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Aloe a Gel in a Cell

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Review Article

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Abstract

Aloe a miracle plant obtained from many species namely aloe vera, aloe barbadensis, aloe perryi, aloe ferox and various other species. Aloe vera the Indian species cultivated in India and other species are cultivated in Africa. Aloe is a cactus-like plant that grows in hot, dry climates. Aloe plant can withstand drought conditions and can grow without rainfall. Aloe produces two substances, gel and latex. Aloe gel is a clear, jelly-like substance found in the inner part of the aloe plant leaf. Aloe latex comes from the plant's skin and is yellow in color. Some aloe products are made from the whole crushed leaf, so they contain both gel and latex. Aloe vera plant has enormous activities in treatment of various skin diseases such as acne, burns, psoriasis, etc. and used in herbal cosmetics. Aloe gel is used in many cosmetic preparations as face wash and herbal creams etc. since the potency, efficacy, safety is more toxicity and side effects are comparatively less. Aloe is used in gum diseases in, dental problems and dental plaque etc. Aloe gel has anti-diabetic activity, used in treatment of glaucoma, and can treat vision problems. It is also used in hepatitis, osteoarthritis, varicose veins, weight loss etc. aloe has tremendous other activities. This review includes various uses, medicinal properties, pharmacological actions, various extracts of these Aloe species are traditionally used and their application used to cure, arthritis, inflammation, immunity, diabetes, hyperlipidemic, antioxidant, atherosclerosis, coronary heart diseases, laxative, antibacterial, antifungal, antiviral, wound healing and antitumor effect. Since aloe has been reviewed in many journal and articles, this review is compiled from recent article of aloes. Hence aloe is an invaluable gift of nature and a miracle plant. Aloe is a medicinal plant from the past, present and future and the invaluable activities present in this plant leads us to promising activities for the research and development for finding new entities.

Keywords: Aloe gel; Herbal Medicine; Medicinal Properties; Phytoconstituents; Pharmacological Activities

Introduction

Aloe vera is one of the most important species of Aloe found in India belonging to family *Liliaceae* [1]. *A. vera* is considered to be one of the most potent and, thereby, the most popular plant in the research field [2]. *A. vera* has been used in herbal medicine for over 2000 years, and has remained an important component in the traditional herbal medicine and complementary alternative medicine of many contemporary cultures [3].

A. vera is a xerophytes [4] which can withstand drought conditions and survive without water for years and aloe also has water holding capacity. Aloe leaf has a thick outer covering protecting the gel from external environment and preserving the gel. They can even grow in low rainfall conditions. They can live in areas of low water availability and they contain a large water storage tissue. The main feature of the *A. vera* plant is its high water content, The remaining portion is reported to contain 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 constitutes around 20–30% and the pulp 70–80% of the whole leaf weight [5].

Various extracts of these Aloe species are traditionally used and their application used to cure, arthritis, inflammation, immunity, diabetes, hyperlipidaemic, antioxidant, atherosclerosis, coronary heart diseases, laxative, antibacterial, antifungal, antiviral, wound healing and antitumor effect, , skin cancer, burns, eczema, psoriasis, digestive problems and blood pressure [6]. As different Aloe species would have varying phytochemical contents due to interspecies variation and varying climate and soil conditions, direct correlation of biological activity would be inaccurate.

Aloe Barbadensis contains secondary metabolites mainly anthraquinones, aloe-emodin, aloetic acid, anthranol, aloin A and B (or collectively known as barbaloin), isobarbaloin, emodin, ester of cinnamic acid, carbohydrates, enzymes, minerals, lipids and miscellaneous organic compounds, amino acids, proteins, polysaccharides and vitamins. Many secondary metabolites in plants have reported potent anti-inflammatory, lipid lowering, and antioxidant activities [7]. Aloe has been used since centuries to cure different complicated diseases, skin allergies, skin infections like psoriasis, scabies, eczema, acne, aloe is used as skin whitening agent, moisturizers, protecting the skin from UV radiations, and they increase the secretion of melanin pigments in the skin, in the treatment of Leucoderma (vitiligo), pigmentation disorders like hyper pigmentation.

