

Recent update on the medicinal properties and use of *Aloe vera* in the treatment of various ailments

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ABSTRACT

Aloe vera (*Aloe barbadensis*) an herb is widely used in Ayurvedic, Homoeopathic and Allopathic streams for its marvelous medicinal properties. This plant is one of the richest natural sources of health for mammals including human beings. The chemistry of the plant has revealed the presence of more than 200 different biologically active substances, which include antimicrobial, antibacterial, antifungal, antiviral, activities of the nonvolatile constituents of the leaf gel. *Aloe* species are widely distributed in the African and the eastern European continents, and are spread almost throughout the world. The genus *Aloe* has more than 400 species but few, such as *A. vera*, *Aloe ferox*, and *Aloe arborescens*, are globally used for trade. Many biological properties associated with *Aloe* species are contributed by inner gel of the leaves. anti diabetic, anti-inflammatory, peptic ulcers, antitumor, anticancer Properties, activity effects on the Immune System, adverse reactions, Laxative effects, wound healing, antiseptic, vitamins, minerals, enzymes, amino acids, stress, sugars. It is known to help slow down the appearance of wrinkles and actively repair the damaged skin cells that cause the visible signs of aging. *Aloe* is a powerful detoxifier, antiseptic and tonic for the nervous system. *Aloe vera* gel contains a large range of vitamins even vitamin B12, Vitamin A, contains B-Group vitamins, Vitamin C, Vitamin E and folic acid. *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. The plant leaves and inner gel contains numerous help it has potential to cure sunburns and minor cuts, and even skin cancer and acts as also acts as extremely powerful laxative. Various parts of the plant have different effects on the body. The present review is an attempt to highlight the proven research related botanical and pharmacological medicinal properties of *Aloe vera*.

KEY WORDS: ALOE VERA; ANTIMICROBIAL; ANTICANCER; COSMETIC, THERAPEUTIC USES;

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INTRODUCTION

Aloe barbadensis Miller, commonly referred to as *Aloe vera*, is one of more than 400 species of *Aloe* belonging to family Liliaceae that originated in South Africa, but have been indigenous to dry subtropical and tropical climates, including the southern USA, (Reynolds *et al.*, 1999). *Aloe vera* has been used for medicinal purposes in several cultures for millennia: Greece, Egypt, India, Mexico, Japan, and China, (Foster *et al.*, 2011). There is 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, (Blumenhal *et al.*, 1998). The herb is used internally to combat most digestive problems, including constipation, poor appetite, colitis, irritable bowel syndrome as well as, asthma, diabetes, immune system enhancement, peptic ulcers, (Brusick *et al.*, 1997; Mansour *et al.*, 2013; Ezuruike *et al.*, 2014; Kavyashree *et al.*, 2015; Pandey *et al.*, 2016).

A. vera is a succulent plant. Succulents are xerophytes, Storage tissue has higher water holding capacity ranging from 99–99.5% (Hamman *et al.*, 2008) and 0.5–1.0% solid material has over 75 different potentially active compounds including water and fat-soluble vitamins, minerals, enzymes, simple and complex polysaccharides, phenolic compounds, and organic acids. Studies on the structural components of the *A. vera* plant leaf portions, the rind was found to be 20–30% and the pulp 70–80% of the whole leaf weight. on a dry weight basis, the percentages of the rind and pulp represented as lipids (2.7% and 4.2%) and that as proteins (6.3% and 7.3%) only accounted for a minor fraction, (Femenia *et al.*, 1999). However, the nonstarch polysaccharides and lignin were found to be 62.3% and 57.6% of the dry weight of the rind and pulp, respectively. *A. vera* gel polysaccharides consist of linear chains of glucose and concentrated mannose molecules, there arrangement linear chains ranging in size from a few to several thousand molecules, (Hutter *et al.*, 1996) is referred as polymannans, (Ni Y *et al.*, 2004; Davis *et al.*, 2006; Chang *et al.*, 2011; Boonyagul *et al.*, 2014; Aranda *et al.*, 2016).

