

Therapeutic and Medicinal Properties of “The Silent Healer” *Aloe vera* (*Aloe barbadensis* Miller): A Systematic Review

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Abstract

The medicinal plants are widely recommended worldwide by the traditional and modern medical practitioners for curing various diseases of patients. *Aloe vera* is well known for its considerable medicinal properties. Aloe is widely used in wound healing, treating burns, minimizing frost bite damage, protection against skin damage from X-rays, lung cancer, intestinal problems, increasing High Density Lipoprotein (HDL), reducing Low Density Lipoprotein (LDL), reducing blood sugar in Diabetics, fighting against Acquired Immuno Deficiency Syndrome (AIDS), allergies and improving immune system. Aloe is used in traditional Indian medicine for constipation, colic, skin diseases, worm infestation, and infections. It is found in variety of commercial products such as, pills, sprays, ointments, lotions, liquids, drinks, jellies and creams. All these uses associated with *Aloe vera* have been attributed to the polysaccharides contained in the gel of the leaves. The chemistry of the plant has revealed that there are more than 200 different biologically active substances.

1. Introduction

Among horticulture crops, medicinal and aromatic plants forms one of the most important groups which have a unique role in sustaining pharmaceutical, perfumery and cosmetic industries in India (Harshavardhan *et al.*, 2016; Raviprasad Sajjan and Venugopal, 2017). Of the thousands of aromatic plants, a few have attained the status of commercial crops which are being cultivated on large scale (Raviprasad Sajjan *et al.*, 2019). Plants are one of the most important sources of medicines. The important advantages claimed for therapeutic uses of medicinal plants in various ailments are their safety besides being economical, effective and their easy availability (De, 2020). According to World Health Organisation, medicinal plants would be the best source for obtaining a variety of drugs. The name *Aloe vera* derives from the Arabic word “Alloeh” meaning “shining bitter substance”, while Verain Latin means “true”. Over the years, this plant has been known by a number of names such as “the wand of heaven”, “heaven’s blessing,” and “the silent healer”. *Aloe vera* (L.) Burm. f. is one of the richest natural sources of health for human beings. So, there is a burning need to educate about the importance of *Aloe vera* for human race and popularize it for greater interest. In western societies, mainly in the USA, *Aloe vera* has been grown mainly to supply the latex component of the leaves primarily to the pharmaceutical industries. Food

and Drug Administration of USA has already approved the developmental study of *Aloe vera* in the treatment of Cancer and AIDS (World Health Organization, 1999).

2. History

The plant of *Aloe vera* and its usage as drug dates back to 6000 years BC. *Aloe vera* is the ever known oldest and the most applied medicinal plant worldwide. It is used for its medicinal properties since rig-vedic times. The Greeks regarded *Aloe vera* as the universal panacea and Egyptians called Aloe “the plant of immortality” (Huseini *et al.*, 2012; Sharma *et al.*, 2014). This Ancient Indian herb has been known from centuries for its unique medicinal properties. The Aloe plant is used in Ayurvedic, Homoeopathic and Allopathic streams of medicine for medicinal purposes in several cultures including Greece, Egypt, India, Mexico, Japan and China (Reuter *et al.*, 2008). Alexander the Great, and Christopher Columbus showed the use of this plant as a medicine to treat soldiers’ wound. Egyptian queens Nefertiti and Cleopatra used it as part of their regular beauty.

3. Botanical Classification

Kingdom : Plantae

Divison : Spermatophyta

Subdivision : Angiospermae

Article History

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Class : Monocotyledoneae

Order : Asparagales

Family : Liliaceae

Genus : *Aloe*

Species : *barbadensis* Miller

4. Habitat

Aloe species are widely distributed in the African and the eastern European continents, and are spread almost across the globe. The genus *Aloe* has more than 550 species but *Aloe barbadensis* Miller and *Aloe aborescens* Miller and *Aloe ferox* are globally used for trade. The Aloe plant is native to southern and eastern Africa along the upper Nile in the Sudan (Hamman, 2008; Naveena, 2011). Further this Aloe was subsequently introduced in to northern Africa and naturalized in the Mediterranean region and other countries throughout the world. Aloe can be found in Mexico, the Pacific Rim countries, India, South and Central America, Iran, Caribbean, Australia and Africa. Aloe is commercially cultivated in Aruba, Bonaire, Haiti, India, South Africa, the United States of America, and Venezuela and the finest quality of Aloe is grown in desert of Southern California (Kanat *et al.*, 2006; Bozzi *et al.*, 2007; Miladi, 2008). This plant need very less water for living and also can survive on saline soils, beaches and is resistance to diseases and insects. It can thrive very well in very hot regions, but cannot tolerate cold. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu.

