



Phytochemical Attributes and Versatile Health Benefits of Aloe vera (*Aloe barbedensis* Mill.)

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Abstract

Aloe Vera could be a characteristic item that's presently a day regularly utilized within the field of cosmetology. In spite of the fact that there are different signs for its utilization, controlled trials are required to decide its genuine viability. The applications of aloe gel in its natural state are numerous; in addition, aloe vera extract is being increasingly incorporated into cosmetics for treatment of various conditions. Its anti-inflammatory properties make it an effective ingredient for combating acne and other skin imbalances. Aloe vera extract help firm and hydrate the skin, improving its elasticity, aids oxygenation and gradual rejuvenation; also to compose cosmetics with a calming purpose, as in after-sun products and after-shave lotions. The high moisturising power of Aloe vera extract is a common item in several products that promise intense hydration, such as hair masks, dark circle attenuating creams and highly effective in cosmetics to combat acne, for having healing and anti-inflammatory properties. The Aloe plant is utilized as a dietary supplement in an assortment of nourishments and as an fixing in restorative items. Chemical examination uncovers that the Aloe plant contains different polysaccharides and phenolic chemicals, outstandingly anthraquinones. Ingestion of Aloe arrangements is related with the runs, hypokalemia, pseudomelanosis coli, kidney disappointment. Aloe Vera can be utilized in different conditions like Gentle to direct burns, Erythema, Genital herpes, Seborrheic dermatitis,

Psoriasis vulgaris, Skin moisturizer, Sort 2 diabetes, Verbal lichen planus diseases, Angina pectoris, Ulcerative colitis, UV-induced erythema, Kidney stones and Alveolar osteitis. The present review article is an effort towards the exploration of cosmaceuticals and phytapharmacological properties of Aloe Vera.

Keywords: Anti-inflammatory, Commodity usage, Aloin, Anthraquinones, Phenolic compounds, Amino acids, IL10

Introduction

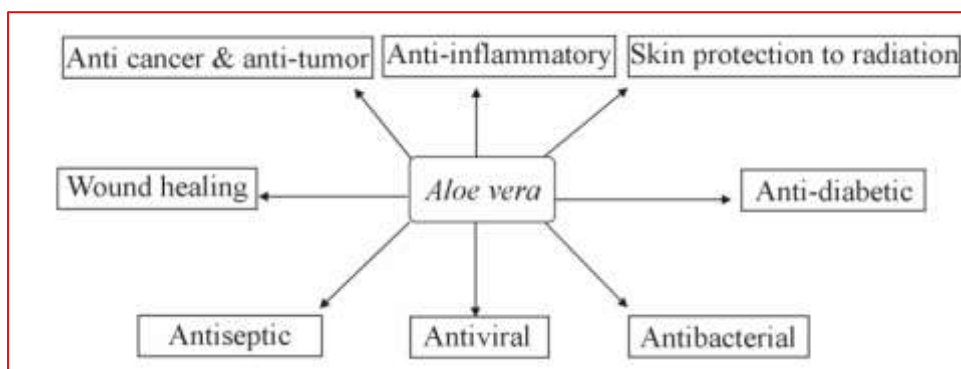
Scientifically known Aloe barbedensis Mill., Aloe vera occupies space Asphodelaceae (Lileaceae) family. It may be a shrubby or arborescent, perpetual, xerophytic, juicy, pea-green colour plant. It develops primarily within the dry locales of Africa, Asia, Europe and America. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu. Aloe vera commonly known as Ghrit Kumari, is the oldest medicinal plant ever known and the most applied medicinal plant worldwide. The cactus like juicy aloe vera has a place to the sort of the liliaceous plants. Aloe is related to other members of the Lily family such as the onion, garlic and turnip families. Aloe's relationship to the lily family is evident from the tubular yellow flowers produced annually in the spring that resemble those of the Easter lily. However, only two species are grown today commercially, with Aloe barbadensis Miller and Aloe aboescens Miller being the most popular. The Aloe plant is grown in warm tropical areas and cannot survive freezing temperatures. [1-3] In the United States, most of the Aloe is grown in the Rio Grande Valley of South Texas, Florida and Southern California. Internationally, Aloe can be found in Mexico, the Pacific Rim countries, India, South America, Central America, the Caribbean, Australia and Africa. The original commercial use of the Aloe plant was in the production of a latex substance called Aloin, a yellow sap used for many years as a laxative ingredient. The plant is either stemless or exceptionally short-stemmed (stem up to 25 cm long) with a normal ~20 takes off in a straight, thick rosette. The clears out develop to up to 40 – 50 cm long and 6 – 7 cm wide. The takes off are or maybe thick, beefy, water holding; concave on the beat side, grey-green frequently ruddy and youthful plants are frequently dotted. The underside of the leaf is curved with a pale pink edge that's dressed with 2 mm long prickly teeth dispersed at each 10 – 20 mm. One leaf can weigh as much as 1.5 to 2 kg. The juicy leaf of the aloe is an adjustment to the exceptionally dry conditions of its living space. The roots of the aloe are generally brief and lay flat implanted within the earth. Aloe Vera is used for vigor, wellness and medicinal purposes since rigvedic times. Health benefits of aloe vera include its application in wound healing, treating burns, minimizing frost bite damage, protection against skin damage from x-rays, lung cancer, intestinal problems, Increasing High Density Lipoprotein (HDL), reducing Low Density Lipoprotein (LDL), reducing blood sugar in diabetics, fighting Acquired Immuno Deficiency Syndrome (AIDS), allergies and improving immune system. Phyto-chemistry of aloe vera gel has revealed the presence of more than 200 bioactive chemicals. Aloe Vera gel is extracted from its leaves and appropriate processing techniques are needed for stabilization as well as preparation of the end products. Aloe