The major polysaccharide, acemannan, repeating units of glucose and mannose in a 1:3 ratio, (Femenia *et al.*, 1999; Ni Y. *et al.*, 2004; Chow *et al.*, 2005). molecular weights ranging from 30 kDa to 40 kDa. Many investigators have endeavored to establish the active principles in *A. vera* gel, (Habeeb *et al.*, 2007). polysaccharides found in the inner leaf parenchymatous tissue or pulp contains proteins, lipids, amino acids, vitamins, enzymes, inorganic compounds, with different carbohydrates, (Hamman *et al.*, 2008). Over 75 active ingredients from the inner gel have been identified, to have therapeutic effects. Different *Aloe* species would

have varying phytochemical contents due to interspecies variation and varying climate and soil conditions, the species of *Aloe* selected for commercial exploitation or selected by the traditional healer, would be based on its local availability and distribution. Biological activities of a plant are due to synergistic action of the different compounds together, (Avijgan *et al.*, 2014; Esmailia *et al.*, 2015; Taukoora *et al.*, 2016).

In South Africa, the most widely distributed *Aloe* species are *Aloe greatheadii* var. *davyana* (Asphodelaceae) and *Aloe ferox* Mill. (Asphodelaceae). *A. greatheadii* grows wild in the northern parts of South Africa, whereas *A. ferox* grows wild primarily in the Eastern and Western Cape provinces. *A. ferox* contains various combinations of glucose and galactose as main monosaccharides, while *A. vera* yields only mannose. *A. vera* is rich in secondary metabolites. Anthraquinones (*Aloe emodin*), tricyclic aromatic quinines and chrysophanol are the major secondary metabolites, (Tan *et al.*, 2011; Xua *et al.*, 2016).

The tricyclic aromatic quinines of *Aloe* were synthesized via the type III polyketide biosynthesis pathway. Recently, novel these novel plant enzymes plant-specific type III polyketide synthases (PKS), octaketide synthase, PKS4, and PKS5 were isolated from *Aloe arborescens* and their functions examined in *E. coli*, (Mizuuchi *et al.*, 2009). their function is associated with biosynthesis of natural tricyclic aromatic quinines in *Aloe*, *Aloesin*, aloin and *Aloe-emodin* (oxidative product of aloin) are the most important secondary metabolites found in *A. vera* gel. Many secondary metabolites reported to have potent anti-inflammatory, lipid lowering, and antioxidant activities, (Rajasekaran *et al.*, 2006).

Aloe is used against skin irritation, skin exposure to UV and gamma radiation, scalds, sunburn wounds, eczema, psoriasis, acne, dermatitis, ulcers, to stimulate cell regeneration. Plants have hypoglycemic, cytotoxic, antiulcer, antidiabetic effects, antibacterial, antioxidant, cardiovascular effect on human. Healing properties, anti-inflammatory, antiviral and antitumor, moisturizing, anti-aging effect, antiseptic properties of plant stimulates the immune system, only a few species of *Aloe* have been considered for commercial importance, of which *A. vera* is considered the most potent and, thereby, the most popular plant in the research field, (Surjushe *et al.*, 2008; Davis *et al.*, 2012; Maharijan *et al.*, 2015; Saito *et al.*, 2016).

CHARACTERISTICS OF ALOE VERA

PHYSICAL CLASSIFICATION

The leaf is long triangular sheaf with two external membranes which are green and leathery. Inside this tough

resistant covering is the gel, which presents itself as a compact, gelatinous mass with a translucent pearly aspect, (Vogler *et al.*, 1999; *et al.*, 2002; Ramachandran *et al.*, 2012; Poor). Leaf pulp having unpleasant sensations was used to extract the juice by a decortication process. It contains some active compounds which detoxified the body stimulating property worthy of highlighting. The nutritional components of Aloe are equally distributed between the pulp and the cortex of the leaf, (Hatano *et al.*, 2005).

BOTANICAL CLASSIFICATION

The botanical genus of *Aloe* is *Liliaceae*, because it germinates from an original bulb in the same way as lilies. Tom Reynolds, a researcher from London, England, coined a new classification. In assessing the specifications and particular characteristics of the Aloe plant, they inserted it into a new botanical family, that of the *Aloaceae*. *Aloe* is a perennial evergreen shrub with succulent leaves having flowers of an elongated tubular form varying in color according to the species, from orange to bright scarlet red, particularly spectacular and reminiscent of an autumn landscape. The *Aloaceae* family contains approximately three hundred and fifty varieties of the plant throughout the planet.

In South Africa alone, in 1955, a total of 132 species were catalogued. The range spanned from the miniature type like *Aloe aristata* and *Aloe brevifolia*, to one which can be defined as the most beautiful in existence in the world, the *Aloe striata*. Among the larger-sized *Aloes*, and those having a cosmetic, curative value, we can mention *Aloe arborescens* Miller, *Aloe ferox*, *Aloe Barbadosensis* Miller *Vera*, *Aloe chinensis*, (Kokate *et al.*, 2005). *Aloe saponaria*, and *Aloe succotrine*. A more



FIGURE 1. *Aloe vera* plant (Chatterjee *et al.*, 2013)

generalized botanical distinction is achieved by observing the trunk and leaves.

