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PLEIOTROPIC EFFECTS OF ALOE VERA

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ABSTRACT

Aloe Vera is an herb distributed throughout the world. It is a perennial, drought resisting succulent herb that belongs to the Asphodelaceae family. It is called the healing plant or the silent healer because of its wound and burn healing properties. It has a vast traditional role in indigenous system of medicine like ayurveda, siddha, unani and homoeopathy. The pharmacologically active ingredients of aloe are concentrated in inner parenchymatous tissue, called aloe gel and outer pericyclic tubules, called aloe sap or aloe juice. Bioactive compounds from Aloe Vera are very effective in various treatments, such as burns, allergic reactions, rheumatoid arthritis, rheumatic fever, acid indigestion, ulcers, diabetes, skin diseases, dysentery, diarrhoea, piles and inflammatory conditions of the digestive system and other internal organs, including the stomach, small intestine, liver, kidney, and pancreas etc. The active ingredients have been shown to have analgesic, anti-inflammatory, antioxidant and anticancer agent and cardio protective activities. Therefore, the present review designed to give a detailed survey of the literature on the possible beneficial pleiotropic effects of Aloe Vera which will helpful for design the new paradigms pathways in traditional, phytochemical and pharmacological research area.

INTRODUCTION

For thousands of years, plants have been used as an important source of medicine in pharmaceutical biology. As per WHO estimates, even today, up to 80 percent of population still relies on traditional medicines [1]. It has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been formulated. It is therapeutically, interesting that important drugs have been developed from plant sources which are being used in traditional system of medicines. The use of plants as a therapeutic material due to their chemical substances of medicinal value is very common all over the world from ancient period of time [2,3]. Natural antimicrobials can be derived from barks, stems, leaves, flowers and fruits of plants, various animal tissues or microorganisms [4]. One of them the genus Aloe is a perennial, succulent xerophyte grown in temperate and sub tropical parts of the world mostly originated from Africa. Aloe vera or Aloe barbadensis belongs to the Asphodelaceae family, of which there are over 360 known species [5]. There have been several species under the genus Aloe, including Aloe vera, Aloe barbadensis, Aloe ferox, Aloe chinensis, Aloe indica, Aloe peyrii etc. Aloe barbadensis Miller is accepted unanimously as the correct botanical source of Aloe [6]. It is commonly called aloe, burn plant, lily of the desert and elephant's gall. It is a cactus like plant with green, dagger- shaped leaves that are fleshy, tapering, spiny, marginated and filled with a clear viscous gel [7,8,9]. Aloe leaf consists of two parts, each of which produces different substances that have completely different composition and therapeutic properties. The inner parenchymal tissues form a clear, thin, tasteless, jelly-like material [10]. The outer pericyclic tubules, occuring just beneath the outer green rind or cutinized epidermis of the leaves, produce bitter yellow exudates [5], with powerful laxative properties [11]. Its bitterness is due to the presence of aloin, aloe-emodin and related compounds [8]. The inner mucilaginous pulp called Aloe gel, lies in the centre of leaf. The Aloe gel consists of 96% water while the remaining 4% contains 75% known substances including Vitamins A, B, C, E, calcium, amino acids and enzymes [8]. Aloe vera (AV) is cultivated in large quantities because of its high demand in industrial, cosmetics and pharmaceutical sectors. It is also called the healing plant or the silent healer, because of it has wound and burn healing properties [12]. The bio active compounds of Aloe are used as astringent, haemostatic, antidiabetic, antiulcer, anti-septic, antibacterial, anti inflammatory, antioxidant and anticancer agent. They are also effective in treating stomach

ailments, gastrointestinal problems, skin diseases, constipation, radiation injury, wound healing, burns, dysentery and diarrhoea [13,14,15,16,8]. AV has been used for medicinal purposes in several countries for millennia, such as Greece, Egypt, India, Mexico, Japan, and China [17]. The polysaccharides present in the Aloe gel are not stable and hence degrade under stress conditions such as heat, presence of acid and enzymatic activities [18]. Therefore, the production process has to be standardised in order to preserve the natural biological activity of the aloe gel [18,19].

ANTITUMOR ACTIVITY OF AV

Glycoprotein and polysaccharide (acemannan) fractions of Aloe gel noted antitumour activity [20]. In recent studies, a polysaccharide fraction has shown to inhibit the binding of benzopyrene to primary rat hepatocytes, thereby preventing the formation of potentially cancer-initiating benzopyrene-DNA adducts. An induction of glutathione S-transferase and an inhibition of the tumor-promoting effects of phorbol myristic acetate has also been reported which suggest a possible benefit of using aloe gel in cancer chemoprevention [21,22].

ANTI- ULCER ACTIVITY OF AV

AV gel has the ability to cure gastric ulcers or protect against its formation in both animals and humans. The various mechanisms by which aloe vera has shown anti-ulcer activities includes its anti-inflammatory properties, healing effects, protective mucus stimulatory effects, regulation of gastric secretions and presence of lectins induced ulcer protection [19].Lectins inhibit aminopyrine uptake by parietal cells and inhibit gastric acid output on acid producing cells (Parietel cells) [23]. It has been noted antiulcer activity of AV on indomethacin induced ulcers in rats [24].

