



Update on Major Active Constituents, Medicinal Values, and other Uses of Aloe Vera

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Review Article

Volume 8 Issue 1

Received Date: May 11, 2023

Published Date: June 23, 2023

DOI: 10.23880/oajvsr-16000237

Abstract

Aloe vera is a well-known medicinal plant belonging to the Liliaceae family. The plant has been used for medicinal purposes by different countries and in several cultures. There is a broad list of the therapeutic claims of different parts of Aloe vera due to its pharmacological activities which are employed in traditional management of diverse veterinary and human diseases. The plant leaves contain numerous minerals, enzymes, amino acids, natural sugars, and other bioactive compounds with emollient, purgative, antimicrobial, anti-inflammatory, antioxidant, aphrodisiac, anti-helminthic, antifungal, antiseptic, and cosmetic values for health care. Aloe vera may also be used in food supplements, is a flavoring agent in food products, and helps to balance metabolism.

Keywords: Aloe vera; Aloe vera juice; Aloe vera gel; Medicinal values; Chemical Constituents

Introduction

Medicinal plants are occupying a prominent position in the pharmacological sector owing to their rich wealth of bioactive compounds [1]. Herbal medicine utilizes plant-natural products as medication after the isolation of their active constituents [2]. Approximately 20% of the plants found in the world have been submitted to pharmacological or biological tests, and a substantial number of new antibiotics introduced on the market are obtained from natural or semi-synthetic resources [3]. The clinical efficacy of many synthetic antibiotics is questioned nowadays with the emergence of multidrug resistance pathogens. The increasing failures of chemotherapeutics and antibiotics exhibited by the pathogenic microbial infection have led to the screening of several medicinal plants for potent microbial activity [4]. Throughout the world, today, extensive investments have occurred in the therapeutic applications of

herbal plant resources, which are of unlimited abundance around us, to improve the quality of life [5]. Aloe vera is a well-known medicinal plant belonging to the Liliaceae family. It is a cactus-like plant that grows readily in hot tropical climates. The slimy gel in the Aloe vera leaf (Aloe vera gel) has traditionally been used for treatment of the digestive tract disturbances, sunburn and wounds and it has been attributed to more than 75 active agents [6].

The plant leaves contain numerous minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, antimicrobial, anti-inflammatory, antioxidant, aphrodisiac, anti-helminthic, antifungal, antiseptic, and cosmetic values for health care [7]. There is a broad list of the therapeutic claims of different parts of Aloe Vera due to its Pharmacological activities which are employed in the traditional management of diverse veterinary and human diseases [8].

Aloe vera is a wonder plant with numerous health benefits. It has been known long back for its health, beauty, medicinal, and skin care properties. It acts as a natural fighter against all sorts of infections, is an efficient anti-oxidant, and helps in treating all digestion-related problems, heartburn, arthritis, stress, diabetes, rheumatic pain, asthma, and cancer. It also acts as a laxative, beauty enhancer and affects lowering blood sugar levels in diabetics. The plant works on congestion, intestinal worms, indigestion, stomach ulcers, colitis, hemorrhoids, liver problems such as cirrhosis and hepatitis, kidney infections, urinary tract infections, and prostate problems and acts as a general detoxifier when taken internally [1,9].

In recent times, Aloe vera gel has been used as an active ingredient in hundreds of skin lotions, sunblocks, and cosmetics [5]. Now a day's, Aloe vera is widely used in Food. It is also approved by the FDA as a flavoring agent & as a food supplement. It is also a main ingredient in many herbal remedies. The objective of this paper is to discuss and describe on chemical constituents, and the medicinal and nutritive value of Aloe vera.

Literature Review

Historical Background of Aloe Vera

Aloe vera has been one of the most important plants used in folk medicine. The name Aloe vera derives from the Arabic word "Alloeh" meaning "shining bitter substance," while "vera" in Latin means "true." Greek scientists regarded

Aloe vera as the universal panacea, Egyptians as "the plant of immortality" and included it among the funerary gifts buried with the pharaohs [10]. The healing benefits of Aloe were recognized in the ancient Indian, Chinese, Greek, and Roman civilizations. It is traditionally used to heal wounds, relieve itching and swelling, and is known for its anti-inflammatory and antibacterial properties [11].

