

Therapeutic and Medicinal Uses of *Aloe vera*: A Review

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ABSTRACT

The plant *Aloe vera* is used in Ayurvedic, Homoeopathic and Allopathic streams of medicine, and not only tribal community but also most of the people for food and medicine. The plant leaves contains numerous vitamins, minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, antimicrobial, anti-inflammatory, anti-oxidant, aphrodisiac, anti-helmenthic, antifungal, antiseptic and cosmetic values for health care. This plant has potential to cure sunburns, burns and minor cuts, and even skin cancer. The external use in cosmetic primarily acts as skin healer and prevents injury of epithelial tissues, cures acne and gives a youthful glow to skin, also acts as extremely powerful laxative.

Keywords: *Aloe vera*; Antimicrobial; Therapeutic; Medicinal Uses; Cosmetic Application

1. Introduction

Plant extracts represent a continuous effort to find new compound against pathogens. Approximately 20% of the plants found in the world have been submitted to pharmacological or biological test, and a substantial number of new antibiotics introduced on the market are obtained from natural or semi synthetic resources [1]. The genus *Aloe* belonging to family Alliaceae is a succulent herb of 80 - 100 cm in height which matures in 4 - 6 years and survives for nearly 50 years under favorable conditions. *Aloe vera* (L.) Burm. *f.* syn. *Aloe barbadensis* Miller, is most biologically active among 400 species [2-4]. According to World Health Organisation, medicinal plants would be the best source for obtaining a variety of drugs [5]. The plant is native to southern and eastern Africa along the upper Nile in the Sudan, and it was subsequently introduced into northern Africa and naturalized in the Mediterranean region and other countries across the globe. The plant is commercially cultivated in Aruba, Bonaire, Haiti, India, South Africa, the United States of America, and Venezuela [6,7] while the finest quality of *Aloe* is grown in desert of Southern California. The plant can survive in hot temperatures of 104°F and with stand in below freezing temperatures until root is not damaged.

1.1. Synonym

Aloe barbadensis Miller, *Aloe chinensis* Bak., *Aloe elongata* Murray, *Aloe indica* Royle, *A. officinalis* Forsk., *A. perfoliata* L., *A. rubescens* DC, *A. vera* L. var. *littoralis* König ex Bak., *A. vera* L. var. *chinensis* Berger, *A. vulgaris* Lam. Most formularies and reference books regard *Aloe barbadensis* Mill. as the correct species name, and *Aloe vera* (L.) Burm. *f.* as a synonym. According to International Rules of Botanical Nomenclature (IRBN), *Aloe vera* (L.) Burm. *f.* is the legitimate name for this species [6].

1.2. Taxonomic Treatment

This succulent perennial herb has triangular, sessile stem, shallow root system, fleshy serrated leaves arranged in rosette having 30 - 50 cm length and 10 cm breadth at the base; colour pea-green. The bright yellow tubular flowers, length 25 - 35 cm, axillary spike and stamens are frequently projected beyond the perianth tube and fruits contain many seeds [7].

