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Review Article

Aloe vera their chemicals composition and applications: A review

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ABSTRACT

It was known to people in Egypt and also Greece for example Aristoteles explains special characteristics of Aloe vera. Jelatin that is extracted from this plant is continuously used to treat burns, cuts and inflamed scars since many years. It is useful for skin damaged from X ray as reported in many researches in journals related X rays. On the other hand concentration of glucose in gelatin, results in high osmotic pressure, that protect skin from live bacteria. Aloe vera include "Antrokinon" chemicals that are known as anti virus, anti bacteria and anti cancer. Aloe vera (Aloe vera) has 400 species but just 2 species; *A.barbadensis* are used for trade in the world. 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 live in very hot regions, but cannot tolerate cold. Aloe vera grows in, Mexico, India, South and central America, Africa, Australia, Carribeans and Iran. This paper reviews history, its chemicals, medical usage, plant morphology, extracts and agronomy of Aloe vera.

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1. Introduction

The plant of Aloe vera and its usage as drug dates back to 6000 years B.C. The plates belonging to Sumer period during 2200 years BC, show use of this plant as a drug. In that plates, it is written about origin of this plant as Africa, that has 240 species and is ever green. Cleopatra said that her beauty is due to use of Aloe vera plant. One prescription that belong to 1550 BC shows Aloe vera plant used for different illness. It was known to people in Egypt and also Greece for example Aristoteles explains special characteristics of *Aloe vera*. Jelatin that is extracted from this plant is continuously used to treat burns, cuts and inflamed scars since many years. It is also used in cosmetics sector, medical sector and beverage sectors. It is useful for skin damaged from X ray as reported in many researches in journals related X rays. Because of high concentration of water and oil in this plant, it helps to protect skin from dryness and so the skin that is burnt or cut heals very quickly.

hand concentration of glucose in gelatin, results in high osmotic pressure, that protect skin from live bacteria. Aloe vera include "Antrokinon" chemicals that are known as anti virus, anti bacteria and anti cancer. Researchers shows that plant is very helpful for treatment of Psoriasis. Aloe vera is very similar to Cactus but belongs to Lily family of Aloe barbadensis groups. Aloe vera has 400 species but just 2 species; *A.barbadensis* and *A.aborescens* are used for trade in the world. 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 live in very hot regions, but cannot tolerate cold. Aloe vera grows in South Texas, Florida and South California in USA. It also grows in Mexico, India, South and central America, Africa, Australia, Carribeans and Iran. This paper reviews history, its chemicals, medical usage, plant morphology, extracts and agronomy of Aloe vera.

Ancient Egyptian papyrus and Mesopotamian clay tablets describe aloe as useful in curing infections, treating skin problems and as a laxative [1]. Cleopatra was said to include aloe cream in her beauty regimen [2]. Aloe was used by Hippocrates and Arab physicians, and was carried to the Western Hemisphere by Spanish

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explorers. Legend has it that Alexander the Great captured the island of Socotra in the Indian Ocean to secure its aloe supplies to treat his wounded soldiers[3]. Aloe is also popular in both traditional Chinese and Ayurvedic medicine (India). The Chinese describe aloe's skin and the inner lining of its leaves as a cold, bitter remedy which is downward draining and used to clear constipation due to accumulation of heat [4]; the gel is considered cool and moist. In Ayurvedic medicine, the traditional medicine of India, aloe is used internally as a laxative, antihelminthic, hemorrhoid remedy, and uterine stimulant (menstrual regulator); it is used topically, often in combination with licorice root, to treat eczema or psoriasis. In Arabian medicine, the fresh gel is rubbed on the forehead as a headache remedy or rubbed on the body to cool it in case of fever, as well as being used for wound healing, conjunctivitis, and as a disinfectant and laxative[5].

Today aloe vera gel is an active ingredient in hundreds of skin lotions, sun blocks and cosmetics[6]. The gel's use in cosmetics has been boosted by claims that it has similar anti-aging effects to vitamin A derivatives[7]. Aloe first gained popularity in the United States in the 1930's with reports of its success in treating X-ray burns [8,9,10]. Recently, aloe extracts have been used to treat canker sores, stomach ulcers and even AIDS. Some natural health enthusiasts promote aloe gel as a cleansing juice [11]. Some naturopaths promote aloe juice as a way to prevent and treat renal stones [12]. Many mothers keep a plant handy in the kitchen where it readily thrives in bright sunlight with little care [13]. When faced with a minor burn, a fresh leaf can be cut and the gel of the inner leaf applied directly to the burn immediately after the injury [14]. The inner leaf lining of the plant is used as a potent natural laxative. In a 1990 survey of members of a health maintenance organization, aloe vera was used by 64%; of these, 91% believed it had been helpful [15]. Aloe is also an ingredient in Compound Benzoin tincture [16].