Hence aloe has abundant activities some recent activities related to this plant are reviewed in this article. Anti-inflammatory, antidiabetic, antihyperlipidemic, antioxidative, Immunomodulatory properties, rheumatoid arthritis, anti-hyperglycemic, antioxidant capacities, antibacterial, anti-mycoplasmic, atherosclerosis, laxative, antimicrobial, antifungal, antibacterial, anticancer, anti-psoriatic and wound healing activities are reviewed in this article.

The clinical evidence of aloe vera gel is popular in cosmetics, many clinical evidences has been reported for the use of aloe vera gel in cosmetic science in treatment of various skin diseases in plastic surgery, in treatment of burns, treating wounds, psoriasis, dermatitis and also as an antidiabetic. Despite aloe gel in treatment of various skin diseases aloe gel is reported in many clinical trials in treating dyslipidemia, liver protection, anti-oxidant effects, anti-cancer, antimicrobial, genital herpes, acne vulgaris, dentistry, eye diseases, etc. Various clinical trials have proven the use of aloe gel in many studies. Since there was no adverse effects of aloe vera gel were reported in any of the above trials. Some patients experienced burning after topical application, contact dermatitis and mild itching. Various clinical trials have proved the use of aloe gel in many studies. All Adverse effects were reversible and aloe vera was generally very well tolerated. Aloe vera gel is used in many drugs as solubility enhancer, penetration enhancer, and absorption enhancer, but when side effects are concerned it is safe on skin with minor or fewer side effects but major side effects are with oral administration of aloe latex leads to kidney failure and cancer.

Anti-Inflammatory Activity

Aloe vera was investigated for anti-inflammatory activity through MMP inhibition studies. The effect of *Aloe vera* on MMP-9 inhibition was tested on peripheral blood mononuclear cells (PBMC). The cell count and viability was determined using dye exclusion technique. Cytotoxicity was evaluated by MTT assay. Activation of MMP-9 was visualized by gelatin zymography. Inhibition of MMP-9 in the presence of aqueous extract of *Aloe vera* was detected by gelatin zymography and confirmed by RT-PCR [8]. The effect of endogenous elicitors on the type III polyketide biosynthesis pathway and identified the metabolic changes induced in elicitor-treated *Aloe vera* adventitious roots was examined in this study. SA has an important role in activation of the plant specific-type III polyketide

biosynthetic pathway, and therefore that the efficacy of *Aloe vera* as medicinal agent can be improved through SA treatment [9].

Antidiabetic

The anti inflammatory potential of *Aloe vera* in alloxan induced diabetes rats was evaluated. *Aloe barbadensis* gel has potent anti-inflammatory potential in experimental diabetes, and thus *Aloe vera* can be used as an alternative remedy for treatment of diabetes mellitus [10].

Anti-Diabetic, Antihyperlipidemic and Antioxidative

The antidiabetic, antihyperlipidemic and antioxidative activity of *Aloe vera* gel extract in diabetic and control rats were evaluated. Serum glucose, total cholesterol, triacylglycerols, Malondialdehyde (MDA), nitric oxide and total antioxidant capacity were estimated. Moreover, *Aloe vera* gel extract contained natural antioxidants (total phenols, total flavonoid, vitamins C and E) which are responsible for the antioxidative effect of this plant [11].

Immunomodulatory Properties

The effect of *A. vera* plant extract on cellular and humoral immune response in rabbits was evaluated. *A. vera* may stimulate both cellular and according to the results, oral administration of *A. vera* affected the composition of lymphocyte subsets and serum immunoglobulins positively humoral immune responses after immunization [12]. The effects of oral supplements of *Aloe vera* extract on hemotology indices and immune cells of rabbit were investigated. *A. vera* has hematopoetic and immunomodulatory effects; thus its extract can be used for the treatment of anemia and immune deficiency problems [13]. Aloe gel was orally administered on some parameters of cellular and humoral immunity viz. mitogen-induced proliferation of splenic lymphocytes and their chemokinetic activity, and anti-sheep red blood cells (SRBC) antibody production in Balb/c mice was evaluated [14].

Rheumatoid Arthritis

The anti-arthritic activity of raw *Aloe vera* gel and its effects in rat model where arthritis was induced by using Freund's Complete Adjuvant (FCA). *Aloe vera* extracts can be beneficial for the reduction of inflammatory edema and also for the reduction of ceruloplasmin in RA condition in rat model. However, further investigations are necessary for more refined therapeutic usage of *Aloe vera* for the treatment of RA in human [15].