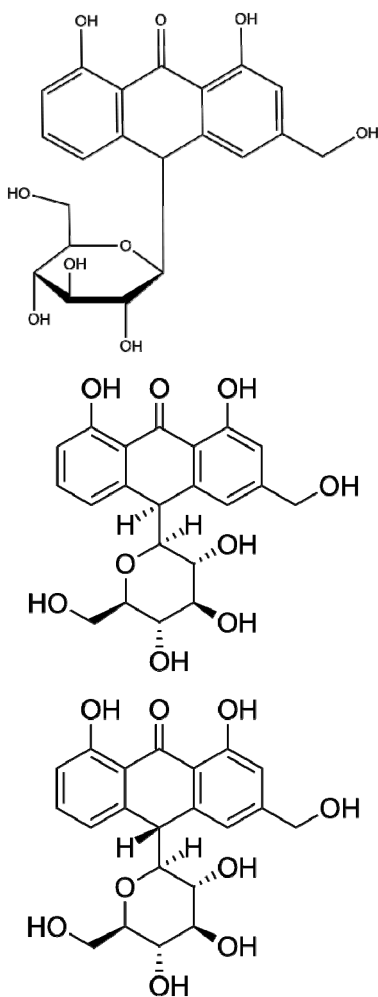
2. Active Ingredients

Leaves have three layers. The outer most layer consist of

15 - 20 cells thick protective layer synthesizing carbohydrates and proteins [8]. (**Figure 1**) The active components of aloe include anthraquinones, chromones, polysaccharides, and enzymes. The anthraquinones and chromones are responsible for the anti-cancer activity, anti-inflammatory, and evacuating [9]. The elements Al, B, Ba, Ca, Fe, Mg, Na, P, Si etc. has also been reported to be present in *Aloe vera* gel [9-11].

2.1. Outer Protective Layers of Leaf

The bitter yellow latex of pericyclic tubules in the outer layer of the leaves contain derivatives of hydroxyanthracene, anthraquinone and glycosides aloin A and B from 15% - 40% in different investigations [12-14]. The other active principles of *Aloe* include hydroxyanthrone, aloemodin-anthrone 10-C-glucoside and chrones.



Structure of Aloin, Aloin A, Aloin B

2.2. Middle Layer of Leaf

The bitter yellow latex containing anthraquinones and glycosides has been reported from the middle layers of

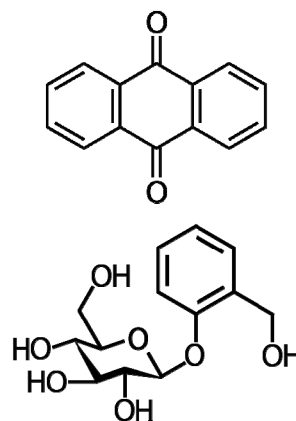


Figure 1. The transverse section of the leaf exhibiting three cells layers, the protective layer, middle layer and colourless inner layer.

leaf [8]. The juice that is originated from cells of the pericycle and adjacent leaf parenchyma, flowing spontaneously from the cut leaf get dried with or without the aid of heat and get solidified should not be confused with *Aloe vera* gel which is also the colourless mucilaginous gel that is obtained from the parenchymatous leaf cells [14]. The parenchymatous tissue or pulp shown to contain proteins, lipids, amino acids, vitamins, enzymes, inorganic compounds and small organic compounds in addition to the different carbohydrates. There is some evidence of chemotaxonomic variation in the polysaccharide composition [15-17] 16-different polysaccharides and 12 major polypeptides (mol wt 15 - 77 kD), and various glycoproteins (29 kD in leaf gel).

2.3. Inner Layers of Leaf

The innermost layer of leaf gel contains water upto 99%, with glucomannans, amino acids, lipids, sterols and vitamins [8,17].



Structure of Anthraquinone and structure of glycosides

The other potentially active ingredients include vitamins, enzymes, minerals, sugars, lignin, saponins, sali-

cyclic acids, and amino acids [18-21]. It has numerous monosaccharide's and polysaccharides; vitamins B₁, B₂, B₆, and C; niacinamide and choline, several inorganic ingredients, enzymes (acid and alkaline phosphatase, amylase, lactate dehydrogenase, lipase) and organic compounds (aloin, barbaloin, and emodin) as described by [22]. The main functional component of *Aloe vera* is a long chain of acetylated mannose [11,23,24]. Aloe gel is often commercialized as powdered concentrate. The therapeutically, it is used to prevent progressive dermal ischemia due to burns, frostbite, electrical injury and intra arterial drug abuse. *In vivo* analysis of these injuries demonstrates that this gel acts as an inhibitor of thromboxane A₂, a mediator of progressive tissue damage [20].