2. Botany

2.1 Medicinal species: *Aloe vera*, *A. barbadensis* (Barbados aloe), *A. vulgaris*, *A. arborescens*, *A. ferox* (Cape aloe), *A. perryi* (Socotrine or Zanzibar aloe). There are over 300 species of aloe, most of which are native to South Africa, Madagascar and Arabia [5]. The different species have somewhat different concentrations of active ingredients [17,18].

2.3 Plant description: The botanical name of Aloe vera is *Aloe barbadensis* miller. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea-green color plant. The aloe plant has long (up to 20 inches long and 5 inches wide), triangular, fleshy leaves that have spikes along the edges. The fresh parenchymal gel from the center of the leaf is clear; this part is sometimes dried to form aloe vera concentrate or diluted with water to create aloe juice products. The sticky latex liquid is derived from the yellowish green pericyclic tubules that line the leaf (rind); this is the part that yields laxative anthraquinones[21]. The flowers (not used medicinally) are yellow.

2.4 Where it's grown: Aloes are indigenous to South Africa and South America, but are now cultivated worldwide except in tundra, deserts and rain forests. In the US aloe is commercially cultivated in southern Texas [22]. It takes approximately four years to reach maturity and has a life span of about 12 years.



Figure 1: Aloe vera plant.

3. AloeVera: Potentially Active Chemical Constituents

From the gel:

1. Polysaccharides: glucomannan and acemannan
2. Other: carboxypeptidase, magnesium, zinc, calcium, glucose, cholesterol, salicylic acid, prostaglandin precursors (gamma-linolenic acid [GLA]), vitamins A, C, E, lignins, saponins, plant sterols and amino acids [3].

From the latex leaf lining:

3. Anthraquinone glycosides: aloin, aloe-emodin, barbaloin

Table 1: Summary of the chemicals composition of A. Vera [23, 24, 25, 26, 27, 28, 29].

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

The gel or mucilage obtained from the flesh of the leaf contains quite different compounds from the bitter latex extracted from the leaf lining [30]. Aloe gel is 99% water with a pH of 4.5 and is a common ingredient in many non-prescription skin salves. The gel contains an emollient polysaccharide, glucomannan. It is a good moisturizer, which accounts for its use in many cosmetics [31]. Acemannan, the major carbohydrate fraction in the gel, is a water-soluble long chain mannose polymer which accelerates wound healing, modulates immune function (particularly macrophage activation and production of cytokines) and demonstrates antineoplastic and antiviral effects [32]. The gel also contains bradykininase, an anti-inflammatory [33], magnesium lactate, which helps prevent itching, and salicylic acid and other antiprostaglandin compounds which relieve inflammation.

The leaf lining (latex, resin or sap) contains anthraquinone glycosides (aloin, aloe-emodin and barbaloin) that are potent stimulant laxatives. These water soluble glycosides are split by intestinal bacteria into aglycones which effect the laxative action. The laxative effect from aloe is stronger than from any other herb, including senna, cascara or rhubarb root; it also has more severe side effects such as cramping, diarrhea, and nausea [34]. For medicinal use, the leaf lining is dried and the residue is used as an herbal laxative. The products are usually taken at bedtime.

They are poorly absorbed after oral administration, but moderately well absorbed after bacterial hydrolysis. They are eliminated in the urine, bile, feces and breast milk. They turn alkaline urine red [35]. Most herbalists recommend that they be avoided during pregnancy due to the risk of stimulating uterine contractions and also avoided during lactation due to the risk of excretion in breast milk [36]. Aloe is seldom recommended as a first choice among laxative preparations due to the severe cramping and nausea associated with its use.

4. Biological activity of Aloe vera

4.1 Healing properties: Various researchers reported that the effective components for wound healing may be tannic acid [37] and a type of polysaccharide [38]. Other researcher have also reported that glucomannan, a mannose-rich polysaccharide and gibberellin a growth hormone interacts with growth factor receptors on the fibroblast thereby stimulating its activity and proliferation which in turn significantly increase collagen synthesis after topical and oral Alov vera [39] Aloe gel not only increased collagen content of the wound but also changed collagen composition and increased the degree of collagen cross linking. Due to this, it accelerated wound contraction and increased the breaking strength of resulting scar tissue [40] An increased synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound following oral or topical treatment has been reported [41].