Vera Gel contains important ingredients including 19 of the 20 amino acids needed by the human body and seven of the eight essential ones that just cannot be made. In industries Aloe Vera is also used to extract liver tonic. [4-8]



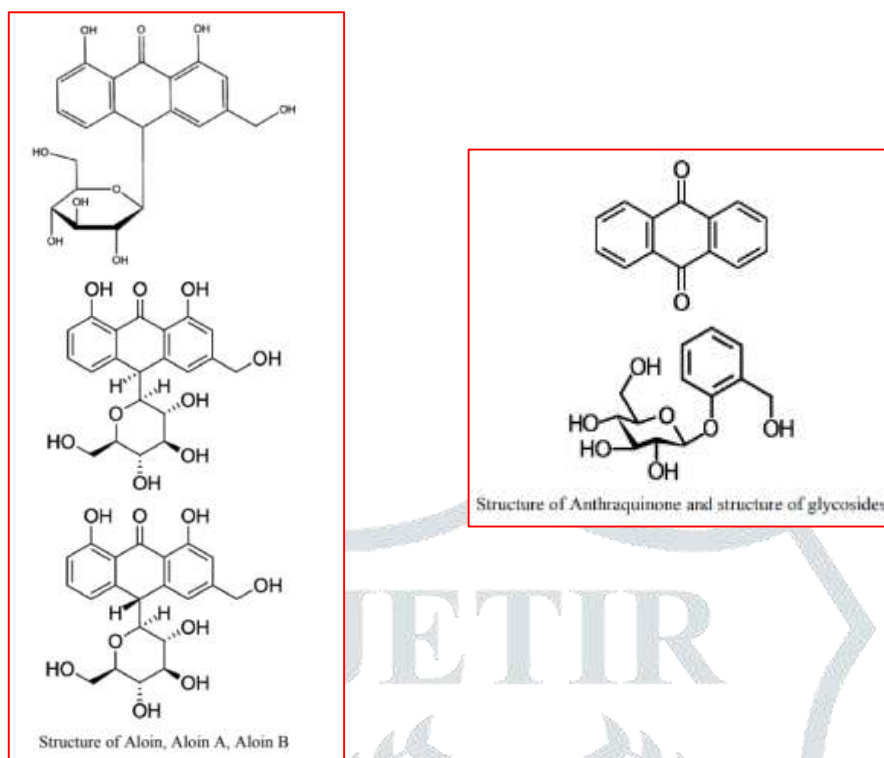
Phytochemistry and Pharmacokinetics of Aloe Vera