Aloe barbadensis miller, commonly referred to as Aloe vera, is one of more than 400 species of Aloe belonging to the family Liliaceae that originated in South Africa, but have been indigenous to dry subtropical and tropical climates, including the southern USA, Greece, Egypt, India, Mexico, Japan, and China [8].

Plant Description and Taxonomy

Aloe vera is a perennial, drought-resisting, succulent plant belonging to the Asphodelaceae (Liliaceae) family [12]. It is a stemless or very short-stemmed plant growing to 80-100 cm tall, spreading by offsets and root sprouts. The leaves are lanceolate, thick and fleshy, green to grey-green, with a serrated margin. The flowers are produced on a spike up to 90 cm tall, each flower pendulous, with a yellow tubular corolla 2-3 cm long (Figure 1). The tissue in the center of the aloe leaf contains a gel that yields aloe gel or Aloe vera gel [13,14]. Aloe vera is classified: as Kingdom: Plantae, Order: Asparagales, Family: Liliaceae, Genus: Genus: Aloe Species: Aloe barbadensis [15].

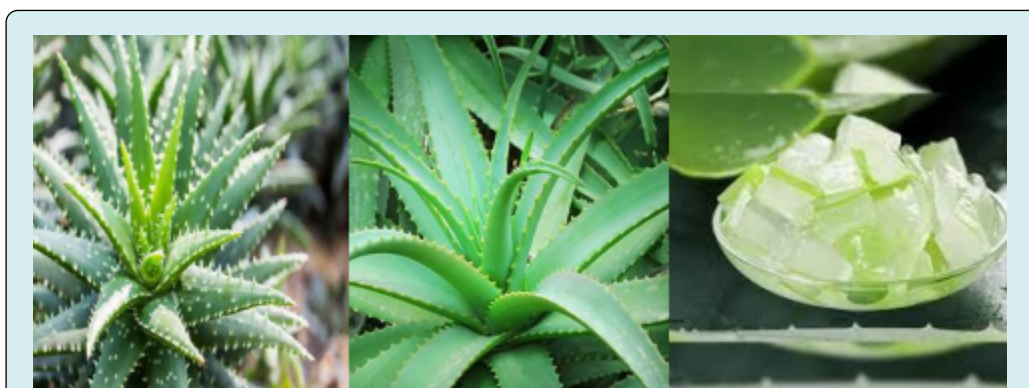


Figure 1: Aloe vera plant and Aloe vera gel [14].

Chemical Constituents of the Aloe Vera

In General active ingredients of Aloe vera and their properties contain 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids [16]. In addition, Aloe vera contains products of the isoprenoid pathway, such as carotenoids,

steroids, terpenes, and phytosterols, and some essential amino acids/nonessential amino acids and enzymes, such as bradykinase, carboxypeptidase, cyclooxygenase and carboxypeptidase. The plant is a rich source of many natural health-promoting substances including Vitamins/Minerals: Vit C, A, E, and B vitamins, B-carotene, Zinc, Calcium, Copper, Magnesium, Manganese, and Phosphorous [4,10].

Anthraquinones/Anthrones: Different types of anthraquinones are present in Aloe Vera. There are about 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 [16]. They act as natural laxatives, painkillers, and analgesics and they contain powerful antibacterial, antifungal, and virucidal properties and also Fatty Acids: Aloe Vera provides four plant steroids: cholesterol, campesterol, sitosterol, and lupeol. All these have anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties [7,17].

Enzymes: Some of the Enzymes in the A.vera are: peroxidase, alliance, catalase, lipase, cellulose, carboxypeptidase, amylase, and alkaline phosphatase. Some enzymes help to break down starch and sugar [16,18].

Sugars: Aloe vera provides monosaccharides (glucose and fructose) and polysaccharides (glucomannans/polymannose). These are derived from the mucilage layer of the plant and are known as mucopolysaccharides. The most common polysaccharides are called glucomannans (beta -1, 4 acetylated mannans) Acemannan, a prominent glucomannan has also been found. A glycoprotein with anti-allergic properties, called alprogen, and a novel anti-inflammatory

compound, glucosyl chromone, has been isolated from Aloe vera gel [10,19].

Saponins: Another constituent of Aloe vera includes saponins. These are soapy substances from the gel that are capable of cleansing and having antiseptic properties. The saponins perform strongly as anti-microbial against bacteria, viruses, fungi, and yeasts [9].