In this way, we can distinguish three large groups of *Aloe*: *acauleas* (without a trunk), *subcauleas* (visible trunk but with a reduced size), (Davis *et al.*, 1994; Das *et al.*, 2015; Sayed *et al.*, 2016).

CHEMICAL CLASSIFICATION

Aloe vera is a unique plant which is a rich source of many chemical compounds (Fig. 1) and plays an important role in the international market. Chemistry of the plant revealed the presence of more than 200 different biologically active substances including vitamins, minerals, enzymes, sugars, anthraquinones or phenolic compounds, lignin, saponins, sterols, amino acids and salicylic acid (Chauhan *et al.* 2007). Studies have found that there are 75 ingredients contained in the *Aloe* leaf. These ingredients have a variety of medical benefits. They are divided into the following categories, (Rodriguez *et al.*, 2005; Davis *et al.*, 2006).

ANTHRAQUINONES

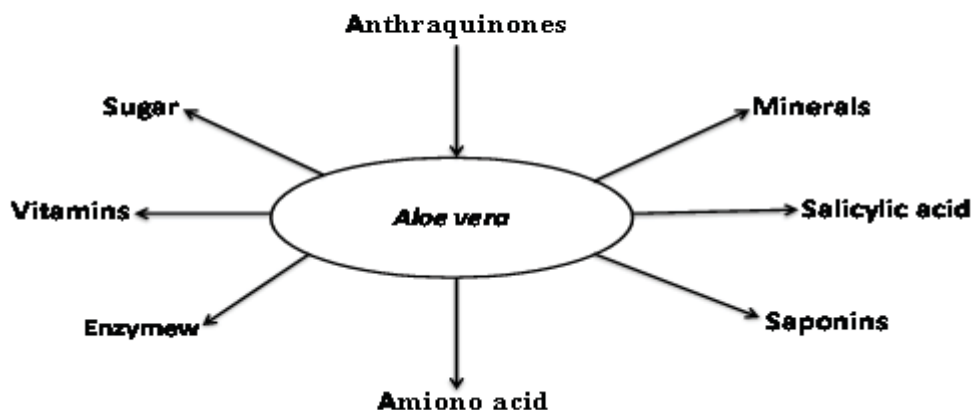
Twelve different types of anthraquinones are present in the sap of *Aloe Vera*: *Aloin*, *Isobarbaloin*, *Anthracene*, *Emodin*, *Ester of Cinnamonic acid*, *Chrysophanic acid*, *Barbaloin*, *Anthranol*, *Aloetic acid*, *Aloe Emodin*, *Ethereal oil* and *Resistannol*. They act as natural laxatives, painkillers and analgesics, and they contain powerful antibacterial, antifungal and virucidal properties.

AMINO ACIDS

Amino Acids are the building blocks of protein, which manufacture and repair muscle tissue. The human body requires 22 amino acids and needs 8 essential ones. *Aloe Vera* provides 20 of 22 required amino acids and 7 of 8 essential ones. These amino acids are.

ENZYMES

Enzymes are natural protein molecules with highly specialized catalytic functions in biochemical reactions produced by all living organisms (microorganisms, plants, animals, and human beings). Although like all other proteins, enzymes are composed of amino acids, they differ in function in that they have the unique ability to facilitate biochemical reactions without undergoing change themselves. Some of the most important enzymes in *Aloe Vera* are: Peroxidase, Aliase, Catalase, Lipase, Cellulose, Carboxypeptidase, Amylase and Alkaline Phosphates.

FIGURE 2. Components of *Aloe vera* (Chauhan *et al.*, 2007)

VITAMINS

Aloe Vera contains numerous vitamins: Vitamins A, C, & E (crucial antioxidants that combat dangerous free radicals in the body). Vitamin B & Choline (concerned with the production of energy, amino acid metabolism and developing muscle mass). Vitamin B12 (responsible for the production of red blood cells) and Folic acid (helps develop new blood cells).