There are as many as 200 different types of molecules in aloe vera. The aloe vera leaf gel contains about 98% water. The total solid content of aloe vera gel is 0.66% and soluble solids are 0.56% with some seasonal fluctuation. On dry matter basis aloe gel consists of polysaccharides (55%), sugars (17%), minerals (16%), proteins (7%), lipids (4%) and phenolic compounds (1%). The aloe vera gel contains many vitamins including the important antioxidant vitamins A, C and E. Vitamin B1 (thiamine), niacin, Vitamin B2 (riboflavin), choline and folic acid are also present. Some authors also suggested the presence of vitamins B12 (cyanocobalamin) in trace amounts which is normally available in animal source. Carbohydrates are derived from mucilage layer of the plant under the rind, surrounding the inner parenchyma or gel. They comprise both mono and polysaccharides. The most important are the long chain polysaccharides, comprising glucose and mannose, known as the glucomannans [β (1, 4) - linked acetylated mannan]. Xylose, rhamnose, galactose and arabinose are also present in trace amounts along with lupeol (a triterpenoid), cholesterol, campesterol and β -sitosterol. Structural studies on aloe vera gel polysaccharides have shown that the gel is composed of at least four different partially acetylated glucomannans, being linear polymers with no branching and having 1,4 glycosidic linkages with glucose and mannose in the ratio of 1:2:8. The viscosity of gel reduces upon hydrolysis of these sugars. When taken orally some of the sugars bind to receptor sites that line the gut and form a barrier, possibly helping to prevent 'leaky gut syndrome'. [4-8]



Graphical Representation of pharmacological usage of Aloe vera

Other reports suggest the presence of glucose and a polyuronide consisting of a high molecular weight glucose mannose polyose and hexouronic acid (31, 60) reported the presence of uronic acid, which gives galacturonic acid and oligosaccharides upon fermentative hydrolysis. It is reported that at least six enzymes are present in the aloe vera gel including bradykinase, cellulase, carboxypeptidase, catalase, amylase and oxidase.[9-11] The carboxypeptidase inactivates bradykinase at site of wound or cut in body and produces pain relieving and anti-inflammatory effect. During the inflammatory process, bradykinase produces pain associated with vasodilatation. The gel also contains glutathionperoxidase as well as several isozymes of superoxide dismutase. It has also been reported that potassium and chloride concentration appeared to be excessive in aloe vera juice in comparison to most plant products whereas the sodium content was found lesser in quantity. Calcium, magnesium, copper, zinc, chromium and iron were also found in the aloe products. Magnesium lactate inhibits histidine decarboxylase and prevents the formation of histamine from the amino acid histidine. Histamine is released in many allergic reactions and causes intense itching and pain. [12-15]

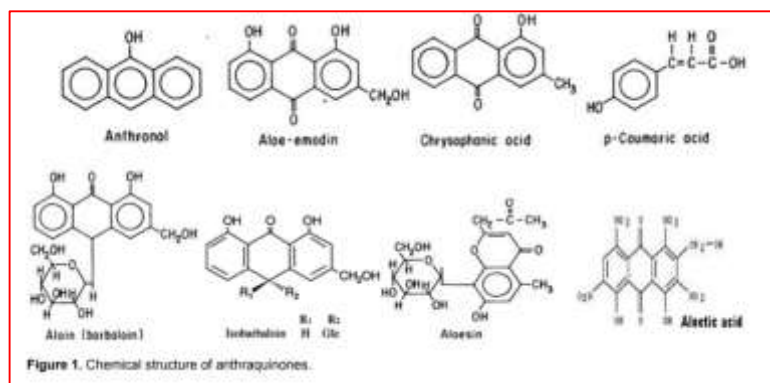


The prevention of its formation may explain the anti-allergic effects of aloe vera gel. Anthraquinones are the phenolic compounds present in the sap or yellow exudates of leaf or aloe vera latex. Aloe latex contains a series of glycosides known as anthraquinones, the most prominent being aloin A and aloin B. The bitter aloes (dried yellow exudates) consists of free anthraquinones and their derivatives i.e. barbloin-10-(1151- anhydroglucosyl)-aloeemodin- 9-anthrone, isobarbloin, anthrone-C- glycosides and chromones. These compounds exerts a powerful purgative effects when ingested in large amounts but when low in concentration, they appear to aid absorption from the gut and are potent antimicrobial and powerful analgesic agents. Isolation and structure determinations of these chromones from the aloe vera leaves were also studied and these compounds were identified to be 8-C-glycosyl-7-O methyl-(S) aloesol, isoaloeresin D and aloeresin E. Acemannan is biologically active in both humans and animals, and is absorbed through the intestine unchanged by digestion.