The *Aloe vera* gel play chief role in stimulation of the complement linked to polysaccharides, hydration, insulation, and protection. Application of fresh gel to normal human cells *in vitro* promoted cell growth and attachment, whereas a stabilized gel preparation was cytotoxic to both normal and tumour cells. This cytotoxicity was attributed to additional substances added to gel during processing [25]. The wound healing powers were due to a high molecular weighted polypeptide in healing of rat's excision wounds [26]. This glycoprotein promotes cell proliferation, so gel improves wound healing by increasing blood supply and increased oxygenation [4,27]. Growth of new blood capillaries (angiogenesis) and tissue regeneration in the burn tissue for a guinea pig has been reported, however, no specific constituents were identified [26]. Further, a low molecular weight compound from freeze-dried gel stimulated angiogenesis in chick chorioallantoic membrane, and a methanol-soluble fraction of the gel stimulated proliferation of arteries in endothelial cells and induced them to invade a collage

substrate [28]. **Table 1** representing the chemical composition and properties and activity of *Aloe vera*.

3. Therapeutic Use

3.1. Wound Healing

Wound healing is a dynamic process, occurring in 3 phases. The first phase is inflammation, hyperaemia and leukocyte infiltration. The second phase consists of removal of dead tissue. The third phase of proliferation consisting of epithelial regeneration and formation of fibrous tissue [30].

A more recent review concludes that the cumulative evidence supports the use of *Aloe vera* for the healing of first to second degree burns [31]. The wound healing property of *Aloe vera* gel has been attributed to Mannose-6-phosphate [25]. Actually, glucomannan and plant growth hormone gibberellins interacts with growth factor receptors of fibroblast and stimulate its activity and proliferation for increases collagen synthesis in topical and oral administration of Aloe according to Hayes [22]. The Aloe administration influence collagen composition (more type III) and increased collagen cross linking for wound contraction and improving breaking strength [17]. It also increases synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound [32].

Acemannan is considered the main functional component of *Aloe vera*, is composed of a long chain of acetylated mannose [11,23,24]. This complex carbohydrate accelerates wound healing and reduces radiation induced skin reactions [33,34]. Macrophage-activating potential acemannan may stimulate the release of fibrogenic cytokines [34,35]. Direct binding of acemannan to growth

Table 1. Chemical composition and properties of *Aloe vera* [29].

Constituents	Number and identification	Properties and activity
Amino acids	Provides 20 of the 22 required amino acids and 7 of the 8 essential ones	Basic building blocks of proteins in the body and muscle tissues
Anthraquinones	Provides Aloe emodin, Aloetic acid, alovin, anthracine	Analgesic, antibacterial
Enzymes	Anthranol, barbaloin, chrysophanic acid, smodin, ethereal oil, ester of cinnamonic acid, isobarbaloin, resistannol	Antifungal and antiviral activity but toxic at high concentrations
Hormones	Auxins and gibberellins	Wound healing and anti-inflammatory
Minerals	Calcium, chromium, copper, iron, manganese, potassium, sodium and zinc	Essential for good health
Salicyclic acid	Aspirin like compounds	Analgesic
Saponins	Glycosides	Cleansing and antiseptic
Steroids	Cholesterol, campesterol, lupeol, sistosterol	Anti-inflammatory agents, lupeol has Antiseptic and analgesic properties
Sugars	Monosaccharides: Glucose and Fructose Polysaccharides: Glucomannans/polymannose	Anti-viral, immune modulating activity of acemannan
Vitamins	A, B, C, E, choline, B12, folic acid	Antioxidant (A, C, E), neutralises free radicals

factors and their stabilization may lead to promotion of prolong stimulation of granulation tissue [33].

The Aloe gel has been used for the treatment of radiation burns and radiation ulcers [36], and complete healing has been observed in two radiation burns patients [7]. The fresh gel was more effective than the cream [7,37] as Aloe gel-treated lesions healed faster (11.8 days) compared to burns treated with petroleum jelly gauze (18.2 days) by *Fulton* [38]. The 27 patients with partial thickness burns have been treated with Aloe gel in a placebo-controlled study [39].