Anti-Hyperlipidemic Agents and Anti-Hypercholesterolemic Agents

A double-blind clinical trial was conducted with hyperlipidemic (hypercholesterolemic and/ or hypertriglyceridemic) type 2 diabetic patients. The aloe gel lowered the fasting blood glucose, HbA1c, total cholesterol, and LDL levels significantly without any significant effects on the other blood lipid levels and liver/kidney function tests. Aloe gel may be a safe anti-hyperglycemic and anti-hypercholesterolemic agent for hyperlipidemic type 2 diabetic patients [16].

Antioxidant Capacities

The antioxidant capacities, and antibacterial activities of *Aloe vera* lyophilized leaf gel (LGE) and 95% ethanol leaf gel extracts (ELGE) was identified using GC-MS and spectrophotometric methods. The antibacterial activity was screened for three different solvents such as aqueous, ethanol, and acetone were used to extract the bioactive compounds for selected human clinical pathogens by agar diffusion method. *Aloe vera* extracts showed promising effects on antioxidant and antibacterial activities [17]. The antioxidant properties of aqueous extract of aloe in animal model was evaluated. The extract exhibited concentration-dependent DPPH and ABTS radical scavenging activity [18]. The antioxidative properties of extracts of *Aloe vera* gel made in methanol (MEAG), 95% ethanol (EEAG), hexane (HEAG), acetone (AEAG) and chloroform (CEAG) were investigated employing various in vitro systems viz. The in vitro antibacterial properties of methanolic extract of *Aloe vera* gel extract were investigated against various common pathogenic bacteria. *Aloe vera* gel extract could be same as a new source of natural antioxidant with potential applications for reducing the levels of lipid oxidation and oxidative stress [19]. The inhibitory potential of AVG against α-amylase, α-glucosidase, and pancreatic lipase activity in vitro was investigated. The glucose entrapment ability, antimicrobial activity, and total phenolic, flavonoid, tannin, and anthocyanin content were also determined. AVG also showed interesting antioxidant properties [20].

Anti-Mycoplasmic Activities

The methanol extracts of leaf skins and flowers of *Aloe vera* were analyzed for their phenolic profiles and screened for their antioxidant and antimycoplasmic activities. Therefore, *A. vera* extracts from leaf skin and flowers can be considered as good natural antioxidant sources [21].

Atherosclerosis

This anti-atherosclerotic effect of *Aloe vera* was evaluated in hypercholesterolemic rabbits. The presence of fatty streaks in arteries of animals with histopathological methods was investigated and compared. High cholesterol diet group significantly increased total cholesterol and CRP [22]. *Aloe vera* leaf gel exerts atherosclerosis risk factors, and also fatty streak formation in hypercholesterolemic rabbits. Then total cholesterol (TC), fasting blood sugar (FBS), triglyceride (TG) and CRP were measured before and after experimental periods this plant exerts its anti-atherosclerotic effects [23]. The effect of *Aloe vera* gel on contractile and cardio protective activity on rat myocardium using isolated heart model was investigated. *Aloe vera* causes increase in myocardial force of contraction and coronary flow; therefore *Aloe vera* may be cardio protective [24].

Laxative

The efficacy of the ethanolic leaf extract of *Aloe vera* against loperamide-induced constipation in rats was evaluated. The effect of the extract compared with Gaviscon, a standard laxative drug. These findings have therefore lent scientific support to the use of the herb as a laxative agent [25].

Antibacterial Activity

This antibacterial activity of *A. vera* purified extracts including gel, boiled skin, boiled gel, and distilled extract against pathogenic bacteria, *Staphylococcus aureus*, methicillin-resistant *S. aureus* (MRSA), *Klebsiella pneumonia* and *Pseudomonas aeruginosa* were elucidated. The *A. vera* distillate extract despite the minimal amount of carbohydrate and protein was more efficient against both Gram-positive and Gram negative bacteria [26].

The antibacterial activity of leaf and gel extracts of *A. vera* were tested against gram positive and gram negative skin infections isolates. The gel extracts of *A. vera* showed antibacterial activity against both gram positive and gram negative isolates. Five standard antibiotics were also tested against the isolated strains. *A. vera* showed promising results compared to five broad-spectrum antibiotics. The skin infectious isolates were resistant against broad-spectrum antibiotics [27].