5. Botany

Aloe vera (L.) Burm. f. commonly referred to as *Aloe barbadensis* Miller. *Aloe barbadensis* Miller is one among the 400 species of Aloe belonging to family Liliaceae that is mainly originated in South Africa. Aloe is a succulent perennial herb. Succulents are xerophytes. Xerophytes are adapted to living in areas of low water availability and they are characterized by possessing a large water storage tissue (Paulsen *et al.*, 2005). Aloe plants have triangular, sessile stem, shallow root system, fleshy serrated leaves arranged in rosette having 30-50 cm length and 10 cm bread that the base. Mature plants can grow as tall as 2 and a half inches to 4 feet with the average being around 28 to 36 inches in length. Each plant usually has clump of 12-16 leaves weighing up to 1.5 kg when mature. The margin of its leaves is a little curled with thistle.

The leaves are composed of three layers, viz, An innermost layer which is clear gel that contains 99% water and rest is made of glucomannans, amino acids, lipids, sterols and Vitamins.

1. The middle layer of latex is bitter, yellow colour and it contains anthraquinones and glycosides.
2. The outer thick protective layer of 15-20 cells is called as rind which has protective function and synthesizes carbohydrates

and proteins.

Aloe latex, also known as Aloe juice, is bitter yellow exudates of the pericyclic tubules in the outer skin of the leaf. The bright yellow tubular flowers, length 25-35 cm, axillary spike and stamens are frequently projected beyond the perianth tube. Flowers are placed in beautiful clustering format the end of florescent stem axis with green to yellow color. The flowers are usually not used medicinally. Fruits contain many seeds (Baby and Justin, 2010). The plants can be harvested on every 6-8 weeks by removing 3-4 leaves per plant. The plant matures when it is about 4 years old and has a life span of about 12 years (Eshun and He, 2004; International Aloe Science Council, 2020).

6. Chemical Constituents

Among the plant kingdom, the medicinal plants are a rich source of biologically active compounds useful both in agriculture and medicine (Raviprasad Sajjan *et al.*, 2014). 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. Aloe contains over 75 different potentially active compounds including water- and fat-soluble vitamins, minerals, enzymes, simple/ complex polysaccharides, phenolic compounds and organic acids (West and Zhu, 2003; Halder *et al.*, 2013). The leaf of Aloe has gel in it and this particular gel contains about 98% water. Aloe gel consists of polysaccharides (53%), sugars (17%), minerals (16%), proteins (7%), lipids (5%) and phenolic compounds (2%). The active components of Aloe include anthraquinones, chromones, polysaccharides, and enzymes. The elements Al, B, Ba, Ca, Fe, Mg, Na, P, Si *etc.* has also been reported to be present in *Aloe vera* gel. Furthermore, the chemical composition of any plant depends upon the local geographical condition, type of soil, and its composition (Lawless and Allen, 2000; Su *et al.*, 2004).

6.1 Vitamins

Aloe vera contains several Vitamins such as, Vitamin A (beta-carotene), C and E, which are antioxidants. It also contains Vitamin B₁₂, folic acid, and choline. Vitamin A, C and E are antioxidants and antioxidant neutralizes free radicals.

6.2 Enzymes

Aloe vera contains many useful enzymes such as, liaise, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, cellulase, lipase, cyclooxygenase, cyclooxygenase, phosphoenolpyruvate, carboxylase, superoxide dismutase, oxidase and peroxidase. Bradykinase helps to reduce excessive inflammation when applied to the skin topically, while others help in the breakdown of sugars and fats (Choi and Chung, 2003; Kanat *et al.*, 2006).

6.3 Minerals

Aloe vera provides calcium, chromium, copper, magnesium,

manganese, potassium, selenium, sodium and zinc. And there are crucial for the proper functioning of various enzyme systems in different metabolic pathways and few are known for antioxidant activity.

6.4 Sugars

Aloe vera provides monosaccharides and polysaccharides. Monosaccharides include glucose and fructose. Polysaccharides include pectins, cellulose, hemicellulose, glucomannan and acemannan. These are derived from the mucilage layer of the plant and are popularly called as mucopolysaccharides (Paulsen *et al.*, 2005; Boudreau and Beland, 2006). Very recently, a glycoprotein with anti-allergic properties, called alprogen and novel anti-inflammatory compound, C-glucosyl chromone, has been isolated from *Aloe vera* (Ramachandra and Srinivasa Rao, 2008).

