



Aloe vera Mill: Its Ethnobotany, Nutrients and Pharmacological Profile

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ABSTRACT

Aloe vera Mill., (locally known as Ghrito kumari in Sanskrit) is a member of the lily family, it's the most impressive medicinal herb invented by nature, Aloe Vera has fast become one of the most commonly used plants in herbal cosmetics and medicines. Whether its creams, gels, lotions, shower gels or just plain Aloe Vera juice, it has become a subject of interest because of its beneficial effects on human health. Aloe Vera did not prove to have much official standings for a long time, people are now realising its importance in many medical sectors. Aloe Vera gel is widely used for skin treatments such as burns or bruises. Additionally, Aloe Vera plants are used in many cosmetic materials and are also consumed as a health drink. But since researchers are still finding more benefits and it has been so far restricted only traditionally system of medicine.

Keywords: Pharmacological properties; phytocomponents; Nutritional: review clinical effectiveness.

INTRODUCTION

The incredible Aloe Vera needs no introduction. Its benefits are well-known, which is why it has earned a permanent place in many a household.

Be it a sunburn or a bad case of acne, aloe vera is a treatment you can always rely on. But, did you know that the humble aloe vera has so much more to offer.

Aloe vera is one of the oldest known medicinal plants gifted by nature, Aloe vera often called Miracle plant known by many names, there are over 250 types of aloe vera of these only 4 or 5 are commonly used in medicines.¹

Aloe Vera is really quite an incredible plant known for 5000 years and used therapeutically.

It is a succulent plant and parts of the lily family (Liliaceous), the same family that garlic and onions belong to.

Different parts of the plant are used for different effects on the body and Aloe Vera has both internal and external applications.

It is good to drink Aloe Vera juice (the inner gel of the aloe plant) almost aloin free and even add it to smoothies to gain some of the benefits of this incredible plant.

Aloe Vera contains over 200 active components including vitamins, minerals, amino acids, enzymes, polysaccharide, and fatty acids-no wonder it's used for such a wide range of remedies.

The bulk of the Aloe Vera leaf is filled with a clear gel-like substance, which is approximately 99% water.

It acts as a natural fighter against all sorts of infection, an efficient anti-oxidant, helps in treating all digestion related problems, heartburn, arthritis, stress, diabetes,

rheumatism pain, asthma, cancer, AIDS.² It also acts as a laxative, beauty enhancer and studies have shown that it has an effect on lowering blood sugar levels in diabetics.



Figure 1: Aloe Vera

Kingdom : Plantae

Order : Asparagales

Family : Xanthorrhoeaceae

Genus : Aloe

Species : *A. vera*

Binomial name : *Aloe vera* (M.)

Vernacular Names

Assamese : Musabhar, Machamber

Bengali : Ghritakalmi, Ghit-Kumari, Musabhar, Kanya

English : India aloe, Small aloe

Gujrat : Eliyo, Eariy, Kunvar, Kumarpathy, Nahani Kanvar, Kamrapathu

Hindi	: Musabhar, Elva, Ghee-kanvar, Kumari, Chhota kanvar
Kannada	: Karilola, Lobasara, Satra, Boralsara Molisara, Kolesara, Kolasoere
Malayalam	: Chenninayakam, Kattavaza Kumari, Kattavala
Marathi	: Korphad, Korkand
Oriya	: Mushaboro, Kumari
Punjabi	: Kalasohaga, Mussubar, Alua
Elva Sanskrit	: Kumarirasambhava, Sahasara, Ghritra Kumari Kanya
Tamil	: Kattalai, Sotthukkatal Bhattu-Katrazhae, Kottaalai Chirkuttali
Telugu	: Musambaramu, Kalabanda
Urdu	: Musabbar, Ailva, Sibr, Ghikwar.

Physical Profile

Aloe vera is a stem less or very short-stemmed plant growing to 60– 100 cm height, spreading by offsets. Mature plants can be grown as tall as four feet with average height around 2628 inches. Each plant has 12 to 16 leaves usually and weighs up to 2-3 kg on maturity. The plants can be harvested after every 6 to 8 weeks by removing 3-4 leaves per plant. It produces erect unbranched flowering stalks in the second year in winter season, which grows 90-150 cm tall. It bears bright yellow and orange flowers, which are arranged in auxiliary spike. It bears thick fleshy leaves in rosette, which gives it a distinct appearance.³ The leaves are green to grey-green, with some varieties showing white flecks on the upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth.

