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## Therapeutic applications, chemical properties and value added *Aloe vera* products: A mini review

Rama Maurya, Renu Mogra and Sandeep K Mauriya

#### Abstract

*Aloe vera Aloe barbadensis* L., belong to family liliaceae. It is an evergreen perennial shrub use for the medicinal purpose. *Aloe vera* contain different chemical and active compound which helps in the treatment of various disease, *Aloe vera* helps in lowering the blood glucose, increased HDL cholesterol and decrease the LDL cholesterol in the blood. *Aloe vera* contains mucilaginous fiber so that intake of *Aloe vera* juice or powder reduces the risk of obesity. There are various value added products are available in the market which have beneficial effect for health. The aim of this paper is to provide general and specific information of *Aloe vera* and its products beneficial properties, focusing its use in the food industry as a new or functional food. This review addresses the following aspects: chemical and functional properties of *Aloe vera*, commercially available value added functional food and beverages; biologically active compounds and therapeutic properties. The plant leaves and inner gel contains numerous help it has potential to cure sunburns and minor cuts, and even skin cancer and acts as also acts as extremely powerful laxative. Various parts of the plant have different effects on the body. The present review is an attempt to highlight the proven research related botanical and pharmacological medicinal properties of *Aloe vera*. *A. Vera* has various medicinal properties such as antitumor, antiarthritic, antirheumatoid, anticancer, and antidiabetic properties.

**Keywords:** Therapeutic applications, chemical properties, *Aloe vera*

#### Introduction

*Aloe vera Aloe barbadensis* L., belong to family liliaceae commonly known as *Aloe barbadensis* Miller. *Aloe vera* sometimes referred as the burn plant, lily of the desert or the wonder plant, In India it is called as Ghritkumari and gayatri plant (Sushen *et al.*, 2017) [14]. *Aloe* is derived from Arabic word alloeh means “bitter its legitimate name according to the international rules of botanical nomenclature is *A. Vera* (L.). *Aloe vera* is one of the oldest known medicinal plants gifted by nature; and is often called “miracle” plant (Srikanth *et al.*, 2016) [11]. It is evergreen perennial, grows wild in tropical climates around the world and is cultivated for agricultural and medicinal purpose. *Aloe vera (Aloe barbadensis* Miller) is a native species to South Africa, which has been widely distributed in the continent of Europe from where they have spread to almost the entire world. Presently, the use of *Aloe vera* has gained popularity because of herbal movement initiated by naturopaths, yoga gurus, alternative medicine promoters and holistic healers. *Aloe vera* has been studied for its clinical effectiveness against a great variety of affections and disorders of the skin, for example, wounds and burns, for its effect as anti-inflammatory, antioxidant, healing, and antibacterial; these actions are biologically attributed to its chemical components. Presently, the use of *Aloe vera* has gained popularity because of herbal movement initiated by naturopaths, yoga gurus, alternative medicine promoters and holistic healers.

*Aloe vera* leaf contains 95% of water, 75 nutrients, 200 active compounds, 20 minerals, 18 amino acids, 12 vitamins and 92 enzymes. It can be used as the source of vitamins like A, B1, B2, B6, B12, C, E, Folic acid, Niacin etc. Due to its succulent properties, it is a rich source of nutrients and essential minerals (Kausar *et al.*, 2016) [6]. Large numbers of *Aloe* containing beauty products, creams, lotions, soaps, shampoos, oils, facial cleaners, moisturizers, etc. are available worldwide.

*Aloe vera* is not only a medicinal plant but also can be used for nutritional benefits. Minerals such as calcium, phosphorous, potassium, iron, sodium, magnesium, manganese, copper, chromium, and zinc. *Aloe vera* 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.

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Free monosaccharides consist of D-mannose and D glucose and trace amounts of xylose, rami nose, galactose and either arabinose are present. Mannose 6 phosphate is a major sugar component in *Aloe vera*. Additional minerals found in *Aloe vera* include copper important for red blood cells, skin and hair pigment, iron involved in oxygen transportation and making of hemoglobin in red blood cell, potassium helps in fluid balance, phosphorus helps in building bones and teeth,

assists in metabolism and maintains body pH and sodium regulates body liquids, helps in nerve and muscle performance, and helps in delivering nutrients to body cells. Another component of *Aloe vera* consists of the lignin, a major structural material of cellulose content that is helpful for penetrative properties and beneficial for skin problems such as eczema and psoriasis.