Lignin's: Pulp-like substance existing with cellulose in the leaf gel of A.vera. Its presence provides a strong ability to penetrate human skin. The medicinal properties of lignins are so far unknown. Lignins penetrate the toughened areas of the skin being beneficial for skin problems such as eczema and psoriasis [7].

Minerals: Aloe vera provides calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium, and zinc. They are essential for the proper functioning of various enzyme systems in different metabolic pathways and few are antioxidants [17,19].

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 [8,16].

Chemical Group	Constituents	Properties and activity
Amino acids	Provides 20 of the 22 required amino acids and 7 of the 8 essential ones.	Basic building blocks of proteins in the body and muscle tissues
Anthraquinones	Provides Aloe-emodin, Aloetic acid, Alvin, anthracite	Analgesic, antibacterial
Enzymes	Anthranol, barbaloin, chrysophanic acid, emodin, ethereal oil, ester of cinnamonic acid, iso barbaloin, resistant	Antifungal & antiviral activity but toxic at high concentrations.
Hormones	Auxins and gibberellins	Wound healing and anti-inflammatory activities
Minerals	Calcium, chromium, copper, iron, manganese, potassium, sodium, and zinc.	Essential for good health.
Salicylic acid	Aspirin like compounds	Analgesic
Saponins	Glycosides	Cleansing & antiseptic
Steroids	Cholesterol, campesterol, lupeol, sistosterol	Anti-inflammatory agents, lupeol have antiseptic and analgesic properties.
Sugars	Monosaccharides: Glucose and Fructose Polysaccharides: Glucomannans/polymannose	The anti-viral, immune-modulating activity of Acemannan
Vitamins	A, B, C, E, choline, B12, folic acid	Antioxidant (A, C, E), neutralizes free radicals
Miscellaneous including organic compounds and lipids	Arachidonic acid, Y-linolenic acid, steroids (campesterol-cholesterol, B-sitosterol), triglycerides, salicylic acid	Essential for the proper functioning

Table 1: Chemical composition and properties of Aloe vera [1,3,9,14,20].

Nutritional Value of Aloe Vera

The Aloe vera plant contains a multitude of essential vitamins and minerals such as vitamins A, B1, B2, B3, B6, B12, C, E, folic acid, choline, calcium, phosphorous, potassium, iron, sodium, magnesium, manganese, copper, chromium, and zinc. Aloe also contains a wealth of amino acids such as isoleucine, leucine, lysine, methionine, phenylalanine, threonine, valine, aspartic acid, glutamic acid, alanine, arginine, cystine, glycine, histidine, hydroxyproline, proline, serine, and tyrosine [9]. It also provides powerful antioxidants and helps to balance metabolism (Table 1). The raw pulp of gel contains approximately 98.5% water, while the mucilage or gel consists of about 99.5% water-free monosaccharides consisting of D-mannose and D-glucose in a molar ratio of 5:4 and trace amounts of xylose, rhamnose, galactose, and either arabinose or fructose. Mannose 6 phosphate is a major sugar component in Aloe vera [21].

Aloe vera extracts may be used in beverages as bitter flavoring agents in food products including health and soft drinks, yogurts, jams, instant tea granules, candies, alcoholic beverages, and ice cream. Aloe vera may also be used in food supplements [22].

Medicinal Value of Aloe Vera

Wound healing effects: Aloe vera is often called the “Natural healer”. Aloe gel is excellent for healing first-degree burns, relieves inflammation, and accelerates healing. It stimulates cell division due to the presence of wound-healing hormones. Aloe vera gel has antibacterial, antifungal, antiviral, and antiseptic properties and helps to heal minor wounds [9].

Aloe Vera is best known for its soothing and healing effects on burns and other wounds. Aloe Vera when applied to a wound increases both the rate of wound closure and the tensile strength of the wound via the proliferation of cells [17]. Brady kinase enzymes help in the reduction of excessive inflammation when applied to the skin topically [23].

Several different mechanisms have been proposed for the wound-healing effects of the extract from Aloe vera leaves [24]. A.vera may have a direct effect on the wound healing process as a whole, by increasing wound contraction and collagen synthesis. Aloe vera gel can not only increase the amount of collagen in wounds but also change the composition of collagen, increase collagen cross-linking and thereby promote wound healing [25]. These include keeping the wound moist, faster maturation of collagen, increase in epithelial cell migration, and reduction of inflammation. The healing property of Aloe vera is related to compounds such as glucomannan and acemannan. The first of these is enriched in polysaccharides like mannose 6-phosphate [26].