The flowers are produced in summer on a spike up to 90 cm height, each flower pendulous, with a yellow tubular corolla 2–3 cm long. Like other *Aloe* species, *Aloe vera* forms arbuscular mycorrhiza, a symbiosis that allows better access of the plant to mineral nutrients in soil. The leaves hold a gooey translucent gel, also extremely bitter, and known all over the world for its unbelievable healing properties. This translucent gel is made up of around 96% water, some organic and inorganic compounds, a type of protein which contains 18 of the 20 amino acids found in the body and lastly, Vitamin A, B, C and E. Another part of the aloe vera plant which is used is the 'sap', a yellow-coloured liquid stuck to the skin of the plant from the inside.⁴

When dried and purified, the powdered aloe is often used as a laxative, though its effectiveness is questionable. One of the most crucial elements found in aloe vera gel is a complex carbohydrate known as acemannan. It allows nutrients to reach the cells, nourish them and at the same time relieve them of toxins. Ayurveda, Chinese herbal medicine and British herbal medicine have all advocated

aloe vera as a healer, when applied or consumed orally. Let's go over some of its most prominent benefits.

The bulk of the Aloe Vera leaf is filled with a clear gel-like substance, which is approximately 99% water, the remaining 0.5-1.0% solid material is reported to contain over 75 different potentially active compounds including water- and fat-soluble vitamins, minerals, enzymes, simple/complex polysaccharides, phenolic compounds, and organic acids. In compositional studies on the structural components of the A. Vera plant leaf portions, the rind was found to be 20-30% and the pulp 70-80% of the whole leaf weight. On a dry weight basis, the percentages of the rind and pulp represented as lipids (2.7% and 4.2%) and that as proteins (6.3% and 7.3%) only accounted for a minor fraction.⁵

Taxonomy and Etymology

The species has a number of synonyms: *A. barbadensis* Mill., *Aloe indica* Royle, *Aloe perfoliata* L. var. *vera* and *A. vulgaris* Lam. Common names include Chinese Aloe, Indian Aloe, True Aloe, Barbados Aloe, Burn Aloe, First Aid Plant. The species epithet *vera* means "true" or "genuine". Some literature identifies the white-spotted form of *Aloe vera* as *Aloe vera* var. *chinensis*; however, the species varies widely with regard to leaf spots and it has been suggested that the spotted form of *Aloe vera* may be conspecific with *A. massawana*. The species was first described by Carl Linnaeus in 1753 as *Aloe perfoliata* var. *vera*, and was described again in 1768 by Nicolaas Laurens Burman as *Aloe vera* in *Flora Indica* on 6 April and by Philip Miller as *Aloe barbadensis* some ten days after Burman in the *Gardener's Dictionary*.⁶

Techniques based on DNA comparison suggest *Aloe vera* is relatively closely related to *Aloe perryi*, a species endemic to Yemen.⁷ Similar techniques, using chloroplast DNA sequence comparison and ISSR profiling have also suggested it is closely related to *Aloe forbesii*, *Aloe inermis*, *Aloe scobinifolia*, *Aloe sinkatana*, and *Aloe striata*. With the exception of the South African species *A. striata*, these *Aloe* species are native to Socotra (Yemen), Somalia, and Sudan. The lack of obvious natural populations of the species has led some authors to suggest *Aloe vera* may be of hybrid origin.

Plantations/Cultivation

The Aloe plant is cultivated in many areas of the world and in climates which are hot and dry. Plantations exist in Africa, Australia, Central America, Mexico, Russia, Japan, and in southern Europe, especially in Spain. Some plantations have been started in Italy, but they are still small and few. Unlike most of the African, South American, and Asian countries, Spain, as part of the European Community, is obliged to follow stringent quality control and production procedures according to European Economic Community standards. Therefore, whatever is declared as organically produced is guaranteed by state certification. This certification

process assures that Aloe comes from cultivations which are not physically and chemically exploited.⁸