3.2. Anti-Inflammatory Action

The anti-inflammatory activity of *Aloe vera* gel has been revealed by a number of *in vitro* and *in vivo* studies through bradykinase activity [40,41]. The peptidase bradykinase was isolated from aloe and shown to break down the bradykinin, an inflammatory substance that induces pain [42]. A novel anti-inflammatory compound, C-glucosyl chromone, was isolated from gel extracts [43]. *Aloe vera* inhibits the cyclo-oxygenase pathway and reduces prostaglandin E2 production from arachidonic acid. Fresh *Aloe vera* gel significantly reduced acute inflammation in rats (carrageenin-induced paw oedema), but not in chronic inflammation [41]. In croton oil-induced oedema in mice, three *Aloe vera* gel sterols were able to reduce inflammation by up to 37%. Lupeol, the most active anti-inflammatory sterol, reduced inflammation in a dose dependent manner. The data suggest that specific plant sterols may also contribute to the anti-inflammatory activity of gel [43]. The aloe sterol includes campesterol, β -sitosterol, lupeol, and cholesterol which are anti-inflammatory in nature, helps in reducing the inflammation pain and act as a natural analgesic. Other aspirin-like compound present in Aloe is responsible for anti-inflammatory and antimicrobial properties [44]. Even, *Aloe vera* extract (5.0% leaf homogenate) decreased inflammation by 48% in a rat adjuvant-induced arthritic inflammatory model [45,46].

3.3. Effects on the Immune System

Alprogen inhibit calcium influx into mast cells, thereby inhibiting the antigen-antibody-mediated release of histamine and leukotriene from mast cells [47]. In a study on mice that had previously been implanted with murine sarcoma cells, acemannan stimulates 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 [48]. Several low-molecular-weight compounds are also capable of inhibiting the release of reactive oxygen free radicals from activated human neutrophils [49].

3.4. Moisturizing and Anti-Aging Agent

Muco-polysaccharides help in binding moisture into the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects have also been studied in treatment of dry skin associated with occupational exposure where *Aloe vera* gel gloves improved the skin integrity, decrease appearance of acne wrinkle and decrease erythema [50]. The Aloe gel gives cooling effect and also acts as a moisturizing agent. It also has role in gerontology and rejuvenation of aging skin. This property of Aloe is because it's biogenic material. *Aloe vera* is used as skin tonic in cosmetic industry.

3.5. Antitumor Activity

A number of glycoproteins present in *Aloe vera* gel have been reported to have antitumor and antiulcer effects and to increase proliferation of normal human dermal cells [51-53]. However, statistically significant clinical studies on the efficacy of *Aloe vera* gel on human health are very limited and often inconclusive [54]. In recent studies, a polysaccharide fraction has shown to inhibit the binding of benzopyrene to primary rat hepatocytes, thereby preventing the formation of potentially cancer-initiating benzopyrene-DNA adducts. An induction of glutathione S-transferase and an inhibition of the tumor-promoting effects of phorbol myristic acetate has also been reported which suggest a possible benefit of using aloe gel in cancer chemoprevention [55,56].

3.6. Laxative Effects

Anthraquinones present in latex are a potent laxative; it's stimulating mucus secretion, increase intestinal water content and intestinal peristalsis [35]. The Aloe are due primarily to the 1, 8-dihydroxyanthracene glycosides, aloin A and B (formerly designated barbaloin) [40,57]. After oral administration aloin A and B, which are not absorbed in the upper intestine, are hydrolysed in the colon by intestinal bacteria and then reduced to the active metabolites (the main active metabolite is aloe-emodin-9-anthrone) [41,58], which like senna acts as a stimulant and irritant to the gastrointestinal tract [59]. Aloe latex is known for its laxative properties. The laxative effect of Aloe is not generally observed before 6 hours after oral administration, and sometimes not until 24 or more hours after.

