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Pharmaceutical, nutritional and cosmetic applications of Aloe vera plant

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Abstract

The Aloe vera plant is used in Ayurvedic, Homoeopathic and Allopathic streams of medicine, and not only as medicine but also as food. The juice leaves are the most valuable part of the plant and it contains numerous vitamins, minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, antimicrobial, anti-inflammatory, anti-oxidant, aphrodisiac, anti-helminthic, antifungal, antiseptic and most of cosmetic values. This plant mainly acts on the human skin and it has potential to cure sunburns, burns and minor cuts, acne, skin cancer and gives a youthful glow to the skin. As an internal property Aloe vera juice acts as extremely powerful laxative. Furthermore; according to Ayurvedic literature Aloe vera is the treatment of various diseases such as fever, colic, indigestion, worm infestation, splenomegaly, liver disorder and it is also used as powerful detoxifier and immune-booster.

Keywords: Aloe vera, cosmetic application, medicinal application, food application

1. Introduction

The Aloe vera plant has been used for centuries for its health, medicinal and cosmetic (skin care) properties. It has more meaningful *Sanskrit* synonyms such as Kumari (beautiful young girl or because of therapeutic uses of pimples, menstrual disorders and its rejuvenation / anti-aging effect), Ambudisrava or Vipulasrava (having profuse gel in the leaves), Maata (like a mother to the patient), GhritaKumarika (leaves having slimy pulp similar to Ghee), Deerghapatrika (having long leaves), Amara or Ajara (having property of rejuvenation or anti-aging), Grihakanya, Sthuladala, Gandala, Kanya, MriduKanya, Sthaleruha, Bahupatra, Kantakapravrutta, Veera, Bhringeshta, Vranaghni, Taruni, Rama, Kapila and Sukantaka [1].

Botanical classification of Aloe vera plant as follows; Kingdom: Plantae, Order: Asparagales, Family: Asphodelaceae, Genus: Aloe, Species: Aloe vera. And also, there are a number of synonyms; Aloe barbadensis Mill, Aloe indica Royle, Aloe perfoliat Linn. var Vera and Aloe vulgaris Lam [2]. Most of the Aloe plants are not toxic, but a few are extremely poisonous.

Aloe vera plant is a stemless or very short stemmed shrub growing to around 60 – 100cm tall, spreading by offsets. The leaves are green to grey – green in colour, with some varieties showing white flecks on their upper and lower stem surfaces. The margin of the thick fleshy leaves are serrated and have small white teeth. The flowers are produced in summer on a spike up to around 90cm tall, each flower being pendulous, with a yellow tubular corolla 2 – 3cm long [3,4].



Fig 1: Aloe vera plant

Aloe vera is only known as a cultivated or naturalized plant. It is believed that the origin of the Aloe vera is Arabia, Somalia, or Sudan and a recently discovered in Oman.

At present, Aloe vera plant is widely spread throughout the tropics and subtropics (more common in dry regions in the America, Asia and Australia). As a cultivated plant, it is probably present in all countries of Africa [5].

2. Active components and its properties

Aloe vera plant contains approximately 75 potentially active components such as; vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids [6, 7].

Table 1: Active components and its properties of Aloe vera [8] [9] [10]

| Main type | Sub types | Properties |
|----------------|---|--|
| Vitamins | Vitamin A, C, E (antioxidants), B ₁₂ , Folic acid (B ₉) and Choline. | Antioxidants neutralizes free radicals. |
| Enzymes | Allylase, Alkaline phosphatase, Amylase, Bradykinase, Carboxypeptidase, Catalase, Cellulose, Lipase and Peroxidase. | Bradykinase helps to reduce excessive inflammation when applied to the skin topically and others help in the breakdown of sugars and fats. |
| Minerals | Calcium, Chromium, Copper, Selenium, Magnesium, Manganese, Potassium, Sodium and Zinc. | Helps to proper functioning of various enzyme systems in different metabolic pathways and few are antioxidants. |
| Sugars | Monosaccharides (glucose and fructose) and Polysaccharides: (glucmannans and polymannose). | Anti-allergic and Anti-inflammatory properties. |
| Anthraquinones | Phenolic compounds traditionally known as laxatives. | Aloin and Emodin act as Analgesics, Antibacterial and Antivirals. |
| Fatty acids | Steroids, Cholesterol, Campesterol, β -sisosterol and Lupeol. | All these have anti-inflammatory action and Lupeol also possesses Antiseptic and Analgesic properties. |
| Hormones | Auxins and Gibberellins. | They have wound healing and Anti-inflammatory actions. |
| Amino acids | 20 of the 22 human required amino acids and 7 of the 8 essential amino acids. | Amino acids help to wound healing process. |
| Salicylic acid | Salicylic acid | It possesses Anti-inflammatory and Antibacterial properties. |
| Lignin | Lignin | It enhances penetrative effect of the other ingredients into the skin. |
| Saponins | Saponins | It have cleansing and antiseptic properties. |

3. Pharmaceutical applications of Aloe vera

3.1 Wound healing (restoration of integrity of injured tissues)

Amino acids that contain in Aloe vera are essential in wound healing process [11]. In addition to, inorganic electrolytes like iron, potassium, magnesium, chromium, copper, sodium, calcium and zinc which are vital part of wound healing process. They stimulate the body to produce antibodies and starts wound healing by releasing growth factors [12]. Many research have proven fast healing of wounds with Aloe vera treatment and it also prevents the scar formation [13].