Chemical Constituents of Aloe Leaf

Carbohydrate Fraction

The aloe vera gel fraction contains complex polysaccharides like polyhexoses and certain other minor carbohydrates like hexans, xylose, mannose, arabinose, galactose, and glucose. Several pectic polysaccharides are rich in hexuronic acid like glucuronic, mannuronic, and galacturonic acid which upon hydrolysis give glucose, mannose, and traces of galactose, arabinose and xylose. The major polysaccharide is acetylated glucomanan - acemanan having ratio of mannose:glucose as 15:1 approximately⁹. Acemanan(core of juice) is the major therapeutically active in *aloe vera* gel. It has molecular weight of approximately 10⁵ daltons. Only products containing acemanan or 1-4 acetylated glucomanans can be accurately labelled as *aloe vera*. The glucomanan is highly acetylated the degree of acetyl substitution is greater than 0.7 per sugar residue. Some sugar residues in glucomanan doubly or even triply substituted. Making them strongly hydrophobic in a normally hydrophilic polysaccharide.¹⁰

Alkaloids

A few alkaloids have been reported to be found in *aloe vera*. A distillation extract of aloe vera gives Dragendroff's a positive reaction.¹¹

Chromones

Chromones are leaf exudates compounds predominantly exist in pericyclic cells underneath the leaf skin. Chromones are ignored as impurities due to their colour and GI irritation. Chromones are derivatives of 8-Cglucosyl-7 hydroxy-5 methyl 2-propyl-4-chromone. Substituted acyl groups are coumaroyl, cinnamoyl, caffeoyl, feruloyl and tiglyl. Variation in chromones arises due to degree of oxidation in propyl side chain and methylation of -OH groups in C7 side chain and esterification of glucose moiety. Aloesin is regarded as the parent compound aloe chromones. Aloe chromones reveal hundreds of structures with anti-inflammatory, anti-ulcer tyrosine kinase inhibition. Skin protection, laxative effect. Some chromones present in *aloe vera* and *aloe nobilis* have been found to act as B secretase inhibitor (BACE 1). It is the valuable target for treatment of Alzheimer disease.¹²

Anthraquinone Glycosides

Fresh leaf is cut open from the base is composed of number of anthraquinone glycosides. These are low molecular weight and hydrophobic in nature. These compounds are linked together act synergistically as a group. The principle one is barbaloin (aloe emodinanthrone C10 glycoside). It is a drastic purgative. This effect of aloin would be due to its biotransformation in the gut to aloe emodin (1, 8-dihydroxy-3-

(hydroxymethyl)-9, 10-anthracenedione according to some authors.¹³

Free anthraquinones and anthrones are present in aloe species and a major component is found in roots and subterranean stem. Anthraquinone Helminthosporin is found in roots of aloe. Aloesaponarin II is an isomer of chrysophanol where position of groups on carbon atoms 1 and 3 are reversed is present in aloe saponaria. 6-hydroxy derivative, deoxyerythrolaccin is also found in aloe saponaria. Chrysophanolanthrone is present in aloe flowers. Anthrone -O-glycosides are not often reported as aloe constituents. Few O glycosides found are aloe-emodin-o-galactoside, aloe-emodin-11O-rhamnoside. 7-O glucosylnataloe - emodin and 11-O- rhamnosyl aloe emodin.¹⁴

Phytosterols

The most common representatives are sitosterol, stigmasterol and campesterol (4-desmethyl sterol). A major function of phytosterols in diet is the inhibition of absorption and subsequent compensatory stimulation of the synthesis of cholesterol. They are generally regarded as a kind of functional factor which could lower serum cholesterol and LDL-C level. Among different kinds of phytosterols, β -sitosterol has the most powerful serum cholesterol-lowering effect.^{14,15}

Lectins

Presence of a lectin like substance in aloe was first reported in 1978. Lectins are characterized by their cell agglutinating activities (hemoagglutinating activities.) Lectins bear at least two sugar binding sites precipitate polysaccharides, glycoproteins and glycol lipids. Lectins are mainly useful for studying cell surface chemical structures and malignant changes in cells. Aloctin A and Aloctin B are lectins purified from *Aarborescens* one of the most studied lectin in aloe.¹⁵

Aloctin A has hemagglutinating and mitogenic ac. Aloctin A is activities of acidic precipitate of aloe extracts. Aloctin B is a fraction with hemagglutinating activity of acidic supernatant of aloe extracts.

Other Components

The leaf gel consists of saponins, tannins, cardiotoxic glycosides, terpenoids (limonene, myrecene), isoprenoids, polyphenols, salicylic acid, sulphur derivatives, organic acids like succinic, malic, lactic and p coumaric acid, aloctin, magnesium lactate, biological growth factors like auxins and gibberilins.

