadensisMiller) on Erythrocytes Anion Transporter and Oxidative Change. *Food and Nutrition Sciences*, 2012; 3: 1697-702.
34. Nejatizadeh FB. Antibacterial activities and antioxidant capacity of Aloe vera. *Org Med Chem Lett*, 2013; 3(5): 1-8.
35. Chatterjee P, Mukherjee A, Nandy S. Protective effects of the aqueous leaf extract of Aloe barbadensis on gentamicin and cisplatin-induced nephrotoxic rats. *APJTB*, 2012; 2: 1754-63.
36. Surjushe A, Vasani R, Saple DG, Aloe Vera: A short review, *Indian Journal of Dermatology*, 2008; 53(4): 163-166.
37. Hamman JH, Composition and Applications of Aloe vera Leaf Gel, *Molecules*, 2008; 13: 1599-1616.
38. Bhuvana KB, Hema NG, Patil RT, Review on aloe vera, *International Journal of Advanced Research*, 2014; 2(3): 677-691.