This mucopolysaccharide deals with the damaging processes of the body by acting as an immune stimulant, principally by stimulating the production of T lymphocytes and macrophages from the thymus and the beta cells of the pancreas. Acemannan has bactericidal and germicidal actions as well as an antifungal action that combats intestinal Candidiasis. Acemannan has the ability to coat and permeate all the gastrointestinal surfaces, increasing the fluidity and the permeability of these membranes. In this way, it allows the easy expulsion of toxins and an even faster absorption of nutritive factors. The chemical name of acemannan is beta-(1,4) acetyl polymannose, because it contains a long chain polymer made up of glucose and mannose. The anthraquinones are a vast

group of substances very widespread in the plant kingdom, possessing a wide range of pharmacological properties, both curative and toxic. The exact mechanism for this substance's ability to have indirect and yet potent effects on the body is not yet known. What is clear, however, is that these substances regulate intrinsic intestinal motility (i.e., not due to the sympathetic or parasympathetic nervous systems, but due to the stimulation of intestinal plexuses, with a subsequent increase of peristalsis and, hence, a laxative action). [16-17] This strong purgative action is closely related to the chemical structure of the molecule. In fact, the anthraquinones present in Aloe are many and the effects differ slightly between them. They include aloe-emodin, aloetic acid, anthranol, chrysophanic acid, an ester of cinnamic acid and resistanol. The typical bitter taste of Aloe is due to these compounds. Their effect on the body is slow, taking between six and twenty-four hours. Botanically, the anthraquinones are found in high concentrations in the sap that runs through the trunk of the plant, with a smaller amount of sap evidenced in the outer layer of the cuticle or skin of the Aloe leaves. Anthraquinones in fresh plants are in a reduced form called anthranols. When these anthranols go through the drying process, the drug quickly converts and is reduced to an oxidized state. Prolonged use of plants containing these drugs can eventually cause lack of colon tone. Excessive doses cause diarrhea with imbalances in intestinal absorption of food or nutritional malabsorption, and electrolyte imbalances. These substances are, therefore, not recommended for pregnant women, exactly because of the strong peristalsis which can occur in the lower abdomen. According to recent research findings, aloins in an isolated form destroy the herpes and influenza viruses by deactivating the protein membrane (coating shell) of the virus. The anthraquinones are part of the aromatic polynuclear hydrocarbons and originate from two main substances: anthracene and fenanthrene. In their structure, comprised of three joined benzene rings, eventual substitutions preferentially occupy positions 9 and 10, which are the most chemically active. Aloetic Acid The specific properties of aloetic acid are not yet fully known, but it seems to act as a natural antibiotic, especially if synergistically combined with Barbaloin, isobarbaloin, and aloe-emodin. This hydroxymethyl anthraquinone comes from the division of aloe-emodin in acid and a simple sugar. The cinnamic acid present in Aloe has an antiseptic and germicidal action. [18-20] This acid also has a role in inflammatory processes, producing an anaesthetic and analgesic effect. Lastly, this acid has a strong detergent action because its molecular structure is very similar to a saponin. This explains why cinnamic acid is present throughout the cosmetics industry and in anaesthetic medicine. Cinnamic acid is an organic acid whose identifying formula is $R-COOH$, where R is a radical made up of long and short chained carbons of varying complexity. In this case, the radical is a modified anthracenic compound. The radical $-COOH$ represents the group that gives the compound its main characteristic, which in this case, is an acid. Chrysophanic acid is an organic acid which, like cinnamic acid, has an anthraquinoid radical. Its properties are similar to those described for the anthraquinones. It is a good purifying agent, laxative, diuretic, and it stimulates bile secretion. Its strong, bitter taste gives it a tonic and digestive effect. The chrysophanic acid present in Aloe also functions as a fungicidal, especially in the intestine. Salicylic acid forms part of the organic chemical