MINERALS

Aloe Vera contains the following minerals: **Calcium:** (essential for proper bone and teeth density). **Manganese:** (a component of enzymes necessary for the activation of other enzymes). **Sodium:** (ensures that the body fluids do not become too acidic or too alkaline). **Copper:** (enables iron to work as oxygen carriers in the red blood cells). **Magnesium:** (used by nerves and muscle membranes to help conduct electrical impulses). **Potassium:** (regulates the acidic or alkaline levels of body fluid). **Zinc:** (contributes to the metabolism of proteins, carbohydrates and fats), **Chromium:** (necessary for the proper function of insulin, which in turn controls the sugar levels in the blood). **Iron:** (controls the transportation of oxygen around the body via the red blood cells).

LIGNIN

This cellulose substance is found in the gel has no known medical properties except it posses the property of penetrating the human skin.

Table 1: Amount of amino acids in *Aloe vera* gel (Mulu *et al.*, 2015)

S. No.	Amino acid	Aloe vera (whole leaves)
1	Tryptophane	0
2	Methionine	0.02
3	Histidine	0.03
4	Cystine	0.04
5	Tyrosine	0.06
6	Isoleucine	0.07
7	Phenylalanine	0.08
8	Leucine	0.09
9	Arginine	0.12
10	Lysine	0.18
11	Proine	0.25
12	Threonine	0.33
13	Valine	0.36
14	Glutamine	0.83
15	Alanine	0.91
16	Glycine	0.95
17	Serine	1.27
18	Aspartic acid	1.75
19	Asparagines	3.29
20	Glutamic acid	4.7
21	Total concentration (nMol/mg dry mass)	15.33

Table 2: Percentage of Minerals in *Aloe Vera* (Mulu *et al.*, 2015)

S. No.	Minerals	<i>Aloe vera</i> (whole leave)
1	Iron	0.1
2	Phosphorous	0.02
3	Zinc	0.02
4	Copper	0.06
5	Magnesium	1.22
6	Calcium	3.58
7	Sodium	3.66
8	Potassium	4.06

SAPONINS

These form soapy lathers when mixed and agitated with water. They have been used in detergents, foaming agents and contain antiseptic properties.

SUGARS

Aloe Vera contains both monosaccharide, such as glucose and fructose, and polysaccharides. Polysaccharides are the most important types of sugars. They aid in proper digestion, maintain cholesterol levels, improve liver functions and promote the strengthening of bones.

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.

THERAPEUTIC USES WITH MECHANISM OF ACTION

WOUND HEALING

The wound healing property of *Aloe vera* gel has been attributed to Mannose-6-phosphate used for first to second degree burns, (Davis *et al.*, 1994; Maenthaisong *et al.*, 2007). Wound healing is a dynamic process, occurring in 3 phases. The first phase is inflammation, hyperaemia and leukocyte infiltration. The second phase consists of removal of dead tissue. The third phase of proliferation consists of epithelial regeneration and formation of fibrous tissue, (Reddy *et al.*, 2011).

Glucomannan and plant growth hormone gibberellin interacts with growth factor receptors of fibroblast and stimulate its activity and proliferation for increased collagen synthesis in topical and oral administration of *Aloe*, (Hayes *et al.*, 1999). The *Aloe* gel has been used for the treatment of radiation burns and radiation ulcers, (Syed *et al.*, 1997) and complete healing has been observed in two radiation burns patients, (Yeh *et al.*, 2003).

The fresh gel was more effective than the cream, (Visuthikosol *et al.*, 1995) as *Aloe* gel treated lesions healed faster (11.8 days) compared to burns treated with petroleum jelly gauze (18.2 days) by Fulton, (Fulton *et al.*, 1990). The 27 patients with partial thickness burns have been treated with *Aloe* gel in a placebo-controlled study, (Montaner *et al.*, 1996). The *Aloe* administration influence collagen composition (more type III) and increased collagen cross linking for wound contraction and improving breaking strength, (Reynolds *et al.*, 1999). It also increases synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound, (Chithra *et al.*, 1998 Joshy *et al.*, 2016).

ANTI-INFLAMMATORY ACTION

In vitro and *In vivo* studies of *Aloe vera* gel in experimental model shows the anti-inflammatory activity due to bradykinase activity, (Che *et al.*, 1991; Tyler *et al.*, 1994). The peptidase bradykinase was isolated from *aloe* break down the bradykinin, an inflammatory substance that induces pain, (Ito *et al.*, 1993).

A novel anti-inflammatory compound, C-glucosyl chromone, was isolated from gel extracts, (Haller *et al.*, 1990). *Aloe vera* inhibits the cyclo-oxygenase pathway and reduces prostaglandin E2 production from arachidonic acid. Fresh *Aloe vera* gel significantly reduced acute inflammation in rats (carrageenin-induced paw oedema), but not in chronic inflammation, (Che *et al.*, 1991).