Amino acids present are lysine, histidine, arginine, aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, valine, methionine, isoleucine, leucine, tyrosine, and phenylalanine.¹⁶

Vitamins present are Vitamin A, B1, B2, B4, B6 and B12. Isoenzyme such as superoxide dismutase is present in inner gel and in the outer aloe leaf skin.

Lignin

This cellulose substance is found in the gel has no known medical properties except it possesses the property of penetrating the human skin.

Saponins

These form soapy lathers when mixed and agitated with water. They have been used in detergents, foaming agents and contain antiseptic properties.

Anthraquinones

There are 12 of these contained in the sap of Aloe Vera: Aloin, Isobarbaloin, Anthracene, Emodin, Ester of Cinnamonic acid, Chrysophanic acid, Barbaloin, Anthranol, Aloetic acid, Aloe Emodin, Ethereal oil and Resistannol. These act as natural laxatives, painkillers and analgesics, and they contain powerful antibacterial, antifungal and virucidal properties.

Minerals

Aloe Vera contains the following minerals: Calcium: (essential for proper bone and teeth density). Manganese: (a component of enzymes necessary for the activation of other enzymes). Sodium: (ensures that the body fluids do not become too acidic or too alkaline). Copper: (enables iron to work as oxygen carriers in the red blood cells).

Magnesium: (used by nerves and muscle membranes to help conduct electrical impulses). Potassium: (regulates the acidic or alkaline levels of body fluid). Zinc: (contributes to the metabolism of proteins, carbohydrates and fats), Chromium: (necessary for the proper function of insulin, which in turn controls the sugar levels in the blood). Iron: (controls the transportation of oxygen around the body via the red blood cells).¹⁷

The percentage of minerals in aloe vera show in table 1.

Table 1: Percentage of Minerals in Aloe Vera

S. No.	Minerals	Aloe Vera (Whole Leaf)
1	Calcium	3.58
2	Magnesium	1.22
3	Sodium	3.66
4	Potassium	4.06
5	Phosphorous	0.02
6	Iron	0.1
7	Copper	0.06
8	Zinc	0.02

Vitamins

Aloe Vera contains numerous vitamins: Vitamins A, C, & E (crucial antioxidants that combat dangerous free radicals in the body). Vitamin B & Choline (concerned with the production of energy, amino acid metabolism and

developing muscle mass). Vitamin B12 (responsible for the production of red blood cells) and Folic acid (helps develop new blood cells).

Amino Acids

Amino Acids are the building blocks of protein, which manufacture and repair muscle tissue. The human body requires 22 amino acids and needs 8 essential ones.

Aloe Vera provides 20 of 22 required amino acids and 7 of 8 essential ones. These amino acids are Table 2.

Table 2: Amount of amino acids in aloe vera gel [18]

S. No	Amino acid	Aloe vera (whole leave)
1	Glutamic acid	4.7
2	Asparagines	3.29
3	Aspartic acid	1.75
4	Serine	1.27
5	Glycine	0.95
6	Alanine	0.91
7	glutamine	0.83
8	Valine	0.36
9	Threonine	0.33
10	Proine	0.25
11	Lysine	0.18
12	Arginine	0.12
13	Leucine	0.09
14	Phenylalanine	0.08
15	Isoleucine	0.07
16	Tyrosine	0.06
17	Cystine	0.04
18	Histidine	0.03
19	Methionine	0.02
20	Tryptophane	0
21	Total concentration (nMol/mg dry mass)	15.33

Sugars

Aloe Vera contains both monosaccharide, such as glucose and fructose, and polysaccharides. Polysaccharides are the most important types of sugars. They aid in proper digestion, maintain cholesterol levels, improve liver functions and promote the strengthening of bones.

Sterols

Sterols are important anti-inflammatory agents. The ones found in Aloe Vera are: Cholesterol, Sitosterol, Campesterol and Lupeol. These sterols contain antiseptic and analgesic properties. They also have pain killing properties similar to aspirin.

Enzyme

Enzymes are natural protein molecules with highly specialized catalytic functions in biochemical reactions produced by all living organisms (microorganisms, plants, animals, and human beings). Although like all other proteins, enzymes are composed of amino acids, they differ in function in that they have the unique ability to facilitate biochemical reactions without undergoing change themselves.¹⁹ Some of the most important enzymes in Aloe Vera are: Peroxidase, Aliase, Catalase, Lipase, Cellulose, Carboxypeptidase, Amylase and Alkaline Phosphates.