The glucomannan up-regulates the fibroblast growth factor stimulating the proliferation of fibroblasts and improving collagen production. Acemannan increases periodontal ligament cell proliferation by up-regulating the growth factor 5, enhancing type I collagen and alkaline phosphatase activity in primary human periodontal ligament cells. The Aloe vera gel polysaccharide acemannan was also shown to activate macrophages; an effect that improved wound healing in a rat model [19,27].

Anti-cancer effects: Aloe vera contains two fractions that are claimed to have anti-cancer effects including glycoproteins and polysaccharides. The anti-cancer activity of polysaccharides isolated from Aloe vera and specifically acemannan has been investigated in many different animal species [3]. Several glycoproteins present in Aloe vera gel have been reported to have antitumor and antiulcer effects and to increase the proliferation of normal human dermal cells [28].

Different studies indicated anti-tumor activity for Aloe Vera gel in terms of decreased tumor burden, tumor shrinkage, tumor necrosis, and reduces prolonged survival rates. One mechanism of action that was proposed for these anti-cancer effects of aloe polysaccharides is stimulation of the immune response [29].

Aloe vera acts as a radiation protector and inhibits testicular damage from gamma radiation and reduces cancer. A. vera juice is the most important that produced from Aloe vera that enables the body to heal itself from cancer and also from the damage caused by radio and chemotherapy that destroys healthy immune cells crucial for the recovery [9]. Aloe vera emodin, and anthraquinones, can suppress or inhibit the growth of malignant cancer cells making it to have antineoplastic properties [3].

Digestive system health: Aloe vera juice is useful to treat gastric intestinal problems like indigestion, candida, and colitis and for relief from digestive issues such as heartburn and irritable bowel syndrome, although it bears the significant potential to be toxic when taken orally [9].

Aloe vera extract (50%) increased the cell viability of dental pulp stem cells being useful for avulsed broken teeth. This effect is attributed to polysaccharides, mainly Acemannan, by inducing osteogenic-specific gene expressions, DNA synthesis, growth factor, and JAK-STAT pathway [30].

Aloe Vera is the most important to act against various micro-organisms and increases total white blood cell count and macrophages. In acute gastric mucosal lesions, the extract dose-dependently inhibits gastric acid secretion and provides gastroprotective activity [31].

Anti-inflammatory action: Inflammation is an innate response of the body against an injury, characterized by swelling, pain, redness, and heat, resulting in a delay in the healing process [17]. Aloe vera Juice contains 12 essential nutrients that inhibit inflammation with rare incidences of side effects [32]. The anti-inflammatory action of Aloe Vera gel not only relieves from pain and discomfort, but also accelerates the healing process. A.vera could inhibit the inflammatory process following burn injury, as characterized by the reduction of leukocyte adhesion, as well as pro-inflammatory cytokines [24].

The anti-inflammatory activity of Aloe vera gel has been revealed by some in vitro and in vivo studies through bradykinase activity. The peptidase bradykinase was isolated from aloe and shown to break down the bradykinin, an inflammatory substance that induces pain. A novel anti-inflammatory compound, C-glucosyl chromone, was isolated from gel extracts [14,16].

Aloe vera inhibits the cyclooxygenase pathway and reduces prostaglandin E2 production from Arachidonic acid. Lupeol, the most active anti-inflammatory sterol, reduced inflammation in a dose-dependent manner. The aloe sterol includes campesterol, β -sitosterol, lupeol, and cholesterol which are anti-inflammatory in nature, help in reducing the inflammation and pain, and act as a natural analgesic. Another aspirin-like compound present in Aloe is responsible for anti-inflammatory and antimicrobial properties [3].

Laxative effects: Latex of Aloe vera that contains Anthraquinones is a potent laxative; it stimulates mucus secretion and increases the intestinal water content and intestinal peristalsis. Aloe latex is known for its laxative properties [1,3]. Dried latex from the inner lining of Aloe leaves has been used traditionally as a laxative taken by mouth. Although few studies have been conducted to assess this effect on Aloe in humans, the laxative properties of Aloe components such as aloin are well supported by scientific evidence [13].

