Health Benefits of *Aloe vera*: A Review

**Abstract**: *Aloe vera* (Fam: Asphodelaceae), an oldest herb has been widely used in ayurvedic medicine from ancient times throughout the world. In addition to being self-resistant from diseases and insects, it can slow down various signs of aging. The demand of *Aloe vera* as a phytoneutrient has increased globally not only in cosmetology but also for preventing degenerative diseases and enhancing body’s immune system. Although *Aloe vera* industry is flourishing, users are misguided enough due to lack of extensive scientific reports regarding its proper health benefits. Present attempt is being made to focus on the importance of *Aloe vera* highlighting the bio-active compounds present in it.

**Key words**: bio-active compounds, immunomodulation, T2DM, functional food, nutraceuticals, traditional knowledge

The herbal plant *Aloe vera* has a history of traditional use. The name has been derived from Arabic word ‘Alloeh’ meaning ‘shining bitter substance’ and Latin word ‘vera’ meaning ‘true’. It is perennial, leaf-succulent, xerophyte, shrubby, pea green coloured plant needing little water for surviving; it can grow in saline soil and is resistant to insects and diseases. It can survive in hot climate but cold intolerant. It is native of South Africa and South America, but is now found worldwide including in India, the Caribbean, Iran and the Pacific Rim countries.1 Over 581 accepted species of *Aloe vera*, belong to Asphodelaceae family are grown throughout the world2 where only two species-*Aloe barbadensis* Miller and *Aloe arborescens* Miller are grown commercially3. Worldwide USA leads the market with 65%, while India and China have a share of 10% each4. As the commercial production has gained importance, *Aloe vera* can be found in a variety of products such as in hand and body lotion, pure *Aloe vera* juice, face sheet mask, face gel, night cream, sunscreen lotion, medicated jelly, pills, sprays, ointments and moisturizer5. Although different parts of *Aloe vera* have been used as a medicine for time immemorial, in the recent past the popularity of *Aloe vera* has increased as a health promoting substance. In this backdrop, an attempt has been made to put together available information from existing scientific literatures as available in Google Scholar, ResearchGate and PubMed, regarding the active components of *Aloe vera* and its possible health benefits.

**Findings**: **History**: It has been found that *Aloe vera* is one of the oldest mentioned plants on record. About 6000 years ago, the first known report is found on the *Aloe vera* juice in ancient Egypt. *Aloe* was known as the ‘Plant of Eternity’. The laxative, anti-inflammatory and pain soothing effect of *Aloe vera* were documented in the ‘Papyrus Eber’ of 1550 BC. About 2000 years ago, the Greek scientists regarded *Aloe vera* as the ‘Universal Panacea’. In China, the treatment book of Shi-Shen described it as the ‘Method of Harmony’. In Japan, it was known as the ‘Royal Plant’. In Sanskrit, *Aloe vera* was known as ‘Ghrita-Kumari’. Kumari means young girl and it has been believed that the plant has the rejuvenating effect and helps in keeping the skin young. Among very few plants, *Aloe vera* was described to possess the qualities to maintain balance between pitta (elements of space and air), kapha (elements of water and fire) and vata (elements of water and earth). In Indian ayurvedic medicine, *Aloe vera* was applied for menstrual problems and to maintain cardiovascular system. The diluted *Aloe vera* juice was known to act as an insect repellent6.

**Description**: An *Aloe vera* plant matures within 3-4 years with a life span about 12 years and can grow a height of about 72-90 cm and about 12 cm wide with up to 21 leaves, which are fleshy, triangular and have spikes at the edges1. A new plant can be harvested by planting about 3-4 leaves from a mature plant after 6-8 weeks3.

**Composition**: Although the composition of a plant depends upon geographical conditions, climate, type of variety and like, it has been found that *Aloe vera* plant contains more than 200 different biologically active components in its various parts such as leaf, root and flower.