Pharmacological Profile

Laxative Effect

Aloe is the most potent laxative drug among anthraquinone drugs (cascara, frangula, senna and rhubarb). Aloe latex possesses laxative properties and is used traditionally to treat constipation. The anthraquinone glycoside Barbaloin acts as a prodrug chemically stable at stomach pH and sugar moiety of glycoside prevents their absorption into upper part of GI tract and after reaching the large intestine glycosides liberate aglycones aloe emodin, rheinmodin and chrysophanol which acts as laxative. Bacterial glycosidases present in colon cleave the C Glycoside bond of glycosides. Their transformations into active aglycones is carried out by *eubacterium* species. Bioavailability of aloe emodin is only less than 10% and half-life is 4850 hours. Taken in doses of 0.25mg laxative action of aloe starts after 6 to 12 hours with loose bowel moment.²⁰

Wound Healing Property

Wound healing progresses through various stages involving different primary growth factors, inflammatory reactants and proliferating cells. *Aloe Vera* acts as both inhibitor and stimulant. It blocks mediators of inflammation in the immune system. It stimulates antibody production and wound healing by growth factor like substances. The molecules present in gel can stimulate fibroblasts, increase collagen and proteoglycan production Increase wound tensile strength while inhibiting inflammation and moderators of pain. Sterols including campesterol B sitosterol and lupeol are believed to have anti-inflammatory properties that aid in the coordination of wound healing activities.²¹

Anti-inflammatory Property

Aloe acts as a thromboxane A2 synthetize inhibitor prevents its production, dilates arteries and enhances local blood flow. Aloe gel can block vasoactive substances responsible for inflammation can constrict small blood vessels, can block PMN (Polymorphonuclear leucocyte) infiltration. Can inhibit production of oxygen free radicals and can dilate the capillaries allowing for increase in blood supply to damaged tissue. Emolin, barbaloin and emodin can be broken down by Kolbe reaction into salicylates.²² Aloe gel contains an abundance of fatty

acids that allow for competitive inhibition of thromboxane production.

Immunomodulatory Action

Aloe gel directly stimulates immune system through its active ingredient acemannan. It increases lympholytic response to alloantigen, it activates macrophages and activates complement C3. Modified aloe polysaccharide prevents UV irradiation induced immune suppression and inhibits UV irradiation induced tumour necrosis factor release from human epidermoid carcinoma cells.

Antibacterial Activity

Acemannan present in aloe gel has been shown to have antibacterial activity against streptococcus species *enterobactercloaceae*, *citrobacter* species, *seratiamarcescens*, *klebsiella pneumonia*, *pseudomonas aeruginosa* *staphylococcus aureus*. Anthrones in *aloe vera* are used as antipsoriatic agents. The antipsoriatic property of anthrones is due to inhibition of oxygen consumption of the cells, reduction in size of intracellular species and decrease in ribosomes and mitochondria interaction with DNA inhibition of various enzyme systems associated with cell proliferation and inflammation and a redox reaction resulting in mitochondrial damage and destruction of membrane lipids.²³

Antidiabetic Activity

It has been reported by Bunyraphatsara and Yogchaiyudha on administration of aloe gel in diabetic patient's blood glucose level reduced from 250 mg to 141 mg and also reduced were serum triglyceride levels. Effect of aloe gel in combination with glibenclamide showed similar decrease in blood glucose level and serum triglyceride levels.²⁴

Antihyperlipidemic Activity

In hyperlipidemic patients who had not responded to dietary interventions 10 ml of gel was administered to hyperlipidemic patient's serum cholesterol levels were observed after 4, 8 and 12 weeks' total cholesterol was decreased by 15.4%, triglycerides by 25.2% and LDL by 18.9 %.