4. Medicinal Uses

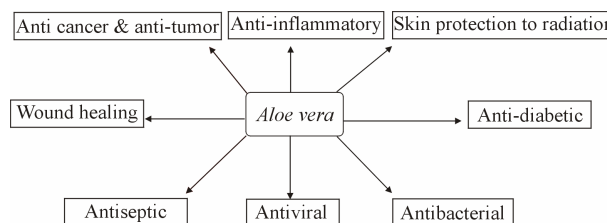
Aloe vera is anthelmintic, aperients, carminative, deobstruent, depurative, diuretic, stomachic and emmenagogue. Juice is used in skin care medicine, dyspepsia, amenorrhoea, burns, colic, hyperadenosis, hepatopathy,

splenopathy, constipation, span menorrhoea, abdominal tumors, dropsy carbuncles, sciatica, lumbago and flatulence. The elio, a product made by juice of this plant, is used for helminthiasis in children and is a purgative, anthelmintic & emmenagogue. A number of glycoprotein present in *Aloe vera* gel have been reported to have anti-tumor and antiulcer effects and to increase proliferation of normal human dermal cells [51-53]. Gel is useful in ulcerative colitis and pressure ulcers, respectively [60,61]. Traditionally, *Aloe vera* gel is used both, topically (treatment of wounds, minor burns, and skin irritations) and internally to treat constipation, coughs, ulcers, diabetes, headaches, arthritis, immune-system deficiencies [54,62].

Aloe vera has been used for medicinal purposes in several cultures for millennia: Greece, Egypt, India, Mexico, Japan, and China [63]. The Egyptians used the *Aloe vera* to make papyrus like scrolls as well as for treatment of tuberculosis [64]. Nadkerni [65] stated various preparations of *Aloe barbadensis* like confection, lotion and juice, useful remedies for curing various diseases. Aloe contains mixture of glucosides collectively called aloin which is the active constituent of various drugs. Traditionally Aloe is extensively used in treating urine related problems, pimples and ulcers etc. It is also used in gerontology and rejuvenation of aging skin. The juice of *Aloe vera* leaves is used as stomachic tonic and purgative. Scientific evidence for the cosmetic and therapeutic effectiveness of *Aloe vera* is limited and when present is frequently contradictory [66,67]. Despite this, the cosmetic and alternative medicine industries regularly make claims regarding the soothing, moisturizing, and healing properties of *Aloe vera*, especially *via* internet advertising [68,69]. The bioactive compounds are used as astringent, haemostatic, antidiabetic, antiulcer, antiseptic, antibacterial, anti-inflammatory, antioxidant and anticancer agent 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 [70] (represents in **Graph 1**). It is used in ayurvedic formulations as appetite-stimulant, purgative, emmenagogue and anthelmintic, for treating cough, colds, piles, debility, dyspnoea, asthma and jaundice [71].

4.1. Cosmetic & Skin Protection Application

Aloin and its gel are used as skin tonic against pimples. *Aloe vera* is also used for soothing the skin, and keeping the skin moist to help avoid flaky scalp and skin in harsh and dry weather. The Aloe sugars are also used in moisturizing preparations [72]. Mixed with selected essential oils, it makes an excellent skin smoothening moisturizer, sun block lotion plus a whole range of beauty products. Due to its soothing and cooling qualities, Maharishi Ayurveda recommends *Aloe vera* for a number of skin



Graph 1. Representing the medicinal utilities of *Aloe vera*.

problems [71]. *Aloe vera* extracts have antibacterial and antifungal activities, which may help in the treatment of minor skin infections, such as boils and benign skin cysts and have been shown to inhibit the growth of fungi that cause tinea [73].