The *aloe* sterol includes campesterol, β -sitosterol, lupeol, and cholesterol which are anti-inflammatory in nature, helps in reducing the inflammation pain and act as a natural analgesic. Other aspirin like compound present in *Aloe* is responsible for anti-inflammatory and antimicrobial properties, (Sydiskis *et al.*, 1991; Ferro *et al.*, 2003; Agarry *et al.*, 2005). Even, *Aloe vera* extract (5.0% leaf homogenate) decreased inflammation by 48% in a rat adjuvant-induced arthritic inflammatory model, (Hanley *et al.*, 1982; Davis *et al.*, 1991).

Three *Aloe vera* gel sterols were able to reduce inflammation by up to 37%. Lupeol, the most active antiinflammatory sterol, reduced inflammation in a dose dependent manner. The data suggest that specific plant

sterols may also contribute to the anti-inflammatory activity of gel, (Haller *et al.*, 1990; Jensen *et al.*, 2015).

EFFECTS ON THE IMMUNE SYSTEM

In a study on mice that had previously been implanted with murine sarcoma cells, acemannan stimulates the synthesis and release of interleukin-1 (IL-1) and tumor necrosis factor from macrophages in mice, which in turn initiated an immune attack that resulted in necrosis and regression of the cancerous cells, (Peng *et al.*, 1991). Alprogen inhibit calcium influx into mast cells, thereby inhibiting the antigen-antibody-mediated release of histamine and leukotriene from mast cells, (Hansel *et al.*, 1994).

Several low-molecular-weight compounds are also capable of inhibiting the release of reactive oxygen free radicals from activated human neutrophils, (Hart *et al.*, 1990; Lee *et al.*, 2001; Zanuzzo *et al.*, 2015).

MOISTURIZING AND ANTI-AGING

Muco-polysaccharides of *Aloe vera* has Agent which help in binding moisture into the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects have also been studied in treatment of dry skin associated with occupational exposure where *Aloe vera* gel gloves improved the skin integrity, decrease appearance of acne wrinkle and decrease erythema, (West *et al.*, 2003).

The *Aloe* gel gives cooling effect and also acts as a moisturizing agent. It also has role in gerontology and rejuvenation of aging skin. This property of *Aloe* is because it's biogenic material. *Aloe vera* is used as skin tonic in cosmetic industry, (Kaushik *et al.*, 2016)

ANTITUMOR ACTIVITY

Glycoproteins present in *Aloe vera* gel have been reported to have antitumor and antiulcer effects and to increase proliferation of normal human dermal cells, (Yagi *et al.*, 1997; Choi *et al.*, 2001; Yagi *et al.*, 2003). 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, (Kim *et al.*, 1997; 1999; Yonehara *et al.*, 2015).

LAXATIVE EFFECTS

Anthraquinones present in latex are a potent laxative; its stimulating mucus secretion, increase intestinal water

content and intestinal peristalsis, (Ishii *et al.*, 1994). The laxative effect of *Aloe* is not generally observed before 6 hours after oral administration, and sometimes not until 24 or more hours after. The *Aloe* effects are primarily due to the 1, 8-dihydroxyanthracene glycosides, Aloin A and B (formerly designated barbaloin) (Tyler *et al.*, 1988; 1994).

After oral administration Aloin A and B, which are not absorbed in the upper intestine, are hydrolysed in the colon by intestinal bacteria and then reduced to the active metabolites (the main active metabolite is *aloe-emodin-9-anthrone*), (Che *et al.*, 1991), which like senna acts as a stimulant and irritant to the gastrointestinal tract. *Aloe latex* is known for its laxative properties, (Reynolds *et al.*, 1993 Haque *et al.*, 2014).