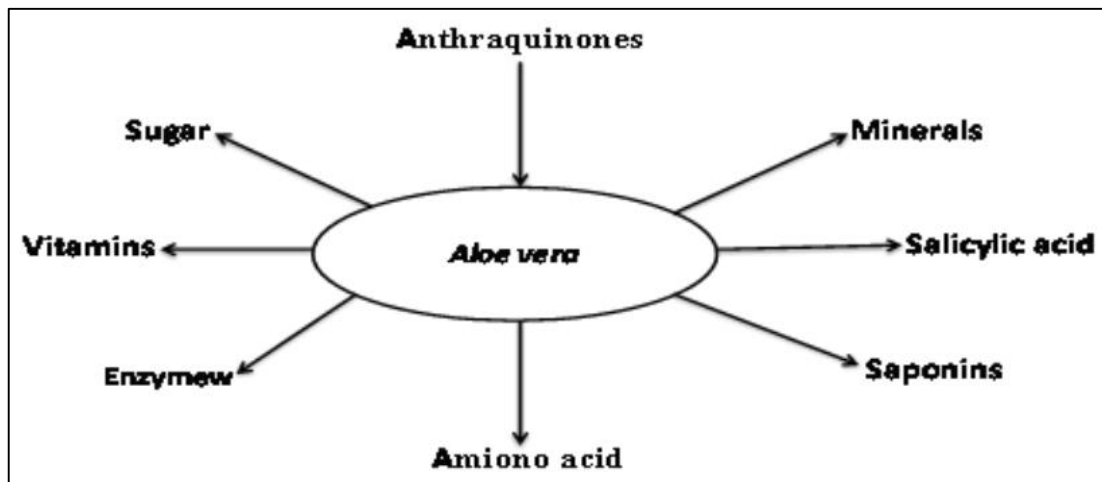


Fig 1: Components of *Aloe vera* (Mahor and Ali, 2016) [7]

Table 1: Summary of the chemical composition of A. Vera leaf pulp and exudates

Chemical Group	Constituents	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
Enzymes	Anthranol,barbaloin, chrysophanic acid, ethereal oil, ester of cinnamonic acid, isobarbaloin, resistannol	Antifungal & antiviral activity but toxic at high concentrations
Anthraquinones	Provides aloe emodin, aloe tic acid, alovin, Anthracine	Analgesic, Antibacterial
Steroids	Cholesterol, lupeol, camp sterol, sistosterol	Anti-inflammatory agents, lupeol has anticancer, antiseptic and analgesic Properties.
Hormones	Auxins and gibberellins	Wound healing and anti-inflammatory
Salicylic Acid	Aspirin like compounds	Analgesic
Saponins	Glycosides	Cleansing & antiseptic
Minerals	Calcium,chromium, copper, iron, manganese, potassium, sodium and zinc	Essential for good health
Sugars	Monosaccharide`s: Glucose and Fructose Polysaccharides: Glucomannans/polymnose	Sugars Monosaccharide`s: Glucose and Fructose Polysaccharides: Glucomannans/polym
Vitamins	A, B, C, E, choline, B12, folic acid	Antioxidant (A,C,E), neutralizes free radicals

(Hamman, 2008) [5].

**Value added food and beverages**

*Aloe barbadensis* miller is the group used for the preparation of several food products. *Aloe vera* leaf contains 95% of water, 75 nutrients, 200 active compounds, 20 minerals, 18 amino acids, 12 vitamins, and 92 enzymes. Barbaloin and homonataloin are the metabolites responsible for the purgative properties of aloe. *Aloe vera* leaf is processed by boiling, pasteurization, and cold processing. Cold processing preserves the enzyme activity and locks the nutrients better in its products. *Aloe vera* juice strengthens immune system, and also helps in digestive disorders like constipation, indigestion. It can also be used as preservative due to the presence of antioxidants. Due to its nutritional value it can be incorporated as base food products like aloe juice, aloe squash, to get nutritional food to human health.