Currently, the plant is widely used in skin care, cosmetics and as nutraceuticals [74]. *Aloe vera* gel has been reported to have a protective effect against radiation damage to the skin [75,76]. Exact role is not known, but following the administration of *Aloe vera* gel, an antioxidant protein, metallothionein, is generated in the skin, which scavenges hydroxyl radicals and prevents suppression of superoxide dismutase and glutathione peroxidase in the skin. It reduces the production and release of skin keratinocyte derived immunosuppressive cytokines such as interleukin-10 (IL-10) and hence prevents UV-induced suppression of delayed type hypersensitivity [77]. Skin burns effect is reported and radiation dermatitis [78-80]. Some researcher has been reported the contact dermatitis and burning skin sensations following topical applications of *Aloe vera* gel to dermabraded skin. These reactions appeared to be associated with anthraquinone contaminants in this preparation [81,82].

4.2. Antiseptic

The antiseptic property of *Aloe vera* is due to presence of six antiseptic agents namely lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulphur. These compounds have inhibitory action on fungi, bacteria and viruses. Though most of these uses are interesting controlled trials are essential to determine its effectiveness in all diseases [83].

4.3. Anti Diabetic

The five phytosterols of *A. vera*, lophenol, 24-methyllophenol, 24-ethyl-lophenol, cycloartanol and 24-methylenecycloartanol showed anti-diabetic effects in type-2 diabetic mice [84]. *Aloe vera* contains polysaccharides which increase the insulin level and show hypoglycemic properties [85]. Noor *et al.*, [86] reviewed the beneficial effects of selective medicinal plant species such as *Allium cepa*, *Allium sativum*, *Aloe vera*, *Azadirachta indica*, *Gymnema sylvestri*, *Syzygium cumini* and *Pterocarpus marsupium*, and emphasize on the role of active bio-

molecules which possess anti-diabetic activity. The treatment of diabetes mellitus has been attempted with various indigenous plants and polyherbal formulations [87-89]. Encouraging results have been obtained from plant extracts with respect to antidiabetic activity, but still only a meager percentage of the plant world has been explored [90]. Medicinal plants like *Trigonella foenum graecum*, *Allium sativum*, *Gymnema sylvestre*, *Syzygium cumini* and *Aloe vera* have been studied for treatment of diabetes mellitus [91]. Extracts of Aloe gum increases glucose tolerance in both normal and diabetic rats [92] and *Aloe vera* sap taken for 4 - 14 weeks has shown a significant hypoglycaemic effect both clinically and experimentally [93]. *Aloe vera* gel is used in reducing sugar in diabetes [7]. The five phytosterols of *A. vera*, lophenol, 24-methyl-lophenol, 24-ethyl-lophenol, cycloartanol and 24-methylenecycloartanol showed anti-diabetic effects in type-2 diabetic mice [84]. Traditional anti-diabetic plants might provide new oral anti-diabetic compounds, which can counter the high cost and poor availability of the current medicines for many rural populations in developing countries [84].

4.4. Anticancer Properties

The role of Aloe in carcinogenicity has not been evaluated well. The chronic abuse of anthranoid-containing laxatives has been hypothesized to play a role in colorectal cancer, however, no causal relationship between anthranoid laxative abuse and colorectal cancer has been demonstrated and [81,82]. Report on cancer prevention is done by [94,95]. *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* emodin, an anthraquinone, has the ability to suppress or inhibit the growth of malignant cancer cells making it to have anti-neoplastic properties [96].

4.5. Stress

Aloe juice is helpful in smooth functioning of the body machinery [97]. It reduces cell-damaging process during stress condition and minimizes biochemical and physiological changes in the body [98]. Oxidative stress refers to chemical reactions in which compounds have their oxidative state changed. Some antioxidants are part of the body's natural regulating machinery while other dietary antioxidants are derived from diet sources. *Aloe vera* is an excellent example of a functional food that plays a significant role in protection from oxidative stress [71,72,99].

