

Therapeutic Properties of Aloe Vera

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Abstract: In this review article attention is put towards the application of a common Indian medicinal plant, Aloe Vera that has been put into use since centuries for its therapeutic and curative properties. Aloe gel, which is found in the interior of the leaves, is being used for topical application for many skin ailments. The gel works by hydrating and protecting a topical wound until the body can repair itself. The bitter latex comes from a layer of cells just beneath the outer skin and has been reported to be beneficial in treatment of intestinal troubles. This sap is taken internally and soothes digestive complaints by acting as a purgative or laxative. An Aloe Vera leaf contains more than 200 different constituents - each of them in relatively minute quantities. The juice consists of, on an average, more than 99% water, thus all the constituents together amount to less than 1%. This indicates that curative actions may be brought about by very small amounts of active ingredients. Phytochemical composition may vary in different Aloe species, health benefits, and possible toxicities. Thus, it is important to not only study and research the relevant medicinal uses of the native Aloe species but also to identify the active components and understand their individual or combined biological mechanisms.

Keywords: Aloe Vera, aloe gel, anti-inflammatory, immune-stimulant, anti-ulcer, anti-diabetic, anti-tumour

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I. Introduction

Aloe Vera, a member of family Liliaceae, has gained immense popularity because of its wide restorative and medicinal properties. It being a hardy perennial tropical plant can be easily cultivated in drought prone areas as it grows optimally in bright sun light. It grows mainly in the dry regions of Africa, Asia, Europe and America. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu. While many species of *Aloe* grow in sandy soil [1] the plant grows best when supplied with an excess of 50 cm of rain annually in nitrogen rich, alkaline soil. Soil nitrogen should ideally be maintained at 0.40%–0.50%. Harvesting of leaves starts after 7-8 months of planting. Typically, the outermost 3–4 leaves are harvested by pulling each leaf away from the plant stalk and cutting at the white base. Care also has to be taken to reduce the loss of juice from the cut portion [2]. From its leaves two types of products are derived: *Aloe* latex and *Aloe* gel. These two substances vary considerably in their chemical composition and have been widely used for medicinal purposes since ancient times. Most of the therapeutic activities of *Aloe* leaf extracts have been attributed to the polysaccharides present in the inner leaf parenchymatous tissue [3], though more than 75 dynamic ingredients from the internal gel have been found, these activities have not been corresponded well with every individual component [4], therefore it is thought that these medicinal properties ought to be allocated to a synergistic activity of the compounds contained in that as opposed to a single active agent [5]. Apart from *Aloe* being used as a cosmetic, it has been known for its anti-inflammatory, laxative, immune-stimulant, antiseptic [6], wound and burn healing, antiulcer, anti-diabetic and antitumor-activities [7]. These therapeutic activities are based on anecdotal evidence or research findings done almost specifically on *Aloe*.

PHYSIOLOGY OF THE PLANT

Aloe Vera is a popular plant, but it is only one of about 400 species in the genus *Aloe*. They have rosettes of fleshy leaves, which may be smooth or spined. The most of *Aloe* species have spines of different rigidity throughout the edges of their succulent leaves. The flowers are tubular shaped, and colour varies from near white to yellow to orange to near-red. The *Aloe* leaf can be divided into three layers: 1) An inner clear gel that contains 99% water and rest is made of glucomannans, amino acids, lipids, sterols and vitamins. 2) The middle layer of latex which is the bitter yellow sap and contains anthraquinones and glycosides. 3) 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 (phloem). These three parts of the inner leaf have been shown to be different from each other both in terms of morphology and sugar composition [3].

CHEMICAL COMPONENTS OF ALOE GEL:

Polysaccharides make up most of the dry matter of the *Aloe Vera* parenchyma. Enzymes such as ascorbic acid oxidase, amylase, Alkaline phosphatase, catalase, cyclooxygenase, lipase, oxidase, carboxypeptidase, etc. are present in the protoplasm. The plant contains a multitude of essential vitamins and minerals such as: Vitamins A, B1, B2, B3, B6, B12, C, E, folic acid, choline, calcium, phosphorous, potassium, iron, sodium, magnesium, manganese, copper, chromium, and zinc. Aloe also contains a wealth of amino acids: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, valine, aspartic acid, glutamic acid, alanine, arginine, cystine, glycine, histidine, hydroxyproline, proline, serine, and tyrosine. It provides 12 anthraquinones, which are phenolic compounds traditionally known as laxatives. Aloin and emodin act as analgesics, anti-bacterial and anti-viral. The plant produces at least six antiseptic agents such as urea nitrogen, lupeol, cinnamonic acid, salicylic acid, sulphur and phenols. Lupeol and salicylic acid present in the juice are very effective pain-killers [8].