ANTIVIRAL ACTIVITY OF AV

The Acemannan is a constituent of AV juice and shown anti-viral and immune-modulating properties. Its healing powers extend to soothing the internal wounds and burns may be due to internal damage of the organs by taking of high-potency drugs for to treat AIDS like chronic diseases. AV also contains glucomannan, a special complex polysaccharide composed largely of the sugar mannose. It interacts with special cell surface receptors on those cells which repair damaged tissues, called fibroblasts and stimulating them finally it activating their faster growth and replication. An extract of mannose, one of the sugars in AV can inhibit HIV-1, the virus associated with AIDS. AV stimulates the human body's immune system, particularly T4 helper cells–white blood cells that activate the immune response against infection [25].

ANXIOLYTIC ACTIVITY OF AV

Psychological stress can be reduced by the tyrosine modulation or changes in dopamine and nor adrenaline concentrations of the brain and this aspect may improve stress condition. It has been studied that AV involved in tyrosine modulation and can affect the level of dopamine neurotransmitter. It is well described that low level of dopamine responsible for anxiety. As per this aspect AV gel modulated the effect of above neurotransmitter and reduced stress and produced anxiolytic response [26].

HYPOLIPIDAEMIC ACTIVITY OF AV

The effect of diabetes mellitus on lipid metabolism is well established. AV showed significant effects on cholesterol, triglycerides, free fatty acids and phospholipids metabolism. In addition, the decreased plasma level of high-density lipoprotein–cholesterol and increased plasma levels of low-density lipoprotein–and very low density lipoprotein have been noted resulting hypolipidemic effects, moreover the cholesterol has been restored with AV extract [27].

HYPOGLYCAEMIC ACTIVITY OF AV

AV gel is well known for reducing the blood sugar level [20]. AV contains polysaccharides which increased the insulin level and show hypoglycemic properties [28]. There are five phytosterols of AV includes lophenol, 24-methyl-lophenol, 24-ethyl-lophenol, cycloartanol and 24-methy-lenecycloartanol showed anti-diabetic effects in type-2 diabetic mice [29]. Extracts of Aloe gum increased glucose tolerance in both normal and diabetic rats [30] however AV sap has shown a significant hypoglycaemic effect both clinically and experimentally [31,32]. The mechanism behind lowering of blood glucose levels is the enhancement of glucose metabolism or it also be attributed to the anti oxidant effect, which reduces the peroxide levels and hence oxidative damage [33, 34].

WOUND HEALING ACTIVITY OF AV

Wounds are the major cause of physical disabilities. Wound healing consists of orderly progression of series of events that establish the integrity of the damaged tissues. AV leaves pulp of Aloe arborescens species is used for medicinal purposes, including treatment of constipation, colitis, asthma, irritable bowel syndrome, diabetes, peptic ulcer, inflammation, heart burn, stress etc. The present study revealed that AV leaves pulp shown wound healing activity through topical route on excision wound model experimentally. The activity was compared with standard

drug Povidone Iodine ointment (5% w/w). AV leaves pulp was found to have better and faster wound healing effect than standard drug Povidone Iodine ointment on experimental excision wound model [35].

ANTIBACTERIAL ACTIVITY OF AV

The antibacterial action of AV gel enhances the wound healing process by its anti bacterial and anti inflammatory actions [36]. Streptoccocus pyogenes and Streptococcus faecalis are the two micro organisms inhibited by AV gel and acts against both gram positive and gram negative bacteria [37,38,39]. Moreover It possesses bactericidal action against Pseudomonas aeruginosa and Candida albicans also [37,40,41]. Leaf pulp and liquid fraction of AV acts against plant pathogenic fungi [8]. Lectin containing fraction of Aloe gel directly inhibits the growth of Cytomegalovirus, by interfering the protein synthesis [42]. The anthraquinone derivatives of Aloe leaf have shown virucidal effects on enveloped viruses [43,44]. Aloe emodin inactivates most of the viruses, including Varicella zoster, influenza and pseudorabies virus and herpes simplex viruses [43,41].

CARDIOPROTECTIVE ACTIVITY OF AV

The AV treated with angina pectoris patients shown marked reduction of serum cholesterol and triglycosides levels and increases HDL levels. Researchers have found that AV easily stimulates the fibroblasts for making new tissues. When fibroblasts are stimulated, proteoglycans, collagens are formed and thus risk of cardio vascular disorders reduced. It has been suggested that AV gel may have a beneficial effect to the accumulation of blood lipids associated disease. AV showed a decreased 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, resulting coronary arteries diseases (CAD) [45,46].

ANTIOXIDANT ACTIVITY OF AV

It is noted that the phenolic compound of AV plant has shown potent antioxidative activity. Aloe barbendol, Aloe emodin, barbaloin A and Aloe chrysone are the compounds having the antioxidative effects [47]. The effects of exudate from Aloe barbadensis leaves shown antioxidant effects in streptozotocin induced-diabetic rats. This study demonstrated that high glucose leads to increased oxidative stress and exudates of Aloe barbadensis leaves showed antioxidant action as indicated by increase scavenging SOD activity and decreased in lipid peroxidation levels experimentally [48].