Cardiovascular effects: Researchers have found that Aloe vera easily stimulates the fibroblasts for making new tissues. When fibroblasts are stimulated, proteoglycans and collagens are formed and, thus risk of cardiovascular disorders decreases [9]. However, studies suggest that the ingestion of Aloe vera gel may have a beneficial effect on the accumulation of blood lipids associated with the disease. Test groups given Aloe vera showed a decrease in total cholesterol, triglyceride, phospholipids, and non-esterified fatty acid levels, each of which, when elevated, seem to accelerate the accumulation of fatty material in large and medium-sized arteries, including the coronary arteries of the heart [12].

Antibacterial activities: Aloe vera gel has antibacterial activity, allowing helpful microorganisms to exhibit their effect on nutrient digestion at the expense of pathogenic bacteria activity in the gastrointestinal tract [32]. A.vera is proposed to have direct antibacterial properties including anthraquinones and saponins. While polysaccharides have been attributed to direct bacterial activity through the stimulation of phagocytic leucocytes to destroy bacteria [18].The Aloe extract was potent against various species of bacteria including *S. aureus*, *S. agalactia*, *E. choli*, *Streptococcus pyogens*, *M. bacterium tuberculosis*, *Pseudomonas aerogenosa*, *Klebsiella pneumonia*, etc [3,18].

Antifungal activity: A refined aloe vera gel preparation reported suppressed the growth of fungus albicans. The purified aloe proteins have been found to exhibit potent antifungal activity against candida paraphimosi, candida krusei, and candida albicans. Aloe gel is used topically for infections that are caused by these fungal agents [4]. This therapeutic benefit of Aloe vera gel leaves might be due to its properties and chemical components. Also, the potency of A.vera in curing ringworm might be due to increasing the ability of internal immunity that strengthens the natural resistance by boosting T- lymphocyte cells that aid the immune system [3,18].

Antiviral activity: The antiviral activities of Aloe extracts may be due to indirect or direct effects. Indirectly they show these effects by stimulating the immune system and directly by anthraquinones. Anthraquinone aloin inactivates various enveloped viruses such as Herpes simplex, Varicella zoster, and Influenza [1,3]. Lectins, fractions of Aloe vera gel, directly inhibited the cytomegalovirus proliferation in cell culture, perhaps by interfering with protein synthesis [17].

Hepatoprotective Activities

Oral use of Aloe juice helps in the recovery of chronic hepatitis patients. Internal intake of Aloe vera has been associated with acute hepatitis. The fresh juice obtained from the cut bases of the leaves is used to treat the liver and spleen [9].

Aloe vera Juice improves the liver function and is an excellent antidote in case of excessive ingestion of alcohol. In addition to this, it also prevents scarring of the liver [31]. The hepatoprotective action was also attributed to preserving the metabolizing enzymes of the liver through an antioxidant activity [33].

Lophenol and Cycloartanol are two phytosterols present in the aloe vera plant and induce downregulation of fatty acid synthesis along with upregulation of fatty acid oxidation in the liver; thus reducing intra-abdominal fat and improving hyperlipidemia [24,26].

Anti-diabetic activities: Aloe vera gel is well known for reducing the blood sugar level. It significantly reduced the fasting blood glucose, hepatic transaminases, plasma and tissue cholesterol, triglycerides free fatty acids, and phospholipids and in addition also significantly increased plasma insulin levels [14].

The dried gel of aloe is employed to treat polygenic disease because it helps to lower blood glucose levels by decreasing internal secretion resistance and conjointly lowers the acyl glycerol levels within the liver and plasma. Aloe helps to boost the blood quality naturally by decreasing the amount of steroid alcohol and acyl glycerol. Since, aloe helps to regulate steroid alcohol, triglycerides, and blood sugar; it directly helps to stop upset. Aloe keeps the blood contemporary and wealthy in chemical elements [34].

According to Sánchez [32]; 31 Aloe vera showed to reduce blood glucose levels, to increase insulin levels, and to improve pancreatic islets (number, volume, area, and diameter and this medicinal plant protected from oxidative stress-induced diabetic nephropathy and anxiety/depression-like behaviors. Polysaccharides found in Aloe vera increase insulin levels and show hypoglycemic properties [3,4].