Aloe also contains three anti-inflammatory fatty acids: cholesterol, campesterol and β -sitosterol (plant sterols). These agents are the source for aloe's effectiveness in treating all kinds of internal and external inflammations including burns, cuts, scrapes, acid indigestion, ulcers and other inflammations of the liver, kidney, colon and pancreas, among others [9].

The muco-polysaccharide (MPS) present in *Aloe Vera* comprised of mannose and glucose moieties and their number determines their biological importance. As it found in reported publication range of MPS from 50-600 molecules reduce inflammation; thus, used in ulcerative colitis, arthritis, and gastric reflux even also found to reduce blood sugar with type I and II diabetes. MPS ranging up to 1,500 molecules: Whereas vitamins and minerals can only function outside the cells, mucopolysaccharides are very effective intracellular antioxidants and free radical scavengers - very important in preventing and treating arteriosclerosis, heart disease and Parkinson's disease. With the ever increasing pollution on the planet and loss of nutrients in the soil, the increase in free radicals and loss of cellular oxygen will only become worse with time. This makes Aloe Vera muco-polysaccharides even more important than ever [10].

II. Pharmacological Activity Of Plant

Wound Healing Effect: Wound healing is a reaction to harmed tissue that outcome in their building of tissue uprightness. It was observed that *Aloe* gel could improve wound healing after topical and systemic administration [11]. Topical administration of *Aloe Vera* gel is generally safe. *Aloe Vera* gel has been studied for immune-stimulatory activities. *Aloe Vera* gel is widely used for the external treatment of minor wounds and inflammatory skin disorders [12]. Clinical investigations suggest that *Aloe Vera* gel preparations accelerate wound healing. Aloe's action comprises of sealing the wound while causing an increased flow of blood to the wound, accelerating wound healing [13]. The wound healing property of *Aloe Vera* gel has been attributed to Mannose-6-phosphate [14]. *Aloe Vera* Gel has been reported to increase both collagen synthesis and proteoglycan synthesis, thereby promoting tissue repair. 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 [12].

Uses in Dental Care: *Aloe Vera* is extremely helpful in the treatment of gum disease; it reduces the bleeding of the gums; it is powerfully antiseptic in gum pockets and its antifungal properties help greatly in the problem of denture stomatitis (red and sore mucous membranes which are permanently covered by a denture). It is extremely helpful in the treatment of gum disease – gingivitis and periodontitis. It reduces swelling of the soft tissues and consequently this reduces the bleeding of the gums. It is powerfully antiseptic in gum pockets where normal cleaning is difficult. Its antifungal properties help greatly in the problem of denture stomatitis [15]. *Aloe Vera* greatly minimizes the bleeding of gums due to its soothing and medicinal properties, reduces inflammation and soft tissue edema. Its gel when applied to dental implants is found effective to reduce inflammation. *Aloe Vera* checks inflammation by its antimicrobial and anti-inflammatory effects [14].

Analgesic Application: The application of *Aloe Vera* gel has shown reduction in joint pain and muscle pain due to arthritis [16]. The peptidase brady-kinase was disengaged from aloe and appeared to separate the bradykinin, a provocative substance that prompts pain [17].

Anti-microbial Activity: The saponins found in Aloe perform strongly as anti-microbials. The activity of *Aloe Vera* gel against bacteria (gram positive and gram negative) has been demonstrated by many methods [13]. The Aloe protein exhibited a potent antifungal activity against *Candida parapsilosis*, *Candida krusei*, and *Candida albicans*. *Aloe Vera* has anthraquinones as an active compound, which is structural analogue of tetracycline. The anthraquinones inhibit bacterial protein synthesis by blocking the ribosomal A site (where the amino-acylated tRNA enters). Therefore, the bacteria cannot grow in the media containing *Aloe Vera* extract [15].

Polysaccharides of *Aloe Vera* gel have been attributed direct bacterial activity through the stimulation of phagocytic leucocytes to destroy bacteria. *Aloe Vera* contains pyrocatechol a hydroxylated phenol, known to have toxic effect on microorganisms like *Helicobacter pylori* and that study showed the novel effectiveness of *Aloe Vera* gel as combination with antibiotics for the treatment of *H. pylori* gastric infection [12].