3.2 Anti-ulcer effects

Juice of Aloe vera prevent and cure gastric ulcers through its anti-inflammatory, wound healing, mucus stimulation and regulation of gastric secretion actions [14]. And also; it can be successfully used for treatment of skin ulcers, mouth ulcers, cold sores and leg ulcers (including diabetic ulcers) [15].

3.3 Anti-inflammatory action

The presence of Anthraquinones and Chromone strengthen the Anti-inflammatory action of the Aloe vera. Therefore; it decrease the severity of pain and size of the wound [16]. Further; it helps to relieve joint pain [17]. The Anti-bradykinin activity of Aloe vera reduces the inflammations and it is more effective against inflammation caused by prostaglandin synthesis as well as infiltration of leukocytes and is less effective against inflammation caused by allergenic agents [18].

3.4 Anticancer activity

Glycoproteins and polysaccharides of the Aloe vera is useful against various types of cancers [18] and these agents stimulate the immune system to fight against cancer cells [19].

3.5 Anti-diabetic effects

Aloe vera gel is an effective Anti-hyperglycemic agent against type 2 Diabetes Mellitus. It lowers the blood glucose level without disturbing the normal blood lipid level and liver or kidney function [20]. There are so many mechanisms to

prevent and cure the Diabetes Mellitus. For examples: increase metabolism, decrease oxidative stress and improve antioxidant status etc.

3.6 Antioxidant effects

Aloe vera gel contains Vitamin A, C and E, which are antioxidants [21]. Previous research have been scientifically proven that the protective effect of Aloe vera gel against dihydrochloride induced oxidative stress and cell death in kidney epithelial cells [22].

3.7 Anti-hyperlipidemic activity

Aloe vera gel effectively reduced the blood cholesterol level, triglycerides and LDL cholesterol [23]. Previous research showed that Aloe vera gel in combination with probiotic lactobacillus rhamnosus can improve the lipid profiles in hypercholesteremic rats together with enhanced cholesterol production and absorption resulting in reduced risk of cardiovascular diseases [24].

3.8 Teeth and gum protection

Aloe vera is widely used to relieve pain and accelerate healing after periodontal flap surgery [25]. Some gum diseases like gingivitis and periodontitis are treated by using Aloe vera to reduce bleeding, control inflammation and stop the swelling of the gums [26].

3.9 Laxative effects

Aloe vera gel is used traditionally to treat constipation because of the content of laxative compound. Anthraquinones present in latex are a potent laxative. It increases intestinal water content, stimulates mucus secretion and increases intestinal peristalsis. Previous research have proven that when take in doses of 0.25mg, laxative effects start within 6–12 h resulting in loose bowel movements [27].

3.10 Genital herpes (Herpes simplex)

Treatment of Genital herpes involves medication for faster healing of sores and lesions so that outbreaks can be reduced or prevented. Aloe vera extract in the form of a hydrophilic

cream has shown effectively to treat genital herpes in men through a more rapid healing process [28].

3.11 Antibacterial properties

Many research proven that Aloe vera gel inhibits the growth of some microorganisms like *Str. pyogenes*, *Shigella*, *Klebsiella*, especially against Gram-positive bacteria causing food poisoning or diseases in humans and animals [29].

3.12 Antifungal activity

Antifungal activity against *Candida* has been reported. For its antifungal properties Aloe vera is used as a fish tank water conditioner [30].

3.13 Antiviral and antitumor activity

These actions performed as indirect or direct effects. The indirect through the stimulation of the immune system and direct to Anthraquinones [31].

4. Nutritional applications of Aloe vera

The demand of functional foods with prolonged shelf life and without chemical preservatives have increased around the world. At present, processing of Aloe vera gel has converted to a big industry owing to its applications in the food industry [32]. Some important food applications of Aloe vera as follows:

4.1 Functional and nutraceutical foods

Mannose polymers with some sugars including glucose and acemannan are present in aloe gel. These together with glycoproteins, enzymes, amino acids and vitamins contribute to the functionality of foods without affecting their quality and acceptability [33].

Famous healthy foods developed from Aloe vera include: Dahi (a fermented South Asian dairy product) by replacing skim milk with Aloe vera gel, Aloe vera gel enriched beverages, Ice-cream, Lassi (a traditional fermented dairy beverage of South Asia), Mango nectar and carbonated beverages. Researchers have investigated that the presence of bioactive compounds of above foods [34].