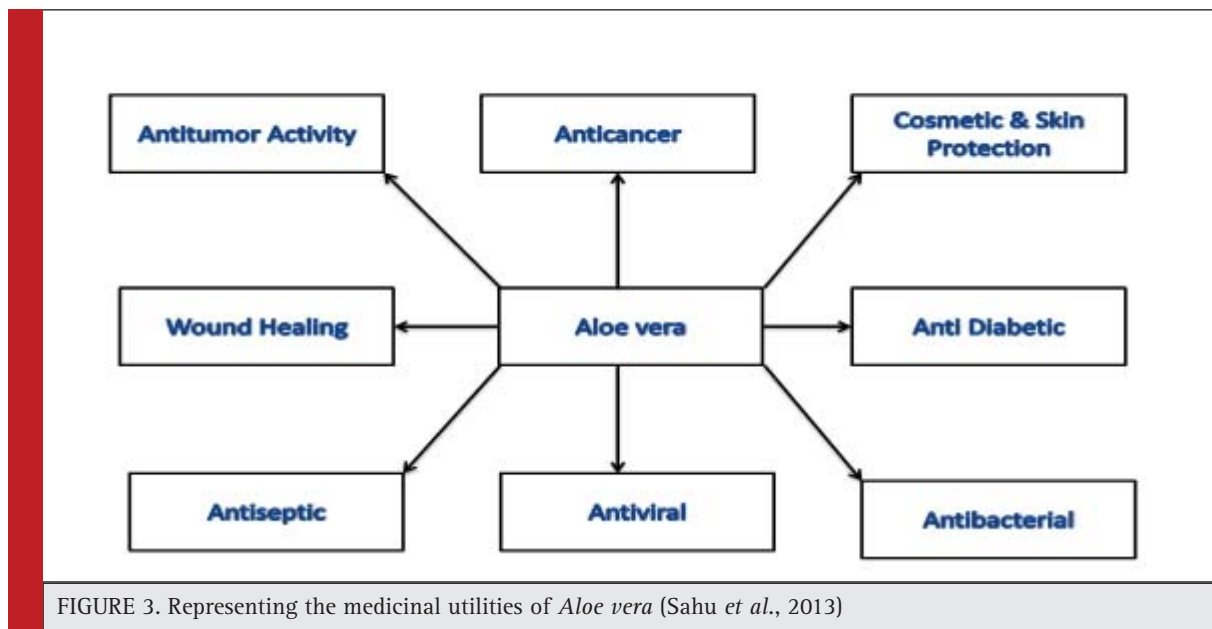
MEDICINAL USES

Aloe vera is anthelmintic, aperients, carminative, deobstruent, depurative, diuretic, stomachic and emmenagogue. Juice is used in skin care medicine, dyspepsia, amenorrhea, burns, colic, hyperadenosis, hepatopathy, splenopathy, constipation, span menorrhoea, abdominal tumors, dropsy carbuncles, sciatica, lumbago and flatulence. It is used in ayurvedic formulations as appetite-stimulant, purgative, emmenagogue and antihelminthic, for treating cough, colds, piles, debility, dyspnoea, asthma and jaundice, (Joseph *et al.*, 2010).

Traditionally, *Aloe vera* gel is used both, topically (treatment of wounds, minor burns, and skin irritations) and internally to treat constipation, coughs, ulcers, diabetes, headaches, arthritis, immune-system deficiencies, (Vogler *et al.*, 1999; Eshun *et al.*, 2004). The bioactive compounds are used as astringent, haemostatic, anti-diabetic, antiulcer, antiseptic, antibacterial, anti-inflammatory, antioxidant and anticancer agent also, effective in treating stomach ailments, gastrointestinal problems, skin diseases, constipation, radiation injury, wound healing, burns, dysentery, diarrhoea and in the treatment of skin diseases, (Baker *et al.*, 1975; Ali SA *et al.*, 2012).

The Egyptians used the *Aloe vera* to make papyrus like scrolls as well as for treatment of tuberculosis, (Nadkerni *et al.*, 1976). Nadkerni stated various preparations of *Aloe barbadensis* like confection, lotion and juice, useful remedies for curing various diseases. *Aloe* contains mixture of glucosides collectively called aloin which is the active constituent of various drugs. Traditionally *Aloe* is extensively used in treating urine related problems, pimples and ulcers etc. It is also used in gerontology and rejuvenation of aging skin.

The juice of *Aloe vera* leaves is used as stomachic tonic and purgative. Scientific evidence for the cosmetic and therapeutic effectiveness of *Aloe vera* is limited and



when present is frequently contradictory, (Ernst *et al.*, 1998; Marshall *et al.*, 2000). Despite this, the cosmetic and alternative medicine industries regularly make claims regarding the soothing, moisturizing, and healing properties of *Aloe vera*, especially via internet advertising, (Kunkel *et al.*, 1984; Boudreau *et al.*, 2006, Sahu *et al.*, 2013, Figure 3).

COSMETIC & SKIN PROTECTION APPLICATION

Aloin 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, (Barcroft *et al.*, 2003). 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, *Aloe vera* extracts have antibacterial and antifungal activities, which may help in the treatment of minor skin infections. 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, (Byeon *et al.*, 1988).