Anti-Cancer Activity: A number of glycoproteins and polysaccharides present in *Aloe Vera* gel have reported antiulcer and anti-tumour effects. The anti-cancer activity of Aloe indicates that its activities through incitement of the scavenging white platelets of the immune system. Consuming *Aloe Vera* internally has been found to heal radiation burns [18]. *Aloe Vera* leaves, has been shown to possess anticancer potential activities, as it inhibits tumor angiogenesis and growth via blocking signal transducer and activator of transcription 3 activation, with the potential of a drug candidate for cancer therapy. Anthraquinone derivatives such as emodin-like natural (emodin, rhein, and aloin) and synthetic (anthraquinone-2-sulfonic acid) anthraquinones have recently been shown to protect in models of amyloid b and t aggregation-induced cell death through anti aggregation properties, and/or enhancing the phosphatidylinositol-3-kinase/ protein kinase B survival mechanism, which suggests that anthraquinone- 2-sulfonic acid could be a new neuro protective compound and a novel caspase inhibitor [19]. *Aloe Vera* produces mucopolysaccharides, emodin, and lectins that aid in fighting cancer. *Aloe* mucopolysaccharides are phagocytized by macrophages that release cytokines. This immune effect contributes to the prevention and healing of malignant neoplasms. Some of the components extracted from *Aloe Vera* have been shown to have anticancer effects *in vitro* and in animals. Emodin, an extract of *Aloe Vera*, can inhibit cell proliferation and induce apoptosis in human liver cancer cell lines through p53- and p21-dependent pathway. Acemannan, a carbohydrate fraction derived from *Aloe Vera* leaf, can stimulate cytokine production in mouse macrophage cell line. This component also has immunomodulating activities by inducing maturation of dendritic cells [20].

Anti-Oxidant Effects: *Aloe Vera* gel is well known for its antioxidant properties as components like magnesium, selenium which are a part of enzymes like glutathione peroxidase and superoxide dismutase and a phenolic anti-oxidant were found to be present in it [21]. They help the cells to become stronger and reduce the effect of free radicals of radiation [22].

Anti-Inflammatory Action: *Aloe* gel reduce inflammation so is highly effective in treatment of burns [11], cuts, scrapes, abrasions, allergic response, rheumatic fever, acid indigestion, rheumatoid arthritis, ulcers, many inflammatory conditions, including the liver, stomach, small intestine, colon, kidney and pancreas. It helps in soothing pain, inflammation and infections.

Aloe Vera gel appears to exert its anti-inflammatory activity through brady kinase activity and thromboxane B2 and prostaglandin F2 inhibition. Lupeol, one of the sterol compounds found in *Aloe Vera*, was the most active and reduced inflammation in a dose dependent manner. Other active ingredient mucopolysaccharides (MPS) which are long chain sugar molecules are effective in the treatment of inflammation, AIDS, and cancer. Study suggests that aloe extracts mediate a second anti-inflammatory mechanism by blocking certain integrins [15].

Anti Diabetic: The dried gel of *Aloe* lowers the triglyceride levels in the liver and plasma and also lowers down the blood sugar level by decreasing insulin resistance. It assists in improving the blood quality by decreasing the levels of triglyceride and cholesterol [21]. Clinical studies have suggested that *Aloe Vera* gel may act as a safe anti-hyperglycemic and anti-hypercholesterolemic agent for type 2 diabetic patients without any significant effects on other normal blood lipid levels or liver/kidney function. *In vivo* and *in vitro* studies strongly demonstrate that the water soluble fraction of *Aloe* spp. possesses glucose-lowering activities and some of its components modulate glucose transporter-4 mRNA expression. It also helps to improve the carbohydrate metabolism, with a recent report suggesting that it helps to improve metabolic condition in obese pre-diabetes and early non-treated diabetic patients by reducing body weight, body fat mass, fasting blood glucose, and fasting serum insulin in obese individuals [23].

Researchers have found that aloe plant polysaccharides have the potential to control blood sugar, stimulate the body's own antioxidant production and even lower cholesterol. Aloe polysaccharides improve the property of immune cells and are also very effective to eliminate waste and other toxins. *Aloe Vera* juice enhances absorption of nutrients and maintains the sugar balance in blood by improving digestive functioning. *Aloe Vera* may enhance the action of the drugs or herbal preparations used with insulin for a diabetic [15].

Stress: Today's fast stressful life causes some bio- chemical and physiological changes in the body, making us susceptible to diseases and dysfunction of organ systems. *Aloe* juice is beneficial in healthy functioning of the body. It reduces cell damaging process during stress condition and minimizes physiological and biochemical changes in the body. Oxidative stress refers to chemical reactions in which compounds have their oxidative state

changed. In the simplest case, oxidation describes the loss of electrons by a molecule, which then becomes what are termed as free radicals. This result in a pro oxidative shift in cellular balance which has been implicated in the cause of many serious diseases, including cancer, cardiovascular diseases such as hypertension and arterio-sclerosis, neurodegenerative diseases such as Parkinson's disease and Alzheimer's dementias, diabetes, ischemia/reperfusion injuries, rheumatoid arthritis, and even the process of aging. *Aloe Vera* is an excellent example of a functional food that provides protection from oxidative stress [18].