NEPHROPROTECTIVE ACTIVITY OF AV

It has been suggested that the nephroprotective effect of Aloe barbadensis due to the inherent antioxidant and free- radical-scavenging properties. It has been studied that in the gentamicin nephrotoxic rats significantly attenuated elevations in the serum creatinine, total protein and blood urea nitrogen levels in dose related fashion of AV and no treatment related effect on uric acid and ions, as well as, attenuation of gentamicin-induced tubulonephrosis. Similar effects of AV were also recorded in the Cisplatin model of acute renal injury [49].

ANTI-INFLAMMATORY ACTIVITY OF AV

Inflammation is an innate response of the body against an injury, characterized by swelling, pain, redness and heat, resulting in delay in the healing process. The anti inflammatory action of AV gel not only relieves from pain and discomfort, but also accelerates the healing process. The effects observed for acetylated mannan in Aloe gel resembles the anti inflammatory action of mannose-6-phosphate [19]. AV also inhibits the cyclooxygenase pathway, reduced the production of prostaglandins resulting reduction of inflammation [20,50]. AV has been found to have antioedema effects [51]. Further, it has been found to decrease the neutrophil count progressing towards the peritoneal cavity and showed a great anti inflammatory potential [52,53].

IMMUNOMODULATORY ACTIVITY OF AV

The gels of AV contain immunomodulatory components such as aloctin A and acemannan. In vitro and in vivo studies proved that aloe gel modulates the immune system (through macrophage activation and cytokine production) which accelerates wound healing [54].

ANTIFUNGAL ACTIVITY OF AV

The antifungal activity of AV against fungi has showed in acetone extract [55,56,57]. The growth of Helicobacter pylori is hindered by the AV in a dose-dependent manner [58]. Two constituents, namely aloin and aloe-emodin were identified as active principles by their activity against Colletotrichum gloeosporides and Cladosporium cucumerinum [57]. On the other hand, it has been observed that AV gel has produced inhibitory effect against fungi like Penicillium digitatum, P. expansum, Botrytis cineria [55]. The inhibitory property of AV towards the growth of fungi can prove to be an additional asset in the therapeutic role that the plant plays role in the current pharmaceutical industry.

MOISTURIZING AND ANTI-AGING ACTIVITY OF AV

AV is currently utilized in manufacturing more than 95 % of the dermatologically valuable products for therapeutic and cosmetic effects. This is due to its implausible moisturizing properties. These effects improve the ability of skin to hydrate it and help in removal of dead skin cells. AV produced collagen and elastin fibers and making the skin more elastic and less wrinkled, thereby, reversing the degenerative skin changes. It softens the skin, by its cohesive action on superficial flaking epidermal cells and also by the action of amino acids. For such incredible characteristics, AV is an ideal ingredient in cosmetics, dermatological procedures [50].

COSMETIC AND THERAPEUTIC ACTIVITY OF AV

Today AV gel is an active ingredient in hundreds of skin lotions, sun blocks and cosmetics [59]. AV gel is also used as an ingredient in commercially available yogurt, beverages, and some desserts [60]. Furthermore, the dried powder obtained from AV gel has been successfully used to manufacture directly compressible matrix type tablets [61]. AV is now widely used on facial tissues, where it is promoted as a moisturizer and/or anti-irritant to reduce chafing of the nose of users suffering from hay-fever or cold. It is a common practice for cosmetic companies to add sap or other derivatives from AV to produce various products such as makeup, tissues, moisturizers, soaps, sunscreens, incense, shaving cream and shampoos etc [60]. Other uses for extracts of AV include the fresh food preservative [62] and water conservation in small farms [62]. It has been suggested that biofuels may be obtained from AV seeds [63]. Aloe is used as a food substance. Some molecular gastronomists have begun to take advantage of its gelling properties.

LAXATIVE/PURGATIVE ACTIVITY OF AV

The laxative effect of Aloe species is reported due to the presence of anthranoid glycosides derivatives, mainly aloin. Morover A. ferox resin extract increased the gastrointestinal motility rate [64].

CONCLUSION

In recent years, ethno botanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. Aloe vera, has an important place among such wound healing medicinal plants, it can also be used in the treatment of inflammation, pain, ulcer and antihyperglycaemic agent. Major value added products from Aloe are gel and juice. The present review revealed that

Aloe vera has a potential activity against various microorganisms as well as the plant has a broad spectrum of properties which make it very useful in the field of cosmetic, pharmaceutical, medical and food industries. The plant contains many vitamins, including the important antioxidant vitamins A, C and F as well as Vitamins B (thiamine), niacin, vitamin B2 (riboflavin), vitamin B12, choline and folic acid. Therefore, *Aloe vera* is the nature's gift to humanity and it remains for us to introduce it to ourselves and thank the nature for its never-ending gift.

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