1. **The leaf**: Each leaf consists of three layers as presented in Table 1.
Table 1.

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Leaf layer details</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Inner leaf pulp; also known as Aloe vera gel</td>
<td>99% water, and residual mass#</td>
</tr>
<tr>
<td>2.</td>
<td>Middle layer latex; also known as aloe juice; it is yellow sap bitter in taste</td>
<td>Glycosylated anthrone upto 35% aloin A and aloin B (also known as barbaloin), glycosylated chromones, aloesin and aloeresin, aloe emodin, glycosylated anthraquinones, pre-anthraquinones, coumarins, ßavonoids and pyrones8^</td>
</tr>
<tr>
<td>3.</td>
<td>Outer thick layer known as rind</td>
<td>Anthraquinones, pre-anthraquinones, and their glycosides</td>
</tr>
</tbody>
</table>

# the residual dry mass contents have been presented in Table 2
^ the structures have been presented in Figure 1

Table 2: Composition of Aloe vera Gel (inner leaf pulp)7

<table>
<thead>
<tr>
<th>Components</th>
<th>% of residual dry mass</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude fibres</td>
<td>35.5</td>
<td>Polysaccharides like glucomannan, acemannan, pectin, cellulose, hemicellulose</td>
</tr>
<tr>
<td>Soluble saccharides</td>
<td>26.8</td>
<td>Monosaccharides like glucose, galactose, mannose, xylose, arabinose, rhamnose</td>
</tr>
<tr>
<td>Minerals</td>
<td>23.6</td>
<td>Magnesium, zinc, calcium, chromium, iron, copper</td>
</tr>
<tr>
<td>Proteins</td>
<td>8.9</td>
<td>Amino acids</td>
</tr>
<tr>
<td>Lipids</td>
<td>5.1</td>
<td>Lupeol, plant sterols, gamma linolenic acid (GLA)</td>
</tr>
<tr>
<td>Others</td>
<td>&lt;1</td>
<td>Vitamin A, C, E, B1, B2, B3, B5, choline, salicylic acid, saponin, carboxypeptidase, coumarin</td>
</tr>
</tbody>
</table>

II. The root: Aloe vera root can reach about 30-40 cm in length and contains some phenolic compounds such as naphthoquinones and free anthraquinones like aloe emodin9.

III. The flower: The Aloe vera flower, yellow in colour, is now used for various therapeutic purposes because of the presence of several phenolic compounds such as caffeic acid, chlorogenic acid, and ferulic acid10.

Health benefits: It has been observed that Aloe vera can support wound healing, act as an antiseptic, laxative, support immune system, reduce inflammation, stress, cancer, diabetes and cardiovascular diseases (CVDs).

1. Wound healing property: The process of wound healing has following three phases
   i. inflammation, hyperaemia and leukocyte infiltration,
   ii. removal of dead tissue,
   iii. proliferation i.e. epithelial regeneration and formation of fibrous tissue11.

Aloe vera containing a mannose rich polysaccharide glucomannan and a plant growth hormone gibberellin, stimulate the activity and also proliferation of growth factor receptors present in fibroblast ultimately resulting in collagen synthesis3. Aloe vera does not only increase collagen synthesis on the wounded site but also alter collagen composition and increase transversal connections among the bands and in the process accelerate wound healing12. Aloe vera also facilitates synthesis of hyaluronic acid and dermatan sulphate in the granulation tissues at the time of wound healing.

2. Anti-inflammatory property: Several sterols that is cyclopentanoperhydrophenanthrene ring containing compound with alcoholic -OH group like lupeol (the most active anti-inflammatory of the sterols present capable of reducing inflammation by about one-third), campesterol, ß-sitosterol are present in Aloe vera13. In addition to the sterols, other anti-inflammatory substances present in Aloe vera gel are C-glucosyl chromone.

Figure 1: Structures of different bio active compounds present in Aloe Vera
and a compound structurally resembling aspirin-salicylic acid.