**Bael and *Aloe vera* Blended Beverages:** Bael is the amazing health benefits, medicinal benefits, ritual use and home remedy. It is a best home remedy which helps to combat with

various daily life health problems like constipation, peptic ulcer, indigestion, respiratory problems, diarrhea, dysentery, piles, diabetes, sexual dysfunctions and so many. Wood apple provides immunity to fight with various infections like bacterial, viral, fungal, daily consumption of the bael helps in treating common digestive problems such as diarrhoea, constipation, cholera, haemorrhoids (piles), and many more due to its availability of tannin. Some aloe products are made from the whole crushed leaf, so they contain both gel and latex. Aloe seems to be able to speed wound healing by improving blood circulation through the area and preventing cell death around a wound. It also appears that aloe gel has properties that are harmful to certain types of bacteria and fungi. *Aloe vera* also contain high amount of nutritive value. When bael incorporated with *Aloe vera* juice its nutritive value is increase which is very use full for the health point of view, this mixture in the daily diet to prevent heart related diseases like heart strokes and attacks. (Mishra *et al.*, 2015) [8].

**Ready to Serve *Aloe vera* Lemon Functional Drink:** The efforts have been made to prepare functional ready-to-serve (RTS) drink made from blend of *Aloe vera* gel and lemon juice extract. The blended juices were prepared by using different proportions of *Aloe vera* and lemon juice *i.e.*, 100:0, 98:2, 96:4, 94:6 and 92:8 and 90:10 respectively. The blended therapeutic RTS drink samples were analyzed for its different physicochemical as well as sensory parameters. Sensory quality evaluated by adopting 9 point hedonic scale after 15 days interval. The developed RTS recommended for the large scale production at industrial level. This study has made to develop functional RTS using *Aloe vera* and lemon juices. Sensory quality parameters showed that *Aloe vera* gel is successfully incorporated with lemon juices in development of blended functional RTS drinks with improved taste, color, flavor and overall acceptability. The blended *Aloe vera* and lemon juice successfully stored for the period of 3 months without significant change in chemical and sensory qualities. Moreover the introduction of new types of value added and nutrient enriched therapeutic plant based beverages might improve socio economic status of the country by enhancing the export trades. *Aloe vera* juice is packed in amber colored glass bottles to avoid the effect of light on the sensitive bioactive agents. Relative humidity and temperature are two most important environmental parameters that affect product quality (Ahlawat and Khatkar, 2011) <sup>[1]</sup>.

#### **Chemical and Functional Properties of *Aloe vera***

**1. Chemical properties:** *Aloe vera* contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids. In addition, *Aloe vera* contains products of the isoprenoid pathway, such as carotenoids, steroids, terpenes, and phytosterols. Samman, and some essential amino acids non-essential amino acids and enzymes, such as bradykinase, carboxypeptidase, cyclooxygenase, and carboxypeptidase. There are over 100 active biologic constituents found within aloe. The plant is a rich source of many natural health-promoting substances including: Anthraquinones, anthrones: Aloe-emodin, aloetic-acid, anthranol, aloin A and B or collectively known as barbaloin, isobarbaloin, emodin, ester of cinnamic acid. Vitamins, Minerals: Vitamin C, A, E, B vitamins, B-carotene, Zinc, Calcium, Copper, Magnesium, Manganese, and Phosphorous. Enzymes: At least five different enzymes have been identified and likely more are contained within amino acids: Twenty-two amino acids are found within aloe. Plant sterols: plant steroids campesterol, cholesterol,  $\beta$ -sitosterol Polysaccharides: Including B1-3 and B1-4 Glucomannans known for their immune stimulating effects. Based on its constituent make up, aloe has a wide array of applications. *Aloe vera* has been one of the most important plants used in folk medicine. Anthraquinone, anthracene, cinnamic acid and anthranilic acid are found in *Aloe vera* plants that are responsible for its activity. *Aloe vera* is used in variety of skin ailments such as mild cuts, insect stings, bruises, poison ivy and eczema. It has also antibacterial and antifungal properties, used as blood purifier, anti-inflammatory, diuretic, uterine tonic, spermatogenic, laxative, and purgative and fever reliever. The anti-arthritis property of *Aloe vera* is due to the anthraquinone compound. *Aloe vera* stimulates the immune system and it is a powerful anti-inflammatory agent. Topical application of *Aloe vera* extract result in the reduction of inflammation and arthritis in adjuvant induced arthritis in one study rats. *Aloe vera* is incredible natural remedies that have