4.2 Antimicrobial agent

Antimicrobial agents inhibit or delay the growth of microorganisms including bacteria, fungi, and viruses. Aloe vera gel has antimicrobial agents and it can effectively inhibit the growth of food borne spoilage and pathogenic microorganisms such as *Staphylococcus aureus*, *Salmonella*, *Streptococcus*, *Escherichia coli*, *Aspergillus Niger* and *Candida* [35]. The polysaccharides of Aloe vera act as a natural barrier to moisture and oxygen that are the main agents of deterioration of fruits and vegetables [36]. They help to control respiratory rate, delay ripening, prevent moisture loss, delay oxidative browning and provide firmness.

5. Cosmetic applications of Aloe vera

Aloe vera gel is extensively used in the cosmetic industry as a base material for various formulations such as moisturizers and suntan lotions which are used as humectant in skin preparations [37]. Aloe vera gel and powder have vast applications in the cosmetic field because of their valuable moisturizing and soothing effects in products such as shampoos, soaps, cleansers and moisturizing creams. Soaps prepared with Aloe vera do not cause irritation and do not leave the skin dry. Aloe extracts added into some shaving creams and lotions are enhance the healing of shaving

wounds. And also, mucilaginous nature of Aloe vera gel serves as a protective barrier between skin and beard in shaving creams [38].

Skin problems such as sunburns, flaky or dry skin, hair and scalp problems, psoriasis, stretch marks, and dandruff are being treated by lotions and sun-blocks prepared by Aloe vera gel. Moreover, Aloe vera provides a protective layer on the skin and it promotes powerful healing effect even at the epithelial level of the skin. Nutritional contents and antioxidant properties of the Aloe vera also promote that healing process [39].

Skin dryness is prevented by the application of Aloe vera before the use of mineral-based make-up. Its moisturizing effect (without giving a greasy feel) makes it perfect for oily skin.

The Giberellin, present in Aloe vera is a growth hormone which stimulates the growth of new cells and heals the skin with minimal scarring.

Antioxidants such as β -carotene, vitamin C and E (present in Aloe vera leaves) improve the natural firmness of the skin and prevent from the skin hydration [40, 41].

Mucopolysaccharides help in binding moisture into the skin. Aloe vera stimulates fibroblast which produces the collagen and elastin fibers making the skin more elastic and less wrinkled. It also has cohesive effects on the superficial flaking epidermal cells by sticking them together, which softens the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects has also been studied in treatment of dry skin associated with occupational exposure where aloe vera gel gloves improved the skin integrity, decreases appearance of fine wrinkle and decreases erythema [42].

6. Adverse effects of Aloe vera

Abdominal spasms and pain may occur after even a single dose and overdose can lead to colicky abdominal spasms and pain, as well as the formation of thin, watery stools. Chronic abuse of Anthraquinones stimulant laxatives can lead to hepatitis [43] and electrolyte disturbances (hypokalemia and hypocalcaemia), metabolic acidosis, malabsorption, weight loss, albuminuria and hematuria [44, 45]. Weakness and orthostatic hypotension may be exacerbated in elderly patients when stimulant laxatives are repeatedly used [46]. Secondary aldosteronism may occur owing to renal tubular damage after aggravated use. Steatorrhoea and protein-losing gastroenteropathy with hypoalbuminaemia have also been observed, as have excessive excretion of calcium in the stools and osteomalacia of the vertebral column [47]. Melanotic pigmentation of the colonic mucosa (*pseudomelanosis coli*) has been observed in individuals' taking Anthraquinones laxatives for extended time periods. The pigmentation is clinically harmless and usually reversible within 4 to 12 months after the drug is discontinued [48]. Aloe vera contains polysaccharides which increase the insulin level and show hypoglycemic properties [49]. As with other stimulant laxatives, products containing Aloe should not be used in patients with intestinal obstruction or stenosis, stony severe dehydration with electrolyte depletion, or chronic constipation [50].

Chronic use may cause dependence and need for increased dosages, disturbances of water and electrolyte balance (hypokalemia) and an atonic colon with impaired function [51]. The use of stimulant laxatives for more than 2 weeks requires medical supervision. Chronic abuse with diarrhoea and consequent fluid and electrolyte losses (mainly hypokalemia)

may cause albuminuria and hematuria and may result in cardiac and neuromuscular dysfunction, the latter particularly in the case of concomitant use of cardiac glycosides (digoxin), diuretics, corticosteroids, or liquorices root.

Aloe should not be administered to patients with inflammatory intestinal diseases, such as appendicitis, crohn's disease, ulcerative colitis, irritable bowel syndrome, or diverticulitis or to children less than 10 years of age. Aloe should not be used during pregnancy or lactation except under medical supervision after evaluating benefits and risks. Aloe is also contraindicated in patients with cramps, colic, hemorrhoids, nephritis or any undiagnosed abdominal symptoms such as pain, nausea, or vomiting^[52, 53].

7. Conclusion

There are vast range of Pharmaceutical, Nutritional and Cosmetics products made by Aloe vera. All these products are most effective and safe to use. However, there are some complications linked with the use of Aloe vera and medical supervision is recommended for long term use of Aloe vera.

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