composites called hydroxyl acids because they possess both a hydroxyl and a carboxyl component, similar to lactic acid and malic acid. Salicylic acid is the principal component of aspirin and its salts, the salicylates, are used as analgesics and anti-rheumatics in the pharmaceutical industry. In Aloe juice, salicylic acid functions as an antiseptic, anti-bacterial, and an anti-inflammatory. Aloe-emodin is a molecule present in the yellow exuded matter, rich in anthraquinones, found in the lining or under the cuticle of the Aloe leaf. It possesses bactericidal and laxative properties and can boast a marked anti-tumoral effect, especially in pre-cancerous and cancerous cells of ectodermic tissues, as is being demonstrated in some of the recent research. Aloe-emodin's chemical description is that of a methoxyanthraquinone derived from the splitting of aloin to form a simple sugar called arabinose and a composite called anthracene. Aloin is an active principle exclusive to the Aloe plant and made up of anthraquinone glycosides. Aloin is the conventional name given to molecules which most represent this class of compounds. If this compound is derived from the barbadensis variety, there is a predominance of Barbaloin. Its therapeutic effects are summed up as purging, detoxifying, and markedly antibiotic. Its chemical composition and physical properties are similar to one another and vary according to the source from which they are derived. Pure Barbaloin is a crystalline solid made up of small needles prismatically coloured, varying from yellow to a yellow-brown and the odour may vary from none to the typical green plant smell, with a decisively bitter taste. The two aloins are distinguished from each other by the differences present in some of their chemical and physical properties, and are recognized by whether they are soluble in water, alcohol, ether, or in inorganic acids. Isobarbaloin possesses a marked analgesic effect and acts as a natural antibiotic.[21-23] Isobarbaloin is also part of the anthrocyanic glycosides. It is specifically a geometric isomer of aloin, meaning that it has the same molecular weight as aloin, but with differently arranged atoms. They are therefore slightly different in their physical and chemical characteristics. It is rich in all vitamins excluding Vitamin D, especially the antioxidant Vitamins A (beta-carotene), C and E and even contains a trace of Vit. B12, one of the very few plant sources of this vitamin. This is important for vegetarians. Several different types of these biochemical catalysts when taken orally aid digestion by breaking down fat. Bradykinase helps to reduce excessive inflammation when applied to the skin topically and therefore reduces pain, whereas others help digest any dead tissues in wounds. Lipases and proteases which break down foods and aid digestion are present. Several minerals such as Ca, Na, Mn, Cu, Mg, K, Zn, Cr and Se are found in Aloe vera. Although minerals and trace elements are only needed in very small quantities, they are essential for the proper functioning of various enzyme systems in different metabolic pathways. Aloe Vera is used for vigor, wellness and medicinal purposes since Rigvedic times. Health benefits of Aloe vera include its application in wound healing, treating burns, minimizing frost bite damage, protection against skin damage from x-rays, lung cancer, intestinal problems, increasing high density lipoprotein (HDL), reducing low density lipoprotein (LDL), reducing blood sugar in diabetics, fighting against acquired immunodeficiency syndrome (AIDS), allergies and improving immune system. [24-28]