Other Health Benefits Of Aloe Vera

Cosmetics and skin protection: The Aloe vera gel may be used as an emollient and moisturizer in cosmetics and personal care products. The gel is used in the cosmetics industry as a hydrating ingredient in liquids, creams, sun lotions, shaving creams, lip balms, healing ointments, and face packs [35]. Other products containing Aloe vera include after-shave gel, mouthwash, hair tonic, shampoo, and skin-moistening gel Aloe vera gels are used as skin tonic against pimples [8]. 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. Aloe sugars are also used in moisturizing preparations. Mixed with selected essential oils, it makes an excellent skin smoothening moisturizer, sunblock lotion plus a whole range of beauty products [3].

Antiseptic effects: Aloe vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols, and sulfur. They all have an inhibitory action on fungi, bacteria, and viruses [28]. These blends also have an inhibitory action on parasites, organisms, and diseases. Despite the way that an extensive part of these usages is captivating controlled trials are critical to choose its practicality in all diseases [3,4].

Moisturizing and anti-aging effect: Aloe Vera is one of the most important and it is rich in mucopolysaccharides which help in binding moisture to the skin. Aloe Vera stimulates

fibroblasts to produce collagen and elastin fibers thereby making more elastic and less wrinkled skin. It also has cohesive effects on the superficial flaking epidermal cells by sticking them together, which softens the skin [1].

The amino acids present in Aloe gel also soften hardened skin cells. Aloe vera gel gloves improved skin integrity and decreased the appearance of fine wrinkles and erythema in the treatment of dry skin associated with occupational exposure indicating its moisturizing effects The Aloe gel gives a cooling effect and also acts as a moisturizing agent. It also has a role in gerontology and the rejuvenation of aging skin [8].

Antioxidant effect: Antioxidants are compounds that prevent or slow down biomolecule oxidative damage caused by reactive oxygen species through free radical scavenging, metal chelation, and enzyme regulation [30]. A.vera contains substantial amounts of antioxidants including a-tocopherol (vitamin E), carotenoids, ascorbic acid (vitamin C), flavonoids, and tannins; and it has been suggested that antioxidant action may be an important property of plant medicines used in the treatment of various diseases [24]. Aloe vera gel is high in polyphenols and natural antioxidants, which help to prevent free radical overproduction, which causes lipid peroxidation and immune cell damage [32].

Toxicity and Contraindication of Aloe Vera

Extensive topical application of Aloe vera gel may cause redness, burning, stinging sensation, and rarely generalized dermatitis in sensitive individuals [17]. 8 Allergic reactions are mostly due to anthraquinones, such as aloin and barbaloin. Allergic reactions Contact dermatitis has been reported, as potentially toxic compounds in Aloe Anthraquinone glycosides [36,37].

Studies have shown that Aloe-emodin, anthraquinones present in A.vera, has been associated with hepatotoxicity, genotoxicity, nephrotoxicity, phototoxicity, and reproductive toxicity [38]. The use of Aloe Vera as a laxative during pregnancy may pose potential teratogenic and toxicological effects on the embryo and fetus [17].

When orally administered it may cause abdominal cramps, diarrhea, red urine, dependency, or worsening of constipation. Prolonged use has been may associate with watery diarrhea and cause electrolyte imbalances (low potassium levels) [36]. Aloe Vera may increase the risk of bleeding. Alert is promoted in people with bleeding disorders or taking drugs that may increase the risk of bleeding [30].

Conclusion

Aloe vera is a plant used as a medicine now and also traditionally to cure a wide range of health complications including skin problems, stomach problems, immune system problems, various lung and heart diseases, and many more, thus referred to as a wonder plant. The active ingredient hidden in its succulent leaves has the power to soothe human life and animal health in different ways. It has been used for its healing, cosmetics, and therapeutic properties since ancient times. The main medicinal constituents of aloe vera are the natural sugar (polysaccharides), anthraquinones, and vitamin which make it an excellent therapeutic agent's especially biological effect: antimicrobial, antioxidant, anti-inflammatory, anticancer, anti-diabetic, and immunomodulation activities. Besides, several medicinal effects of the plants; large variation in the composition of aloe vera wasn't adequately identified, and a Specific dose of aloe vera for specific diseases wasn't set through scientific research. Therefore further study is needed to refine the use and improvement of the efficacy of this important medicinal plant.

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