4.2 Immune modulation: Immunostimulant and anti-inflammatory (gel) ,In a case studies of 14 HIV-1+ patients who were prescribed 800 mg/day of acemannan, there was a

significant increase in the number of circulating monocyte and macrophages which mirrored clinical improvements [42]. In a pilot study in HIV-infected persons acemannan increased the number of white blood cells and improved symptoms [43]. Aloe extracts also increased phagocytosis in asthmatic adults [44]. Alprogen inhibit calcium influx into mast cells, thereby inhibiting the antigen-antibody-mediated release of histamine and leukotriene from mast cells [45]. 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 [46]. Several low-molecular-weight compounds are also capable of inhibiting the release of reactive oxygen free radicals from activated human neutrophils [47].

4.3 Antimicrobial: Aloe vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulfur. They all have inhibitory action on fungi, bacteria and viruses. Acemannan acts alone and synergistically with azidothymidine (AZT) and acyclovir to block reproduction of Herpes and the AIDS virus [48]. Antifungal Aloe extract treatment of guinea pig feet that had been infected with *Trichophyton mentagrophytes* resulted in a 70% growth inhibition compared with untreated animals [49]. 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 [50,51,52].

4.4 Skin and mucus membranes: In humans, aloe has been reported to accelerate healing from deep scrapes, frostbite, flash burns of the conjunctiva, and even canker sores [53, 54,55]. Only one study has had an opposite effect; that is, aloe-treated surgical wounds healing by secondary intention took longer to heal than comparison wounds [56]. Despite the conflicting research, some dentists and otolaryngologists use aloe gel to promote healing in injured tissues in the mouth, nose, sinuses and ear [57]. Aloe gel has most often been used as a topical treatment for burn wounds [58]. In a study of 27 adults with partial thickness burns, those treated with aloe healed an average of six days faster than those treated with Vaseline gauze [59]. Psoriasis remedy In a 1995 double-blind, placebo controlled study of aloe's effect on 60 patients with psoriasis vulgaris, an aloe vera extract (0.5%) in a hydrophilic cream resulted in a significant clearing of the psoriatic plaques in 83.3% of the aloe-treated patients versus 6.6% of the placebo group [60]. The aloe treatment was well tolerated with no adverse drug-related side effects. Its moisturizing effects has also been studied in treatment of dry skin associated with occupational exposure where aloe vera gel gloves improved the skin integrity, decreases appearance of fine wrinkle and decreases erythema [61]. It has also anti-acne effect.

4.5 Effects on skin exposure to UV and gamma radiation: Aloe vera gel has been reported to have a protective effect against damage to skin [62, 63]. 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 and hence prevents UV-induced suppression of delayed type hypersensitivity [64].

4.6 Anti-diabetic effects: Several pre-clinical (in animal) and clinical (in human) trials showed a blood glucose lowering effects for Aloe vera gel preparations in different forms (e.g. juice or as constituents in bread etc.). In a study on streptozotocin-induced diabetic rats oral administration of Aloe vera gel (alcohol insoluble residue extract) significantly reduced the fasting blood glucose, hepatic transaminases, plasma and tissue cholesterol, triglycerides, free fatty acids and phospholipids and in addition also significantly increased plasma insulin levels. The decreased plasma levels of high density lipoprotein cholesterol and increased levels of low density lipoprotein cholesterol in the streptozotocin-induced rats were restored to normal after treatment with gel extract [65]. From the findings of another study on streptozotocin-induced diabetic rats, it was suggested that the mechanism of action of Aloe vera extracts to reduced blood glucose levels is by enhancing glucose metabolism. It was further proposed that the glucose lowering effect could be explained by an antioxidant mechanism because it attenuated oxidative damage in the brains of streptozotocin-induced mice and reduced peroxidation levels in the kidneys of streptozotocin-induced diabetic rats [66].

5. Conclusions: Aloe vera bulk as well as extracts are widely used in food, cosmetic, healthcare, skincare and medical industry as active ingredients for extra therapeutic, hygienical, rejuvenating, health enhance effectives. Although, Aloe vera has wide spectrum of the properties and uses. Food and Drug Administration of USA has already approved the developmental study of Aloe vera in the treatment of Cancer and AIDS. In future, controlled studies are required to prove the effectiveness of Aloe vera under the various conditions.

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