The plant leaves contains numerous vitamins, minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, anti-microbial, anti-inflammatory, antioxidant, aphrodisiac, anti-helmenthic, antifungal, antiseptic and cosmetic values for health care. This plant has potential to cure sunburns, burns and minor cuts, and even skin cancer. The external use in cosmetic primarily acts as skin healer and prevents injury of epithelial tissues, cures acne and gives a youthful glow to skin, also acts as extremely powerful laxative. Ayurveda, Aloe is known as Kumari or “Young Girl”, because aloe is believed to bring back youthful energy and femininity. Aloe is used as a tonic for the female reproductive system. Aloe is said to have alliterative, tonic, rejuvenating, purgative, and vulnerary actions in Ayurveda. Aloe is also believed to tone all three of the Ayurveda constitutions, Vatta, Pitta and Kapha. It is used in traditional Indian medicine for constipation, colic, skin diseases, worm infestations and infections. Aloe is internally used as laxative, antihelminthic, haemorrhoid treatment, and uterine stimulant (menstrual regulator). [25-29] It is used topically, often in combination with liquorice root, to treat eczema or psoriasis. People in Tamil Nadu, India often prepare a curry using *A. vera* which is taken along with Indian bread (nan bread) or rice. The bitter yellow latex of pericyclic tubules in the outer layer of the leaves contain derivatives of hydroxyanthracene, anthraquinone and glycosides aloin A and B from 15% - 40% in different investigations. The other active principles of Aloe include hydroxyanthrone, aloemodin-anthrone 10-C-glucoside and chrones. The bitter yellow latex containing anthraquinones and glycosides has been reported from the middle layers. The transverse section of the leaf exhibiting three cells layers, the protective layer, middle layer and colourless inner layer. The juice that is originated from cells of the pericycle and adjacent leaf parenchyma, flowing spontaneously from the cut leaf get dried with or without the aid of heat and get solidified should not be confused with Aloevera gel which is also the colourless mucilaginous gel that is obtained from the parenchymatous leaf cells. The parenchymatous tissue or pulp shown to contain proteins, lipids, amino acids, vitamins, enzymes, inorganic compounds and small organic compounds in addition to the different carbohydrates. There is some evidence of chemotaxonomic variation in the polysaccharide composition. 16-

different polysaccharides and 12 major polypeptides, and various glycoproteins in leaf gel. The innermost layer of leaf gel contains water upto 99%, with glucomannans, amino acids, lipids, sterols and vitamins. The other potentially active ingredients include vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids. It has numerous monosaccharide's and polysaccharides; vitamins B1, B2, B6, and C; niacinamide and choline, several inorganic ingredients, enzymes (acid and alkaline phosphatase, amylase, lactate dehydrogenase, lipase) and organic compounds (aloin, barbaloin, and emodin) as described by. The main functional component of Aloe vera is a long chain of acetylated mannose. Aloe gel is often commercialized as powdered concentrate. Therapeutically, it is used to prevent progressive dermal ischemia due to burns, frostbite, electrical injury and intraarterial drug abuse. In vivo analysis of these injuries demonstrates that this gel acts as an inhibitor of thromboxane A₂, a mediator of progressive tissue damage. The Aloe vera gel play chief role in stimulation of the complement linked to polysaccharides, hydration, insulation, and protection. [26-30]