3. Antiseptic property: Due to the presence of six antiseptic agents such as lupeol, salicylic acid, urea nitrogen, cinnamic acid, phenols and sulfur, Aloe vera acts as an anti-microbial agent and can inhibit the growth of bacteria, virus and fungi. Saponin substances present in Aloe vera have a cleansing effect, also act as antiseptic, capable of inhibiting the growth of micro-organisms including yeasts.

3.1. Antibacterial activities: Acemannan present in Aloe vera inhibits the growth of Pseudomonas aeruginosa bacteria and also prevents it from adhering to human lung epithelial cells. Aloe vera extract is also very potent against the strains of Mycobacterium such as M. fortuitum, M. smegmatis, M. kansasii and M. tuberculosis as well as against P. aeruginosa, E. coli, S. aureus and S. typhi. Also, due to the presence of terpenoids, flavonoids and tannins, Aloe vera can act as a strong bactericidal agent. Aloe vera gel is potent against Streptococcus pyogenes and Streptococcus faecalis bacteria.

3.2. Antiviral activities: A component of Aloe vera, acemannan acts either alone or synergistically with acyclovir and azidothymidine (AZT) to inhibit the growth of Herpes simplex and HIV. Lectins present in Aloe vera gel, inhibit the growth of cytomegalovirus in cell culture by interfering with protein synthesis. A purified sample of aloe emodin and anthraquinone aloin can inhibit the growth of various viruses including Herpes simplex (type I and type II), Influenza, and Varicella zoster virus.

3.3. Antifungal activities: Aloe vera pulp and Aloe vera liquid are capable of inhibiting the growth of fungi such as Fusarium oxysporum and Aloe vera in liquid form is also capable of inhibiting the growth of Rhizoctonia solani and Colletotrichum coccodes. About 70% growth reduction in respect of infected pig feet with Trichophyton mentagrophytes has been reported on administration of Aloe vera in gel form. Aloe vera leaf can inhibit the growth of Pseudomonas aeruginosa and Candida albicans.

4. Laxative property: Aloe vera latex is known for its laxative properties. Anthraquinones present in aloe latex are known as potent laxative for stimulating mucous secretion, intestinal peristalsis and increasing water retention in intestine. After oral administration, barbaloin present in Aloe vera, does not absorb in the upper intestine, get hydrolysed in the colon by intestinal bacteria to active metabolites such as aloe emodin-9-anthrone, a potent G.I. tract stimulant. The laxative effect is generally observed after 6-24 hours of oral administration. The anthraquinones have a great water holding capacity, increase gastro-intestinal motility and thus reduce the faecal transit time.

5. Immunomodulatory property: Aloe vera gel polysaccharides can boost up the immune system by enhancing the work of the macrophages in the intestine and increase the activity of T-Lymphocytes by up to 50% to penetrate bacteria, viruses, tumour cells and various pathogens. Alprogen present in Aloe vera, can inhibit calcium influx into the mast cells and thus also inhibiting antigen-antibody mediated release of histamine and leukotriene from mast cells. It has been reported that, HIV-infected patients improved their symptoms by consuming 800 mg acemannan per day which increases the number of circulating monocytes and macrophages in the blood. Several other low molecular weight substances are capable of scavenging free radicals from activated human neutrophil cells.

6. Antistress property: Now-a-days, almost everyone experiences stress in their life due to rapid biochemical and physiological changes within the body which can make individuals susceptible to diseases and cause organ dysfunction. Aloe vera in juice form can help maintain normal body functioning by reducing cell damaging process during stress, minimising the biochemical and physiological changes within body. Aloe vera, as a functional food which refers to foods that offer health benefits beyond nutritional value, plays a significant role in reducing oxidative stress. To cope with pollution and junk food induced stress, it is suggested to detoxify the body from time to time and in this regard Aloe vera in juice form can act as a natural detoxifying agent that is also rich in micro nutrients.