Anti-cancer Activity

The polysaccharide acemannan is found to be effective in treatment of fibrosarcoma in dogs, cats and mice and increased survival rates. The anti-tumour effect of acemannan may be due to stimulation of production of tumor necrosis factor, interleukin1 and interferon by macrophages. *Aloe Vera* in combination with squalene and vitamin A and E has been demonstrated to have chemo protective properties in prevention and treatment of mouse skin tumors. A recent clinical study has shown that concomitant administration of aloe and melatonin increase therapeutic results of breast cancer gastrointestinal cancer, brain glioblastoma as it increases interleukin 2 activity. It has also been demonstrated that



aloe latex enhances the activity of 6 – fluorouracil and cyclophosphamide.²⁵

Aloe Vera in Burning Mouth Syndrome

Burning mouth syndrome is the most common among woman in middle aged to elderly aged groups it is idiopathic, manifested as subjective burning sensation of tongue lips and entire oral cavity without any objective lesions. Clinical studies have confirmed the potential of topical *aloe vera* gel in combination with tongue protector (glycerine) showed an improvement in burning mouth symptoms²⁶. However, a double blind study performed by Su to determine whether *aloe vera* is able to reduce the severity and duration of radiotherapy induced mucositis did not improve mucositis head and neck cancer patients.

Aloe Vera in Arthritis

Aloe Vera helps to relieve joint pains is by reducing inflammation. Bradykinin is part of the body's complex mechanism that causes painful inflammation. In studies, *Aloe Vera* has been shown to possess anti-bradykinin activity. *Aloe Vera* contains the enzyme bradykinase, which breaks down bradykinin. Sterols in *aloe vera*, like steroid drugs, have an anti-inflammatory effect. However, steroids inhibit "healing" or tissue regeneration- which conversely *Aloe vera* promotes²⁷. Natural sterols having the strongest anti-inflammatory effect in *Aloe Vera* are- lupeol, beta sitosterol, and campesterol.

Antifertility Activity

The study investigated the effects of *Aloe Vera* aqueous leaf extract on testicular weight and semen parameters of Sprague-Dawley rats. Twenty-four adult male Sprague-Dawley rats weighing between 130-150 grams were divided into 4 groups. The results showed that sperm count of rats that received 70 mg/kg and 100 mg/kg of *Aloe Vera* extract decreased significantly when compared with the control. However, the decrease in sperm motility and testicular weight was not statistically significant across the groups. These results suggest that *Aloe Vera* has potential antifertility effects in the male rat.²⁸

Antiulcer Activity

A. vera is an herbal remedy widely used for a variety of illnesses; *A. vera* leaf extracts have been promoted for digestion and are used in the treatment of peptic ulcer for cyto protective action whereby *A. vera* gel expresses antibacterial properties against both susceptible and resistant *H. pylori* strains and acts as a novel effective natural agent for combination with antibiotics for the treatment of *H. pylori* gastric infection.

One study demonstrated that newly formulated aloe- and myrrh-based gels proved to be effective in topical management of minor recurrent aphthous stomatitis and was superior in decreasing ulcer size, erythema, and exudation; myrrh resulted in more pain reduction in a randomized, double-blind, vehicle-controlled study.

Effect on Estrogen Status

Isolated emodin and aloe-emodin from *A. vera* gel specifically suppress breast cancer cell proliferation by targeting estrogen receptor- α protein stability through distinct mechanisms, which suggests a possible application of anthraquinones in preventing breast cancer cell proliferation through estrogen receptor- α inhibition. *A. vera* gel also helps to maintain ovarian steroid status in polycystic ovary-like condition wherein steroidogenesis altered and disturbed estrogen : testosterone ratio.²⁹

Antiviral Activity

Many reports have suggested that *A. vera* gel has antiviral activity that prevent virus adsorption, attachment, or entry to the host cell. An *in vitro* study has shown that crude extract of *A. vera* gel has antiviral activity against herpes simplex virus type 2 strain. Anthraquinone derivatives, such as *Aloe*-emodin, emodin, and chrysophanol, reportedly exhibit antiviral activity wherein their inhibitory mechanism and effect against influenza A virus with reducing virus-induced cytopathic effect and inhibiting replication of influenza A.³⁰

A. vera has been described as an antibacterial agent. The *Aloe* protein of 14 kDa from the *A. vera* leaf gel was isolated and the purified *Aloe* protein exhibited a potent antifungal activity against *Candida parapsilosis*, *Candida krusei*, and *Candida albicans*. *A. vera* has anthraquinones as an active compound, which is structural analogue of tetracycline. The anthraquinones acts like tetracycline that inhibits bacterial protein synthesis by blocking the ribosomal A site (where the aminoacylated tRNA enters). Therefore, the bacteria cannot grow in the media containing *A. vera* extract. Pandey and Mishra established the susceptibility of Gram-positive and Gram-negative bacteria to an extract of the inner gel of *A. vera*.