Antimicrobial Activity

The antimicrobial activity of *Aloe vera* juice with different solvents viz; hexane, ethyl acetate, petroleum ether and ethanol against Gram positive bacteria (*B. subtilis, S. aureus*), Gram negative bacteria (*E. coli, K. pneumoniae, P. aeruginosa*) was determined. This study also estimated the amount of minerals present in fresh *Aloe vera* juice by Atomic Absorption Spectroscopy [28]. The ethanol, methanol and acetone extracts of *Aloe vera* gel were studied for their antimicrobial activity against four Gram-positive and Gram-negative bacteria using agar well diffusion method. Fractions obtained from the extracts by Thin Layer and Column Chromatography was studied for their antagonistic properties using Spot Assay Technique. Compounds with maximum antibacterial activity isolated from the ethanol and methanol extracts were identified as on the basis of Gas Chromatography Mass Spectrometry [29]. The antimicrobial activities of acetone, ethanol and methanol extracts of *Aloe vera* gel against some common human pathogens namely *Staphylococcus aureus*, *Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi* and *Klebsiella pneumonia* were investigated using the agar well diffusion method. The differences between the maximum and minimum antibacterial activity of the various extracts on the test organisms were statistically significant [30]. Antibacterial activity in the Dimethyl sulfoxide extract of *Aloe vera* gel using four different concentrations (25, 50 100 and 200 µg/ml) was evaluated. *Aloe vera* gel at optimum concentration could be used as an antiseptic for prevention of bacterial infections [31]. The antimicrobial potential of DMSO crude extracts of *Aloe barbadensis* Miller (*Aloe vera*) gel against the selected pathogens *Bacillus subtilis, Salmonella typhi, Escherichia coli, Staphylococcus aureus, Proteus vulgaris, Aspergillus fumigatus, Candida albicans* and *Penicillium* sps was examined. It is hoped that this study would lead to the establishment of some compounds that could be used to formulate new and more potent antimicrobial drugs of natural origin [32].

Antifungal Activity

Aloe vera gel extracted from the *Aloe vera* leaves was evaluated for their antifungal activity 0.15%, 0.25% and 0.35% concentration against five plants pathogenic fungi viz., *Aspergillus niger, Aspergillus flavus, Alternaria alternata, Drechslera hawaiensis* and *Penicillum digitatum* 0.35% concentration *Aloe vera* gel completely inhibited the growth of *Drechslera hawaiensis* and *Alternaria alternata* [33].

Antiviral Activity

The antiviral activity of a crude hot glycerine extract of *Aloe vera* gel against HSV-2 replication in Vero cell line was tested. The extract showed antiviral activity against HSV-2 not only before attachment and entry of virus to the Vero cells but also on post attachment stages of virus replication. Therefore, compounds of *Aloe vera* from Bushehr could be a good candidate as a natural source for antiviral drug development against HSV-2 [34].

Anticancer Effect

The in vitro anticancer effect of *Aloe vera* (*A. vera*) and *Calligonum comosum* (*C. comosum*) extracts against hepatocellular carcinoma (HepG2) cells was investigated. HepG2 cells were tested against different doses of *A. vera* and *C. comosum*. Viability of the cells was assessed by MTT assay. The extracts could have anti-hepatocarcinogenic effect, at least in part, through modulation of apoptosis [35].

Wound Healing Activity

Formulation and optimization of a herbal gel of *Aloe vera* extract containing Carbopol 934 as gelling agent and to investigate the effects of topical application of Carbopol 934 gel containing *Aloe vera* extract on the healing of skin wounds surgically induced in Wistar rats. The prepared gel has promising effect on the wound healing process [36].

Aloe vera gels in different concentrations were tested for its wound healing activity by topical application in experimental rats. The effect of *Aloe vera* gel on wound healing was evaluated by wound excision model. The effect produced by *Aloe vera* gel with reference to wound contraction, wound closure, decrease in surface area of wound, tissue regeneration at the wound site and histopathological characteristics were significant in treated rats. The effect of *Aloe vera* gel on biochemical studies revealed significant increase in collagen and decreased hexosamine content and malondialdehyde levels when compared with control. *Aloe vera* gel can be traditional used for management of wounds [37].

The anti-inflammatory and wound healing activities of this plant in Wistar rats. *A. littoralis* raw mucilaginous gel (ALRMG) and also two gel formulations prepared from the raw mucilaginous gel were used in this study. *A. littoralis* is a potential wound-healing and anti-inflammatory agent in rats. Further studies are needed to find out the mechanism of these biological effects and also the active constituents responsible for the effects [38].