internal and external applications. There are so many active components in this plant which improves human which was known to us before thousands of years. Some benefits of *Aloe vera* will be studied in this article. *Aloe vera* also is used as an adaptogen, in helping to fight against stress.

**2. Functional properties:** *Aloe vera* leaf gel helps to improve immunity and protects heart, liver, pancreas, spleen, kidneys, brain and other vital organs of body. The whole leaf extract galvanizes the cells of immune system. The phagocytes of human body increase their scavenging activities, thus cleaning the body and giving a whole cascade of protective actions, which strengthen immunity. Acemannan is one of the polysaccharides which dramatically increase the white blood cells or macrophages cells. The most important are the long chain polysaccharides, comprising glucose and mannose, known as the glucomannans. The polysaccharides are absorbed completely and appear in the blood stream unchanged hence they act as immunomodulators. The bitter aloes consist of free anthraquinones and their derivative: barbaloin, aloemodin-9-anthrone, isobarbaloin, anthrone-Cglycosides and chromones. In large amounts these compounds exert a powerful purgative effect, but when taken in smaller amounts they appear to aid absorption from the gut, are potent antimicrobial agents and possess powerful analgesic effects. *Aloe vera* extracts when consumed (150 mg/kg and 300 mg/kg) respectively for 5 days, there was a significant increase in the total white blood cell count and macrophages with the engulfed SRBC with increase in concentration. This shows the immune modulatory property of the extract. (Sushen, *et al.*, 2013) <sup>[14]</sup>

**3. Biologically active compounds and therapeutic properties:** Bioactivity and Pharmacological Properties, Antioxidant Activity Plant-derived antioxidants for example phenolics, are known to be imperative components due to their prospective beneficial possessions. It has been reported that the reduction of cancer and cardio-vascular diseases, consumption of antioxidant rich plant food is constructive for good health. Effectively *Aloe vera* possesses many pharmacological activities including anti-inflammatory and anti tumour with the involvement of the mediation of ROS level. Some antioxidant components are present naturally in the aqueous extract of *Aloe vera* leaves which includes total phenols, flavonoids, ascorbic acid,  $\beta$ -carotene and  $\alpha$ -tocopherol. Inhibitory Activity against microorganisms numerous studies have elucidated the antagonistic activity of *Aloe vera* against fungi, virus and bacteria and it was screened against selected clinical pathogens by agar diffusion method using aqueous, ethanol and acetone extract of *Aloe vera* and showed that paramount enmity activity against bacteria and fungus was present in acetone extract. The growth of *Helicobacter pylori* is hindered by the *Aloe vera* in a dose-dependent manner. The sterol extract showed higher activity against *Streptomyces*, *Greus* and *Candida albicans* as compared to other bacteria and fungi when screened for antibacterial and antifungal activities respectively. Dried latex (*Aloe drug*) and extractives of *Aloe vera* obtained by hexane, ethyl acetate and methanol were tested to assess their activity against some pathogenic fungi, and to understand the chemical nature of the active principles present in them.

1. Anthraquinone Aloe-emodin, aloetic acid, anthranol, aloin A and B (or collectively known as barbaloin), isobarbaloin, emodin and ester of cinnamic acid.