Hepatoprotective Effect

Isolated phytosterols, namely lophenol and cycloartanol, have the ability to induce the downregulation of fatty acid synthesis and a tendency for upregulation of fatty acid oxidation in the liver, which favours the reduction in intra-abdominal fat and improvement of hyperlipidaemia. Further, addition to sterol regulatory element-binding transcription factor 1/peroxisome proliferator-activated receptor (PPAR)- α ratio was decreased; metabolic syndrome-related disorders were improved and liver steatosis in *Aloe*-sterol-treated Zucker diabetic fatty rats. *Aloe* formulas also suppress obesity-induced inflammatory responses by reducing levels of the proinflammatory cytokines, PPAR γ /liver X receptor α , and 11 β -hydroxy steroid dehydrogenase, and enhance anti-inflammatory cytokines in white adipose tissue and liver. The beneficial effects of *Aloe* formula with respect to obesity-induced insulin resistance and hepatic steatosis have been associated with its action on PPAR γ /liver X receptor α . Saito showed that *A. vera* gel extract prevents ethanol-induced fatty liver by suppressing mRNA expression of lipogenic genes in the liver.³¹ The



combination of probiotic *Lactobacillus rhamnosus* GG and *A. vera* gel have a therapeutic potential to decrease cholesterol levels and the risk of cardiovascular diseases.³²

Adverse Effects, Toxicity and Drug Interactions

Laxative Abuse

Aloe latex when used as a laxative causes abdominal complaints such as abdominal pain, cramps, flatulence. Other side effects include hemorrhoidal congestion and coloration of urine. Urine becomes orange if pH is acidic or reddish purple if pH is alkaline due to renal excretion of hydroxyl anthracene derivatives. Prolonged use of antidiarrhoeal causes watery diarrhea results in electrolytic imbalance.³³ Loss of sodium leads to secondary hyperaldosteronism. Increase in loss of potassium can lead to hypokalemia. This results in fatigue, muscular weakness, weight loss, mental disturbances, steatorrhea, electrocardiographic abnormalities and kidney dysfunction.

Dark brown colouration of intestinal mucosa due to pigment lipofuscin has been found due to abuse of aloe extending upto rectum.

Anthraquinone derivatives have shown genotoxicity in salmonella assay. In recent years the risk of colon cancer has been related to use of anthraquinone laxatives.

It has also been demonstrated that a positive correlation between melanosis coli a marker for chronic abuse of anthranoid laxatives and colon carcinoma exists.³⁴ The possible drug interaction shoe in Table 3.

Table 3: Aloe-Drug Interactions³⁵

Possible Drug Interaction	Possible Mechanism
Aloe latex and Anthranoid Derivatives	
Antidiarrheal	Antagonism
Glucosins	Synergism
Cardioactive glycosides	Potassium depletion leading to adverse cardiovascular effect
Liquorice, corticosteroids, Diuretics	Potassium depletion may be exacerbated
NSAIDS	Antagonism
Vitamins	Reduced absorption of vitamins
Minerals	Reduced absorption of minerals
Aloe Gel	
Hydrocortisone	Additive effect
Antidiabetic	Additive effect
UV radiation	photo dermatitis

Quality and Safety Assurance in the Processing of Aloe Vera Gel Juice

To ensure the biological integrity, the organoleptic stability and quality of final product the following are the steps which require hazard control points.

Addition of Vitamin C and Citric Acid

The pH of *aloe vera* gel juice is a measure of its active acidity which influences its flavour, processing requirements and safety. In order to ensure effective pasteurization and to achieve better flavor pH of *aloe vera* juice is usually adjusted to 3.0 to 3.5 with citric acid addition. pH is examined by automatism pH measurement.³⁶ If pH is greater than 3.5 it should be adjusted by citric acid. This it can prevent growth of bacilli and clostridia.