Aloe vera gel has 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. Skin burns effect is reported and radiation dermatitis, (Shelton *et al.*, 1991; Visuthikosol *et al.* 1995; Bosley *et al.*, 2003; Vastrad *et al.*, 2015).

ANTISEPTIC

The antiseptic property of *Aloe vera* is due to presence of six antiseptic agents namely lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulphur. These compounds have inhibitory action on fungi, bacteria and viruses, (Zawahry *et al.*, 1973; Qian *et al.*, 2015; Anjum *et al.*, 2016).

ANTI DIABETIC

Reviewed the beneficial effects of selective medicinal plant species such as *Allium cepa*, *Allium sativum*, *Aloe vera*, *Azadirachta indica*, *Gymnema sylvestre*, *Syzygium cumini* and *Pterocarpus marsupium*, and emphasize on the role of active bio-molecules which possess anti-diabetic activity. The five phytosterols of *A. vera*, lophenol, 24-methyllophenol, 24-ethyl-lophenol, cycloartanol and 24-methylenecycloartanol showed anti-diabetic effects in type-2 diabetic mice, (Tanaka, *et al.*, 2006; Noor *et al.*, 2008). Traditional anti-diabetic plants might provide new oral anti-diabetic compounds, which can counter the high cost and poor availability of the current medicines for many rural populations in developing countries.

Extracts of *Aloe* gum increases glucose tolerance in both normal and diabetic rats, (Awadi *et al.*, 1987) and *Aloe vera* sap taken for 4 - 14 weeks has shown a significant hypoglycaemic effect both clinically and experimentally, (Ghannam *et al.*, 1986). The treatment of diabetes mellitus has been attempted with various indigenous plants and polyherbal formulations, (Chaurasia *et al.*, 1994; Mitra *et al.*, 1996). *Aloe vera* contains polysaccharides which increase the insulin level and show

hypoglycemic properties, (Yagi *et al.*, 2006; Epifanoa *et al.*, 2015; Muammar *et al.*, 2016).

ANTICANCER PROPERTIES

Aloe vera juice 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. *Aloe vera* emodin, an anthraquinone, has the ability to suppress or inhibit the growth of malignant cancer cells making it to have antineoplastic properties, (Thomson *et al.*, 1971). The role of *Aloe* in carcinogenicity has not been evaluated well. The chronic abuse of anthranoid-containing laxatives has been hypothesized to play a role in colorectal cancer, and (Siegers *et al.*, 1992; 1993). *Aloe vera* tincture and melatonin administration was studied as standard therapy against metastatic solid tumors, (Furukawa *et al.*, 1991; Fenig *et al.*, 2004; Shalabia *et al.*, 2015; Chouhan *et al.*, 2016).

STRESS

Aloe vera is an excellent example of a functional food that plays a significant role in protection from oxidative stress, (Barcroft *et al.*, 2003; Joseph *et al.*, 2010). *Aloe* juice is helpful in smooth functioning of the body machinery, (Saroj *et al.*, 2004). It reduces cell-damaging process during stress condition and minimizes biochemical and physiological changes in the body, (Foster *et al.*, 1999).

Oxidative stress refers to chemical reactions in which compounds have their oxidative state changed. Some antioxidants are part of the body's natural regulating machinery while other dietary antioxidants are derived from diet sources, (Kaithwasa *et al.*, 2014; Zhou *et al.*, 2015; Cartera *et al.*, 2016).

REDUCES INFLAMMATION

It improves joint flexibility and helps in the regeneration of body cells. It strengthens joint muscles, which therefore reduces pain and inflammation in weakened or aged joints. (Sahgal *et al.*, 2015; Susman *et al.*, 2016)

INCREASES ENERGY LEVELS

Our diets include many substances which can cause fatigue and exhaustion. Taken regularly, *Aloe vera* juice ensures a greater feeling of well-being, allowing energy levels to increase and also helps maintain a healthy body weight, (Lad *et al.*, 2013; Kumbhar *et al.*, 2015; Pani *et al.*, 2016)

BUILDS IMMUNITY

It is especially great for those who have chronic immune disorders like polysaccharides or fibromyalgia since

the polysaccharides in *Aloe vera* juice stimulate macrophages, the white blood cells that fight viruses, (Hart *et al.*, 1989; Turner *et al.*, 2004; Algieri *et al.*, 2015; Shokri *et al.*, 2016).