6.5 Anthraquinones

Aloe vera provides anthraquinones which include, Aloe-emodin, aloetic-acid, anthranol, barbaloin, isobarbaloin, emodin, ester of cinnamic acid. Anthraquinones are phenolic compounds traditionally known as laxatives. Aloin and emodin have analgesic, anti-bacterial and anti-viral properties (Jones, 2007).

6.6 Fatty Acids

Aloe vera provides steroids which include cholesterol, campesterol, β -sisosterol and lupeol. All these fatty acids have anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties.

6.7 Hormones

Aloe vera provides hormones such as, auxins and gibberellins which have a strong role in wound healing and have anti-inflammatory action.

7. Medicinal Uses

Recently, only a few species of *Aloe* have attained commercial importance, of which *Aloe vera* is considered the most potent and thereby it is most valued in the research field. *Aloe vera* have been claimed to have numerous useful medicinal properties such as antiarthritic, anticancer activity, antidiabetic effect, anti-inflammatory activity, antimicrobial activity, antibacterial activity, antifungal activity, antioxidant effect, antihyperlipidemic activity, antirheumatoid, antitumor, antiulcer activity, antiviral activity, antiseptic effect, laxative effect, antistress effect, heart diseases, effect on estrogen status, burns and wound healing effect, immunomodulatory effect, intestinal absorption, hepatoprotective effect, hypoglycemic, hypolipidemic, skin problems, emollient, purgative *etc.* (Su *et al.*, 2004; Ramachandra and Srinivasa Rao, 2008). *Aloe vera* has become a big industry worldwide due to its application in the cosmetic, food, and pharmaceutical industries. It is used as a base material in the cosmetic and toilet industry, therefore used in skin moisturizers, soaps, shampoos, sun lotions, makeup creams, perfumes, shaving

creams, bath aids and many other products. It is utilized in functional foods especially for the preparation of health drinks with no laxative effects (Kanat *et al.*, 2006). It is also used in other food products including confectionery, milk, lassi. The *Aloe* powder is used in laddu, curd, lassi, ice cream and yoghurts preparation, *etc.* (Eshun and He, 2004; Boudreau and Beland, 2006). *Aloe* is widely used as a bitter agent. Pharmaceutical products are available for topical applications (gels and ointments) and oral use (tablets and capsules) (Hamman, 2008).

7.1 Skin Problems

Today, the *Aloe vera* plant has been used for various purposes in dermatology for various skin problems, such as boils, acne, erythema (redness of the skin), psoriasis and skin cysts. *Aloe vera* is one of the chief ingredients currently used in over 95 percent of the dermatologically valuable extracts manufactured cosmetics industries. Many studies have shown that Aloin and its gel are used as skin tonic against pimples. *Aloe* is also used in skin care, as nutraceuticals and cosmetic industries primarily for soothing the skin, and keeping the skin moist to help avoid flaky scalp and skin in harsh and dry weather and gives a youthful glow to skin, also acts as extremely powerful laxative (Huseini *et al.*, 2012; Sharma *et al.*, 2014). Because of high concentration of water and oil in this plant, *Aloe* can also be used as a moisturizer for oily skin and primarily acts as skin healer and prevents injury of epithelial tissues, cures acne and in turn removes dead skin cells. *Aloe* has got ability to hydrate itself very quickly. The gel's use in cosmetics has been boosted by claims that it has similar anti-aging effects to vitamin A derivatives (Reuter *et al.*, 2008).

7.2 Burns and Wound Healing Effect

Aloe has potential to cure sunburns, burns and minor cuts, and even skin cancer. Several pre-clinical (in animal) and clinical (inhuman) trials showed that, *Aloe* gel not only increased collagen content of the wound but also changed collagen composition and increased the degree of collagen cross-linking. The wound healing property of *Aloe* gel has been attributed to Mannose-6-phosphate. The *Aloe vera* gel polysaccharide Acemannan accelerates wound healing and reduces radiation induced skin reactions and may lead to promotion of prolong stimulation of granulation tissue (Josias, 2008; Sharma *et al.*, 2014). *Aloe vera* gel contains a glycoprotein with cell proliferating-promoting activity. In addition, its healing property is related to a compound that is called methanol-soluble fraction of the gel which contains a glycoprotein with mainly cell proliferating promoting activity and stimulates the proliferation of artery endothelial cells in an *in vitro* assay and induce them to invade a collagen substrate. Recently, *aloe* extracts have been used to treat canker sores and stomach ulcers (Jones, 2007).