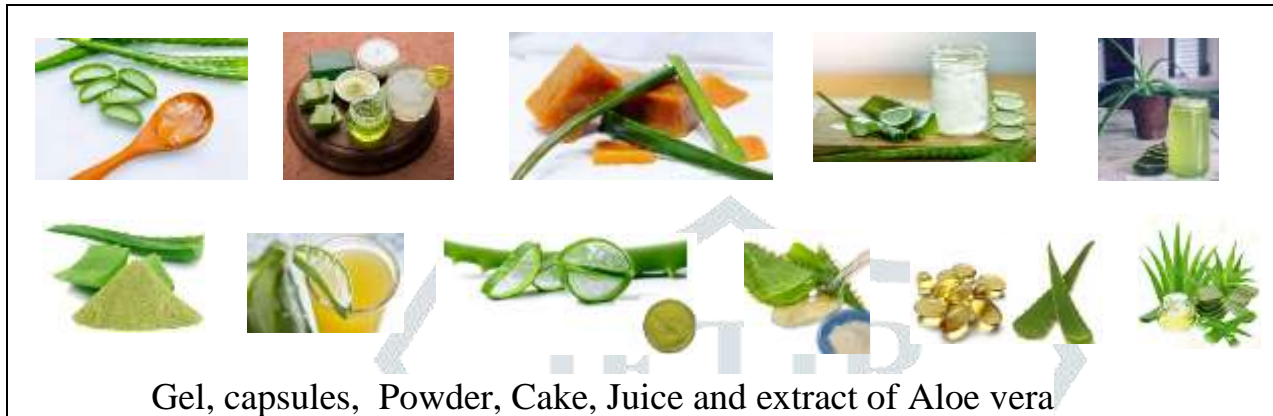
Cosmetic & Skin Protection Application

Alain and its gel are used as skin tonic against pimples. Aloe vera is also used for soothing the skin, and keeping the skin moist to help avoid flaky scalp and skin in harsh and dry weather. The Aloe sugars are also used in moisturizing preparations. Mixed with selected essential oils, it makes an excellent skin smoothening moisturizer, sun block lotion plus a whole range of beauty products. Due to its soothing and cooling qualities, Maharishi Ayurveda recommends Aloe vera for a number of skin problems. Aloe vera extracts have antibacterial and antifungal activities, which may help in the treatment of minor skin infections, such as boils and benign skin cysts and have been shown to inhibit the growth of fungi that cause tinea. Currently, the plant is widely used in skin care, cosmetics and as nutraceuticals. Aloe vera gel has been reported to have a protective effect against radiation damage to the skin. Exact role is not known, but following the administration of Aloe vera gel, an antioxidant protein, metallothionein, is generated in the skin, which scavenges hydroxyl radicals and prevents suppression of superoxide dismutase and glutathione peroxidase in the skin. It reduces the production and release of skin keratinocyte derived immunosuppressive cytokines such as interleukin-10 (IL-10) and hence prevents UV-induced suppression of delayed type hypersensitivity. Skin burns effect is reported and radiation dermatitis. Some researcher has been reported the contact dermatitis and burning skin sensations following topical applications of Aloe vera gel to dermabraded skin. These reactions appeared to be associated with anthraquinone contaminants in this preparation. [31-32]

Commodity usage of Aloe vera

The leaves of Aloe are eaten as vegetable. Pickle made by small pieces of leaf pod is a common preparation in western Rajasthan . The immature flower stalk that are completely free from bitter content, are also used for vegetable purpose. Fresh fleshy leaf pod is a part of green salad and helpful in treatment of indigestion and constipation. Sharma and Goel 2002 standardized the

recipes of various Aloe product viz., vegetable, pickles, laddo, jam, squash, biscuits and churna by using sensory evaluation technique. Saroj and Purohit (2004) standardized the recipe for preparation of some culinary products from sweet type Aloe (*Aloe barbadensis*). It helps to cure diabetes, ulcer, heart disease . Now a day's Aloe vera juice is available in the market to enhance immune response against various diseases. Besides juice, Aloe vera leaf powder is also being used by food processing industries in preparation of yoghurt and other food products.



Gel, capsules, Powder, Cake, Juice and extract of Aloe vera

The gel is most commonly used part of the plant which has been processed and used in different products. Today, the industry is flourishing and gel is being used as fresh gel juice. It has also been suggested that bio-fuels could be obtained from Aloe vera seeds. It is common practice for cosmetic companies to add sap or other derivatives from Aloe vera to products such as makeup items, tissue papers, moisturizers, soaps, sunscreens, incense, shaving cream, and shampoos. Traditionally, Aloe is extensively used for medicinal purpose particularly for urine related problems, pimples and ulcers. Aloin and its gel are used as skin tonic and have a cooling and moisturizing affects so it is used in preparation of creams, lotions, shampoos and allied products. Aloe contents of different market products are about 20% (sunburn treatments, creams and ointments), 95% (juices), 50% (beverages), 10% (drinks), and 5-10% (capsules). [15,18,21,33-34]

Conclusion

Aloe vera is a succulent plant. Succulents are xerophytes, which are adapted to living in areas of low water availability and are characterized by possessing a large water storage tissue. The main feature of the Aloe vera plant is its high-water content, ranging from 99-99.5%. Phytochemistry of Aloe vera gel has revealed the presence of more than 200 bioactive chemicals. Commercially, aloe can be found in pills, sprays, ointments, lotions, liquids, drinks, jellies, and creams, to name a few of the thousands of products available. It is a source of 19 out of 20 essential amino acids which is required by our body and these amino acids help in smooth functioning of our complex enzyme system. Studies have proved the antiseptic, anti-inflammatory, antiviral and antifungal properties of Aloe vera and the use of this plant is proved beneficial. This plant is proved to be non-allergic and very good in building up the immune system. Aloe vera is gaining popularity in dentistry as it is completely natural and there are no side effects being reported with its use. This

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

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