2. Carbohydrate Pure mannan, acetylated mannan, acetylated glucomannan, glucogalactomannan, galatan, galactogalacturan, arabinogalactan, galactoglucoarabinomannan, pectic substance, xylan, cellulose, chromones, isoaloesin-D, isoarabaichromone and neoaloesin.
3. Enzymes Phosphatase, amylase, carboxypeptidase, catalase, cyclooxygenase, cyclooxygenase, lipase, oxidase, phosphoenolpyruvate carboxylase and superoxide dismutase.
4. Inorganic compounds Calcium, chlorine, chromium, copper, iron, magnesium, manganese, potassium, phosphorous, sodium and zinc.
5. Organic compounds and lipids Arachidonic acid, linolenic acid, triglycerides, triterpenoid, gibberellins, lignin, potassium sorbate, salicylic acid and uric acid.
6. Non-essential and essential amino acids Hydroxyproline, isoleucine, leucine, lysine, methionine, phenylalanine, proline, threonine, tyrosine and valine.
7. Proteins Lectins and lectin-like substance.
8. Saccharides Mannose, glucose, L-rhamnose and aldopentose.
9. Vitamins B1, B2, B6, C,  $\beta$ -carotene, choline, folic acid,  $\beta$ -carotene, choline, folic acid,  $\alpha$ -tocopherol.

### Therapeutic application of *Aloe vera*

#### 1. Wound Healing

The wound healing property of *Aloe vera* gel has been attributed to Mannose-6-phosphate used for first to second degree burns. Wound healing is a dynamic process, occurring in 3 phases. The first phase is inflammation, hyperemia and leukocyte infiltration. The second phase consists of removal of dead tissue. The third phase of proliferation consists of epithelial regeneration and formation of fibrous tissue. The Aloe administration influence collagen composition and increased collagen cross linking for wound contraction and improving breaking strength. It also increases synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound.

#### 2. Anti-Inflammatory Action

In vitro and in vivo studies of *Aloe vera* gel in experimental model shows the anti-inflammatory activity due to bradykinase activity. The peptidase bradykinase was isolated from aloe break down the bradykinin, an inflammatory substance that induces pain. A novel anti-inflammatory compound, C-glucosyl chromone, was isolated from gel extracts, (Haller *et al.*, 1990). *Aloe vera* inhibits the cyclooxygenase 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. Sitosterol,  $\beta$  The aloe sterol includes campesterol, 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.

#### Intestinal absorption

Aloe material has been used for drug absorption enhancement for drugs with low bioavailability due to extensive efflux. *Lactobacillus brevis* strains were isolated from naturally fermented *Aloe vera* gel which inhibited the growth of many harmful enteropathogens without restraining most normal

commensals in the gut and hence were named POAL (probiotics originating from *Aloe* leaf) strains; these and exhibit discriminative resistance to a wide range of antibiotics. Aloin, present in the gel, is metabolized by the colonic flora to reactive Aloe-emodin, which is responsible for the purgative activity.

**Anti-diabetic effects:** 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. *Aloe vera* gel complex reduced body weight, body fat mass, and insulin resistance in obese pre diabetes and early non-treated diabetic patients. *Aloe vera* gel 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. Dietary aloe formula also reduces obesity-induced glucose tolerance not only by suppressing inflammatory responses but also by inducing anti-inflammatory cytokines in the white adipose tissue and liver, both of which are important peripheral tissues affected by insulin resistance.

***Aloe vera* for Ear and nose infections:** Dried *Aloe vera* leaf gel powder mixed with raw turmeric juice put few drops into ear and nose 3 to 4 times a day to reduce infections.

***Aloe vera* gel:** The gel, more correctly 'mucilage' is best known for treating injuries and irritations of the skin, especially minor burns, and cuts, it is a common house plant that is often kept in kitchens as a first aid a piece of the succulent leaf can be cut off and opened and the gel applied directly to the burn or cut it should not be used on deep wounds. The ability of the herb to treat burns is very well-established in the practice of medicine and it is often used in the hospital to treat burns from radiation therapy. It can also treat some of the underlying causes of hair loss such as acne, dandruff, and seborrhea for the same reason. *Aloe vera* gel is as toothpaste cleanses the mouth and to prevent gum disease and blood sugar levels, with the potential of new treatments for diabetes.

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