4.6. Adverse Reactions

Abdominal spasms and pain may occur after even a sin-

gle dose and overdose can lead to colicky abdominal spasms and pain, as well as the formation of thin, watery stools. Chronic abuse of anthraquinone stimulant laxatives can lead to hepatitis [100] and electrolyte disturbances (hypokalaemia, hypocalcaemia), metabolic acidosis, malabsorption, weight loss, albuminuria, and haematuria [101,102]. Weakness and orthostatic hypotension may be exacerbated in elderly patients when stimulant laxatives are repeatedly used [103]. Secondary aldosteronism may occur owing to renal tubular damage after aggravated use. Steatorrhoea and protein-losing gastroenteropathy with hypoalbuminaemia have also been observed, as have excessive excretion of calcium in the stools and osteomalacia of the vertebral column [104]. Melanotic pigmentation of the colonic mucosa (pseudomelanosis coli) has been observed in individuals taking anthraquinone laxatives for extended time periods. The pigmentation is clinically harmless and usually reversible within 4 to 12 months after the drug is discontinued [101].

Aloe vera contains polysaccharides which increase the insulin level and show hypoglycemic properties [85]. Noor *et al.*, [86] reviewed the beneficial effects of selective medicinal plant species such as *Allium cepa*, *Allium sativum*, *Aloe vera*, *Azadirachta indica*, *Gymnema sylvestre*, *Syzygium cumini* and *Pterocarpus marsupium*, and emphasize on the role of active biomolecules which possess anti-diabetic activity. As with other stimulant laxatives, products containing Aloe should not be used in patients with intestinal obstruction or steno sis, stony severe dehydration with electrolyte depletion, or chronic constipation [105]. Chronic use may cause dependence and need for increased dosages, disturbances of water and electrolyte balance (e.g. hypokalaemia), and an atonic colon with impaired function [105]. The use of stimulant laxatives for more than 2 weeks requires medical supervision. Chronic abuse with diarrhoea and consequent fluid and electrolyte losses (mainly hypokalaemia) may cause albuminuria and haematuria, and may result in cardiac and neuromuscular dysfunction, the latter particularly in the case of concomitant use of cardiac glycosides (digoxin), diuretics, corticosteroids, or liquorices root. Aloe should not be administered to patients with inflammatory intestinal diseases, such as appendicitis, Crohn disease, ulcerative colitis, irritable bowel syndrome, or diverticulitis or to children less than 10 years of age. Aloe should not be used during pregnancy or lactation except under medical supervision after evaluating benefits and risks. Aloe is also contraindicated in patients with cramps, colic, hemorrhoids', nephritis, or any undiagnosed abdominal symptoms such as pain, nausea, or vomiting [105,106]. Leaf anti-hyperglycemic activity with protective effect on pancreas, liver and small Intestine in rabbits was studied [93,107-109].

5. Antimicrobial Activities

5.1. Antibacterial Activity

Aloe vera gel was bactericidal against *Pseudomonas aeruginosa* and acemannan prevented it from adhering to human lung epithelial cells in a monolayer culture [110, 111]. A processed *Aloe vera* gel preparation inhibited the growth of fungus *Candida albicans* [112]. The gel contains 99.3% of water, the remaining 0.7% is made up of solids with carbohydrates constituting for a large components [99]. Concentrated extracts of *Aloe* leaves are used as laxative and as a haemorrhoid treatment. *Aloe* gel can help to stimulate the body's immune system [113]. Glucomannan and acemannan have been proved to accelerate wound healing, activating macrophages, stimulating immune system as well antibacterial and antiviral effects [23,79,114-118]. *Streptococcus pyogenes* and *Streptococcus faecalis* are two microorganisms that have been inhibited by *Aloe vera* gel [112,119]. Using a rat model, it was suggested that the antibacterial effect of the *Aloe vera* gel *in vivo* could enhance the wound healing process by eliminating the bacteria that contributed to inflammation [120]. The aloe extract was potent against three strains of Mycobacterium (*M. fortuitum*, *M. smegmatis* and *M. kansasii*) and a strong anti-mycobacterial activity against *M. tuberculosis* ss well as antibacterial activity against *P. aeruginosa*, *E. coli*, *S. aureus* and *S. typhi*. The preliminary phytochemistry revealed presence of terpenoids, flavonoids and tannins. Thus, *Aloe secundiflora* could be a rich source of antimicrobial agents and it can give scientific backing to its use by the local people of Lake Victoria region of Kenyas [121].