The antibacterial, anti-inflammatory, and antioxidant activities and probable toxic effects of *Aloe vera* (AV) in a rat peritonitis model were investigated.

AV decreased IL-1β, IL-6 and PGE2 in peritonitis, showing good anti-inflammatory effect. AV showed antioxidant effect on the chosen antioxidant parameters Cu, Zn-SOD, MDA, and NO. It was concluded that, AV might be used in peritonitis for its probable UF increasing, anti-inflammatory, and antioxidant effects [39].

Antipsoriatic Activity

An ethanolic extract of the gel was assessed for antipsoriatic activity using a mouse tail model of psoriasis. Taken together, the extract showed an overall antipsoriatic activity of 81.95%, compared with 87.94 for tazarotene, in the mouse tail model for psoriasis [40].

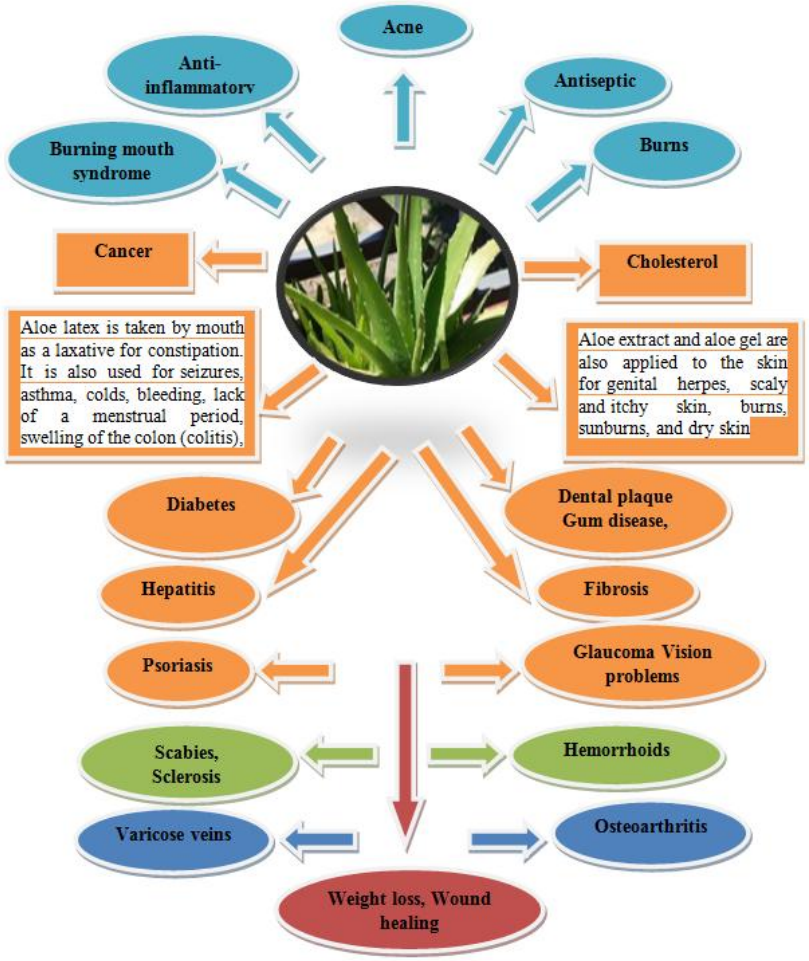

Figure 1: Medicinal properties and uses of Aloe.

Conclusion

Aloe is a plant which has many valuable medicinal properties and has been used since ancient times in the treatment of various acute and chronic diseases. Aloe gel has different active constituents which include amino acids, carbohydrates, enzymes, glycosides, minerals, lipids, proteins, and vitamins etc. Since aloe plant is reviewed in many articles this review includes the medicinal properties and uses, phytoconstituents, pharmacological actions, etc. Aloe is a plant from the past, present and future this plant can be still explored and it may contain many, phytoconstituents which can be isolated from the plant. This plant has been used in many polyherbal formulations in the treatment of different skin diseases. Still further research can be carried out on this plant. The plant may have promising effects in the field of research and development. Even scientists are working on this plant to explore and carry out many research works. Aloe is gift from nature with a plenty of uses so further research is recommended on this plant.

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