7. Antidiabetic property: It has been reported, following a study carried out in mice model that
phytosterols present in *Aloe vera* like lophenol, 24-methyl-lophenol, 24-ethyl-lophenol, cycloartenol and 24-methylenecycloartenol have beneficial effects in T2DM. It has also been indicated that oral administration of *Aloe vera* gel in streptozotocin-induced diabetic rats can reduce fasting blood sugar (FBS) as well as increase plasma insulin level. If administered for a period of 4-14 weeks, *Aloe vera* latex has shown hypoglycemic effects, possibly because of the presence of some polysaccharides in it. Hence *Aloe vera* can serve as a cost-effective ingredient in formulations specially for the economically weaker population in less developed countries like India, recipient of dubious distinction of being the diabetic capital of the world.

8. **Anticancer property:** The role of *Aloe vera* in cancer prevention has yet not been well evaluated. It has been shown that *Aloe vera* juice enables healing power of body and prevents cancer as well as prevents the damage of healthy immune cells by chemotherapy and radiations during cancer recovery. Emodin present in *Aloe vera* has the ability to suppress or inhibit the growth of malignant cancer cells. *Aloe vera* tincture and melatonin administration has a positive effect against metastatic solid tumours. Acemannan in *Aloe vera* has an anticancer and immune stimulation effect. The compounds present in *Aloe vera* have been used as an immune stimulating agent in cats and dogs to prevent cancer. It has been shown that a polysaccharide fraction present in *Aloe vera* inhibit the binding of benzopyrene to primary rat hepatocytes and thereby prevent the formation of benzopyrene-DNA adducts, a pro-carcinogen.

9. **Anti-cardiovascular disease property:** It has been reported that if *Aloe vera* gel, as alcohol insoluble residue extract, could be administered in streptozotocin-induced diabetic rats, it can reduce the levels of total cholesterol (TC), triglycerides (TG), free fatty acids (FFA) and phospholipids in blood as well as maintain plasma levels of HDL and LDL cholesterols. It has also been indicated that albino laboratory rats fed with high cholesterol diet with glucomannan from *Aloe vera* have decreased levels of TC, TG, phospholipids and non-esterified fatty acid as well as increased levels of HDL and HDL-TC ratio. Hence, *Aloe vera* in gel form can have positive impact on lipid metabolism and can be an effective active ingredient for the people who are at risk of coronary heart diseases. *Aloe vera* extracts can increase unsaturated fatty acids in blood that can scavenge free radicals from the body.

**Discussion:** It is now common to attempt preventing diseases and achieve a healthy life making use of traditional knowledge. Various strategies like dietary habit, exercise and supplements have been adopted to prevent the onset of degenerative diseases and reduction of the degree of suffering from them. As *Aloe vera* in use for the last 6000 years throughout the world for its medicinal value and also it can reduce the extent of adverse impacts in diseases such as T2DM, CVDs and different forms of cancer mainly through its antioxidant, free radical scavenging and detoxifying actions, it may be coupled with other strategies. US-FDA has permitted *Aloe vera* in the treatment of cancer and AIDS. It can be used in treating wound healing, inflammation, constipation and stress. It can also be used as an antiseptic agent due to bactericidal, virucidal and anti-fungal activity. Due to its nutraceutical activity, *Aloe vera* is gaining popularity worldwide. Several phytochemicals present in *Aloe vera* have the power to improve human health. Moreover, *Aloe vera* has been reported to be effective against indoor air pollution which results from several SHE factors and HFE issues including improper ventilation and poor design of kitchen at home because of its capacity to remove benzene, formaldehyde and like. Now, *Aloe vera* is also fortified in various food products such as ice-cream, curd, lassi, jam, jelly, fruit juice, candy, chocolate and desserts.

**Conclusion:** It may be concluded that *Aloe vera* plant is having numerous health benefits and no major adverse effect has been reported yet. But needless to mention that there is huge scope for further research.

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