Pasteurization

The spoilage microflora of *aloe vera* gel juice is limited to acid tolerant bacteria, yeasts and molds in the environment of pH 3.0 to 3.5. At pasteurization the aloe gel juice is thermally treated continuous monitoring of temperature and by testing the microbiological load of the pasteurized product to check that it is in conformity with current microbiological standards. Retreatment of juice is needed if pasteurization loses control.³⁸

Different Aloe Based Products

The primary component of the plant used in most products is the leaf which can be processed in two ways to get Aloe Vera juice. The yellow sap aloe latex that drains when leaf is cut open from the base. It is used in OTC laxative preparations of Aloe Vera. This substance is found between the rind and inner leaf material and is bitter yellowish brown to reddish bitter tasting substance. It contains anthraquinones including powerful constituent called aloin which acts as a laxative.³⁹ IASC (International Aloe Science Council) Standard for aloin in products for oral consumption is < 10ppm. For topical use it is 50 ppm of aloin.

Aloe Vera Leaf Juice

Aloe Vera leaf juice is made by taking entire Aloe Vera leaves and grinding them up via some type of maceration. Enzyme such as cellulose breaks down the rind and heavier weight material and then the resultant slurry is filtered by charcoal filtration to remove any other unwanted material such as aloe latex.⁴⁰

Vera gel

It is a gel present in parenchymatous tissue of the leaf. It oozes out naturally when fillet or chunk is separated from the leaf skin.

Aloe Vera inner leaf juice

Aloe Vera inner leaf juice is made by removing the rind prior to processing either by machine or by hand and then rinsing away the aloe latex. The remaining

gelatinous inner leaf material is then ground crushed into Aloe Vera inner leaf juice. The health drink should contain 85-90 % aloe vera juice. The thinning of aloe gel takes place due to degradation of polysaccharides by various enzymes.

Curacao Aloes

It is yellow to yellowish brown or olive brown in colour. It is naturally drained from aloe vera leaves (after cutting). It is then boiled on an open fire in large copper pans until it thickens and then allowed to harden.

Cape Aloes

It is obtained in a similar way from aloe ferox species. Curacao aloes and cape aloes are used as a source of anthraquinone derivatives in preparation of laxative drinks.

Aloin

Occurs as lemon yellow to dark yellow to yellow green microcrystalline powder or as minute crystals and tastes intensely bitter. It's the term used for mixture of anthraquinone principles obtained from Aloe. It varies with a variety of aloe. Extremely bitter in taste and lacks a sugar molecule (Difference to aloe emodin).^{40,41}

Concentrated Aloe Vera Juice

Concentrated juice provides a small dose of aloe. The juice is concentrated under thin film vacuum evaporation at temperature not exceeding 50°C to avoid breakdown of polysaccharides. It is in the strength 5X, 10X and 40X with percentage of solids 2.5, 5 and 20 respectively. However, there is loss of terpenes which give a characteristic flavour to aloe juice. Darkening of juice is due to polyphenolic condensation and destruction of polysaccharide due to the action of cellulose.

Aloe Vera Spray Dried Powder

It is highly concentrated version (200X) fine powder light to beige colour only 0.05 to 0.5% can be used in formulations. The inner gel (fillet) is carefully removed of freshly harvested aloe leaves to minimize disruption of the Aloin layer. The gel is then further processed to remove the pulp and fibre. The resultant gel is pasteurized to maintain its efficacy. The gel is then concentrated utilizing low temperature evaporation to produce a liquid concentrate ready for spray drying. The gel remains under refrigeration until dried.

The gel concentrate is spray dried without the use of a matrix, nor the addition of preservatives or other additives.⁴¹

Freeze Dried or Lyophilized Aloe

This process, employing high vacuum technology and precise temperature control, is obviously very expensive. Freeze-drying is potentially the method of choice for production of the finest quality finished product to be used in the manufacture of cosmetics. If high quality aloe,

prepared from gel fillets and subjected to careful preliminary/intermediate processing is the feedstock for lyophilisation, a very high quality product will result.⁴² However, it is more economical to feed poor quality, over-processed, over concentrated colour changed aloe with high solids content into the process.

CONCLUSION

This review demonstrate that the leaves of *Aloe vera barbandies* Mill have a tremendous potential as a potent source for novel therapeutic activity and Nutrients value in Complete Health management.

The pharmacological profile reveals it to be fit for its may be performed to study the detailed mechanism of action of aloe vera leaves in various metabolic activities in human, which will be beneficial to mankind.

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.

The results obtained support the fact that more work needs to be done on the purification, identification and quantification of the active components and the toxicity of active components, their side effects and pharmacokinetic properties with the view of their use for *in vivo* studies.

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