5.2. Antiviral Activity

Several ingredients in *Aloe vera* gel have been shown to be effective antiviral agent. Acemannan reduced herpes simplex infection in two cultured target cell lines [122]. Lectins, fractions of *Aloe vera* gel, directly inhibited the cytomegalovirus proliferation in cell culture, perhaps by interfering with protein synthesis [123]. A purified sample of aloe emodin was effective against infectivity of herpes simplex virus Type I and Type II and it was capable of inactivating all of the viruses, including varicella-zoster virus, influenza virus, and pseudorabies virus [124]. Electron micrograph examination of anthroquinone treated herpes simplex virus demonstrated that the envelopes were partially disrupted. Such results indicate that anthraquinones extract from variety of plants are directly virucidal to enveloped viruses. These actions may be due to indirect effect due to stimulation of the immune system. The anthraquinone aloin also inactivates various enveloped viruses such as herpes simplex, varicella zoster and influenza [124].

5.3. Antifungal Activity

Aloe vera was evaluated on the mycellium development of *Rhizoctonia solani*, *Fusarium oxysporum*, and *Colletotrichum coccodes*, that showed an inhibitory effect of the pulp of *A. vera* on *F. oxysporum* at $10^4 \mu\text{l L}^{-1}$ and the liquid fraction reduced the rate of colony growth at a concentration of $10^5 \mu\text{l L}^{-1}$ in *R. solani*, *F. oxysporum*, and *C. coccodes* [125,126]. It is also reported that the *Aloe* juice have antiinflammatory, anti-arthritic activity, antibacterial and hypoglycaemic effects [127]. For bacteria, inner-leaf gel from *Aloe vera* was shown to inhibit growth of *Streptococcus* and *Shigella* species in vitro [128]. Agarry *et al.*, [129] reported that the *Aloe* gel inhibited the growth of *Trichophyton mentagrophytes* (20.0 mm), while the leaf possesses inhibitory effects on both *Pseudomonas aeruginosa* and *Candida albicans*. In contrast, *Aloe vera* extracts failed to show antibiotic properties against *Xanthomonas species* [130]. Other uses for extracts of *Aloe vera* include the dilution of semen for the artificial fertilization of sheep, used as fresh food preservative [131] and used in water conservation in small farms [132]. Another constituent of *Aloe vera* includes saponins. These are soapy substances from the gel that are capable of cleansing and having antiseptic properties. The saponins perform strongly as anti-microbial against bacteria, viruses, fungi and yeasts [133].

6. Conclusion

The active ingredients hidden in its succulent leaves have the power to soothe human life and health in a myriad ways. The plant has importance in everyday life to soothe a variety of skin ailments such as mild cuts, antidote for insect stings, bruises, poison ivy and eczema along with skin moisturizing and anti ageing, digestive tract health, blood and lymphatic circulation and functioning of kidney, liver and gall bladder makes it a boon to human kind. *Aloe vera* as the "wonder plant" is multiple from being an antiseptic, anti-inflammatory agent, helps in relieving like cancer and diabetes, and being a cosmetic field. The plant is in need to a greater research emphasis for better utilization of this plant for human-kind. *Aloe vera* is undoubtedly, the nature's gift to humanity for cosmetic, burn and medicinal application and it remains for us to introduce it to ourselves and thank the nature for its never-ending gift.

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