Cosmetic and Skin Protection Application: The plant extract is widely used as skin moisturizing agent and for treating pimples. Studies show that *Aloe Vera* improves the skin's ability to hydrate itself, helps in the removal of dead skin cells and has an effective penetrating ability that helps transport healthy substances through the skin. Each of these factors makes *Aloe Vera* an ideal ingredient in cosmetic and dermatological products. In fact, *Aloe Vera* is currently one of the most important ingredients in the cosmetics industry, being utilized in over 95 per cent of the dermatologically valuable extracts manufactured worldwide. The aloe sugars are also used in moisturizing preparations. Mixed with selected essential oils, it makes an excellent skin smoothing moisturizer, sun block lotion plus a whole range of beauty products [24]. It has also been found useful in the treatment of many skin infections, such as benign boils or skin cysts and have been shown to reduce the growth of fungi that cause tinea. At present it is widely used in skin care products, cosmetics and as nutraceuticals. [18].

Clinical uses: The clinical use of *Aloe Vera* is supported mostly by anecdotal data. Though most of these uses are interesting, controlled trials are essential to determine its effectiveness in all the following diseases.

A. Uses based on scientific evidence: These uses have been tested in humans or animals. Safety and effectiveness have not always been proven.

Conditions: Seborrheic dermatitis, psoriasis vulgaris, genital herpes, skin burns, diabetes (type 2), HIV infection, cancer prevention, ulcerative colitis wound healing (results of aloe on wound healing are mixed with some studies reporting positive results and others showing no benefit or potential worsening), pressure ulcers, mucositis, radiation dermatitis, acne vulgaris, lichen planus, frostbite, aphthous stomatitis, and constipation [24].

B. Uses based on tradition or theory: The below uses are based on tradition or scientific theories. They often have not been thoroughly tested in humans, and safety and effectiveness have not always been proven.

Conditions: Alopecia, bacterial and fungal skin infections, chronic leg wounds, parasitic infections, systemic lupus erythematosus, arthritis and tic douloureux.

Side effects

Topical: It may cause redness, burning, stinging sensation and rarely generalized dermatitis in sensitive individuals. Allergic reactions are mostly due to anthraquinones, such as aloin and barbaloin. It is best to apply it to a small area first to test for possible allergic reaction [25].

Oral: Abdominal cramps, diarrhea, red urine, hepatitis, dependency or worsening of constipation. Prolonged use has been reported to increase the risk of colorectal cancer. Laxative effect may cause electrolyte imbalances (low potassium levels).

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

Interactions: Application of aloe to skin may increase the absorption of steroid creams such as hydrocortisone. It reduces the effectiveness and may increase the adverse effects of digoxin and digitoxin, due to its potassium lowering effect. Combined use of *Aloe Vera* and furosemide may increase the risk of potassium depletion. It decreases the blood sugar levels and thus may interact with oral hypoglycemic drugs and insulin [25].

Thus, though *Aloe Vera* has wide spectrum of the properties and uses, some of them could be myths and some of them could be real magic. In future, controlled studies are required to prove the effectiveness of *Aloe Vera* under various conditions.

III. Conclusion

Aloe Vera, an ancient Indian herb, has a long history as a medicinal plant with diverse therapeutic uses. Through human trade and migration, this plant earned a reputation to cure burns and wounds throughout ancient civilizations. India is one of those countries that are talented with the exceptional topographical elements essential for cultivation of *Aloe Vera* and other potential medicinal plants. The plant exhibits many pharmacological activities such as antioxidant, antimicrobial, immune boosting, antitumor, hypo-glycemic, hypo-lipidemic, wound healing and anti-diabetic. Although it was claimed that some of the biological activities of this plant can be attributed to the polysaccharides present in the leaf gel, it is an overwhelming assignment to

connect singular polysaccharides to particular remedial properties. With the innovative advancements in the field of analytical chemistry, it has become easier to extract and characterize the active compound of the leaf gel and it is possible that more data in such manner will be made available at a quicker rate. Fascinating pharmaceutical applications such as skin penetration improvement effects and intestinal absorption enhancement activities have recently been shown for *Aloe Vera* gel. The dried gel has also showed potential as an excipient in modified release matrix type tablets. The US Food and Drug Administration has already approved the developmental study of *Aloe Vera* in the treatment of cancer and AIDS. It would be worthwhile embarking on an intensive scientific experimentation and investigation on this apparently valuable medicinal agent and to promote its large-scale utilization.

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