7.3 Laxative Effect

According to the National Center for Complementary and

Alternative Medicine (NCCAM) in the US, part of the National Institutes of Health, Aloe latex contains strong laxative compounds. Aloe latex is known for its laxative properties. The laxative effect from Aloe is stronger than any other herbs. The Aloe is due primarily to the 1,8-dihydroxyanthracene glycosides, Aloin-A and B. The leaf lining (latex, resin or sap) contains anthraquinone glycosides (aloin, aloin-emodin and barbaloin) that are potent stimulant laxatives (Josias, 2008; Chinnusamy *et al.*, 2009). Therefore researchers are of the opinion that Aloe plant is very helpful as it increases intestinal water content, stimulates mucus secretion and increases intestinal peristalsis. Therefore it is used chiefly in treatment against piles.

7.4 Antiseptic Effect

The presence of antiseptic agents such as, lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulphur makes Aloe to be known for its antiseptic activity. These compounds mainly have best inhibitory action on fungi, bacteria and viruses (Ramachandra and Srinivasa Rao, 2008).

7.5 Anti-inflammatory Activity

A more recent review concludes that the cumulative evidence supports the use of novel anti-inflammatory compound called C-glucosyl chromone which was isolated from gel extracts from fresh *Aloe vera* significantly reduced acute inflammation in rats. Aloe inhibits the cyclo-oxygenase pathway and reduces prostaglandin E2. Very recently, the study has shown that, novel anti-inflammatory compound called C-glucosyl chromone was isolated from gel extracts. Furthermore, the peptidase bradykinase has been isolated from Aloe which has shown to breakdown the bradykinin, an inflammatory substance that induces pain (Su *et al.*, 2004; Baby and Justin, 2010).

7.6 Antistress Effect

In the modern era, many people suffer from stress and stress related diseases. Aloe is believed to fight against stress effectively. *Aloe vera* is an excellent example of a functional food that plays a significant role in protection from oxidative stress. Oxidative stress refers to chemical reactions in which compounds have their oxidative state changed. During stress related condition, *Aloe vera* has long been associated with the treatment to reduce cell-damaging process and minimizes bio-chemical and physiological changes in the body (Hamman, 2008; Chinnusamy *et al.*, 2009).

7.7 Antidiabetic Effect

A number of clinical studies have confirmed that, Aloe vera gel significantly reduced the fasting blood glucose (FBG), hepatic transaminases, total cholesterol (TC), triglycerides (TG), free fatty acids (FFA) and phospholipids and in addition also significantly increased plasma insulin levels and showed hypoglycemic properties. The five phytosterols of *Aloe vera* such as, lophenol, 24-methyl-lophenol, 24-ethyl-lophenol, cycloartanol and 24-methyl- lenecycloartanol showed anti-

diabetic effects in type-2 diabetic mice (Eshun and He, 2004; Boudreau and Beland, 2006).

7.8 Heart Diseases

Heart diseases are still one of the major causes of death in the Modern world. Aloe vera is known to decrease total fat levels in patients with high cholesterol. Research have also been reported which suggest a possible benefit of using Aloe gel in coronary heart disease associated with the accumulation of blood fats (lipids) in the lining of the arteries. The evidence suggests that the ingestion of Aloe gel may have a strong effect on fat (lipid) metabolism which, if active inhuman subjects, would tend to decrease the risk of coronary artery disease in people (Huseini *et al.*, 2012; Sharma *et al.*, 2014).

7.9 Immunomodulatory Effect

One of the chief polysaccharide, Acemannan is the major carbohydrate fraction obtained from Aloe vera leaves. In a pilot study, the acemannan of Aloe has increased the number of white blood cells and improved symptoms in the HIV-infected patients (Huseini *et al.*, 2012). Acemannan has also proved to stimulate the synthesis and release of interleukin-1 (IL-1) and tumor necrosis factor from macrophages in mice, which in turn initiated an immune attack that resulted in necrosis and regression of the cancerous cells. Acemannan helps enlarge the thymus gland in size by 40%. The thymus is what produces the T cells of the immune system (Josias, 2008; Chinnusamy *et al.*, 2009).

7.10 Antitumor

In recent studies, a number of glycol-proteins present in Aloe gel have been reported to have antitumor and antiulcer effects and in turn increase proliferation of normal human dermal cells.

7.11 Anticancer Activity

Aloe vera juice enables the body to heal itself from cancer and also from the damage caused by radio and chemotherapy that destroys healthy immune cells crucial for the recovery. Aloe vera is known to act as radiation protectors and inhibits testicular damage from gamma radiation and reduces cancer (Paulsen *et al.*, 2005). *Aloe vera* emodin, an anthraquinone, has the ability to suppress or inhibit the growth of malignant cancer cells making it to have anti-neoplastic properties (Sharma *et al.*, 2014).

7.12 Antimicrobial Activities

7.12.1 Antibacterial Activity

Aloe vera includes "Antrokinon" chemicals that are known as antiviral, antibacterial and anticancer. Several ingredients in Aloe vera gel have shown to have bactericidal effect against *Pseudomonas aeruginosa*. Acemannan prevented bactericidal activity from adhering to human lung epithelial cells in a monolayer culture. Two important microorganisms such as, *Streptococcus pyogenes* and *Streptococcus faecalis* have been found to be inhibited by Aloe vera gel. The aloe extract is

potent to be effective against three strains of Mycobacterium (*M. fortuitum*, *M. smegmatis* and *M. kansasii*) and a strong anti-mycobacterial activity against *M. tuberculosis* as well as antibacterial activity against *P. aeruginosa*, *E. coli*, *S. aureus* and *S. typhi* (Miladi, 2008; International Aloe Science Council, 2020).

7.12.2 Antiviral Activity

Studies on Aloe vera gel have been shown to possess effective antiviral agent. Acemannan reduced herpes simplex infection in two cultured target cell lines. Aloe emodin in Aloe vera was evaluated against infectivity of herpes simplex virus type I and type II and it was capable of inactivating all of the viruses such as, varicella zoster virus, influenza virus, and pseudo-rabies virus. The anthraquinone aloin extracted from the inner leaf of Aloe also inactivates various enveloped viruses such as herpes simplex, varicella zoster and influenza (Boudreau and Beland, 2006; Jones, 2007). It was concluded from few studies that under the conditions tested, the anthraquinones acted directly on the envelope of the anthraquinone-sensitive viruses, resulting in the prevention of virus adsorption and subsequent replication.

7.12.3 Antifungal Activity

Aloe vera has proven effect against 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*. The saponins perform strongly as anti-microbial against bacteria, viruses, fungi and yeasts. The saponins substances from the gel that is capable of cleansing and having antiseptic properties. Aloe vera gel reportedly inhibited the growth of *Candida albicans* (Hamman, 2008).

7.13 Depression, Learning and Memory

A recent systematic review suggested that, Aloe vera has found to reduce depression and improved memory in mice. Experiments carried out on laboratory mice have concluded that, *Aloe vera* enhances learning and memory, and also alleviates depression in mice (West and Zhu, 2003).

8. Precautions

Reports have shown that Aloe have side effects in humans, when consumed in improper dosages. Hence, many important experimental studies have been performed to confirm the upper dose of Aloe gel without any side effects to establish the maximal allowable daily intake of active Aloe gel (World Health Organization, 1999); Josias, 2008). Use Aloe with caution and utmost care to avoid contamination of aloin from the yellow exudates, as aloin is reported as DNA damaging and causes cancer. Although Aloe is quite safe for human consumption but consulting a doctor before consuming in any form is advisable. Also one has to consult a physician while taking any prescription medications. At higher doses, however, a decrease of central nervous system (CNS) activity was observed. A recent systematic review suggests that

upper limit of dose of *A. vera* gel plays a crucial role for the treatment of various diseases. Studies in Aloe showed that, Aloe should not be used internally during pregnancy, lactation or childhood and by patients suffering from abdominal pain, appendicitis or intestinal obstruction (Boudreau and Beland, 2006; Jones, 2007).

Aloe is seldom recommended as a first choice among laxative preparations due to the severe cramping and nausea associated with its use. Allergic reactions are mostly due to anthraquinones, such as aloin and barbaloin which is present in Aloe (Huseini *et al.*, 2012). It is best to apply it to a small area first to test for possible allergic reaction.

9. Conclusion

Aloe is very good source of medicinal properties such as, immunomodulatory, wound and burn healing, hypoglycemic, anticancer, gastro-protective, antifungal, and anti-inflammatory properties. Despite its long history of use of *Aloe vera*, there remains a lack of consistent scientific evidence to support many of the therapeutic and medicinal claims. The pharmacological attributes of *Aloe vera* have been revalidated in modern sciences through various scientific studies.

These scientific studies are good enough proof that drug has immense potential in medicinal properties. This scientific review article will surely help the researchers as well as clinicians dealing with Aloe to know its medicinal usage as this herb is seemed to be highly valuable, possessing many pharmaceutical therapeutic applications. *Aloe vera* bulk as well as extracts is widely used in food, cosmetic, healthcare, skin care and medical industry as active ingredients for extra therapeutic, hygienical, rejuvenating, health enhance effectives. Thus, it is quite promising as a multipurpose medicinal agent so further experiments are needed to be extracted.

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