DETOXIFIES

Aloe vera juice is a great natural aid to detox. With our stressful lives, the pollution around us and the junk foods we eat, we all need to cleanse our systems from time to time. Drinking *Aloe vera* juice provides a fantastically rich cocktail of vitamins, minerals and trace elements to help our bodies deal with these stresses and strains every day, (Chaturved *et al.*, 2007; Cellini *et al.*, 2014; Lee *et al.*, 2015; Mehta *et al.*, 2016)

ALOE VERA PROTECTS ALUMINIUM INDUCED CHANGES IN BRAIN ENZYME ACTIVITY

Aluminium sulphate has significantly altered the normal levels of acetyl cholinesterase, sodium potassium ATPase and glutathione of rat brain. The levels of brain enzymes were found to be highly decreased in both the aluminium treated groups. But in contrast to this, elevated levels of acetyl cholinesterase, sodium potassium ATPase and glutathione were noticed in aloin and aluminium sulphate co treated groups, indicating the protective role of aloin against aluminium sulphate toxicity, (Jakkala and Ali 2015).

AMELIORATION OF HISTOPATHOLOGICAL DAMAGES IN TESTIS OF ALBINO RATS BY ALOE

Aloin has been recently found to ameliorate the toxic effects of aluminium sulphate, the histological structures of the seminiferous tubules and their cell cytoplasm, nuclei, nutritive cells, which were found to become near normal by treatment of aloin for more than 30 days, (Miraj *et al.*, 2014; Jakkala and Ali 2016).

ANTIMICROBIAL ACTIVITIES

ANTIBACTERIAL ACTIVITY

The *Aloe* extract was potent against three strains of *Mycobacterium* (*M. fortuitum*, *M. smegmatis* and *M. kansasii*) and a strong anti-mycobacterial activity against *M. tuberculosis* ss well as antibacterial activity against *P. aeruginosa*, *E. coli*, *S. aureus* and *S. typhi*. *Streptococcus pyogenes* and *Streptococcus faecalis* are two microorganisms that have been inhibited by *Aloe vera* gel. Glucomannan and acemannan have been

proved to accelerate wound healing, activating macrophages, stimulating immune system as well antibacterial and antiviral effects, (Davis *et al.*, 1987; 1988; Kaufman *et al.*, 1989; Visuthikosol *et al.*, 1995; Djeraba *et al.*, 2000).

Aloe vera gel was bactericidal against *Pseudomonas aeruginosa* and *acemannan* prevented it from adhering to human lung epithelial cells in a monolayer culture, a processed *Aloe vera* gel preparation inhibited the growth of fungus *Candida albicans*, (Hegggers *et al.*, 1979; Stanley *et al.*, 2014; Kumar *et al.*, 2015; Rezazadeh *et al.*, 2016).

ANTIVIRAL ACTIVITY

Electron micrograph examination of anthro-quinone treated herpes simplex virus demonstrated that the envelopes were partially disrupted. Such results indicate that anthraquinones extract from variety of plants are directly virucidal to enveloped viruses.. The anthraquinone aloin also inactivates various enveloped viruses such as herpes simplex, varicella zoster and influenza, (Sydiskis *et al.*, 1991). Several ingredients in *Aloe vera* gel have been shown to be effective antiviral agent. acemannan reduced herpes simplex infection in two cultured target cell lines, (Kemp *et al.*, 1990).

Lectins, fractions of *Aloe vera* gel, directly inhibited the cytomegalovirus proliferation in cell culture, perhaps by interfering with protein synthesis. A purified sample of aloe emodin was effective against infectivity of herpes simplex virus Type I and Type II and it was capable of inactivating all of the viruses, including varicella zoster virus, influenza virus, and pseudorabies virus, (Jia *et al.*, 2008; Silvaa *et al.*, 2014; Sadeghi *et al.*, 2015; Rezazadeh *et al.*, 2016).

ANTIFUNGAL ACTIVITY

Aloe vera was evaluated on the mycellium development of *Rhizoctonia solani*, *Fusarium oxysporum*, and *Colletotrichum coccodes*, that showed an inhibitory effect of the pulp of *A. vera* on *F. Oxysporum*, *R. solani* reduced the rate of colony growth, (Cheesbrough *et al.*, 1984; Rodriguez *et al.*, 2005), (Agarry *et al.*, 2005). reported that the *Aloe* gel inhibited the growth of *Trichophyton mentagrophytes*, while the leaf possesses inhibitory effects on both *Pseudomonas aeruginosa* and *Candida albicans*. In contrast, *Aloe vera* extracts failed to show antibiotic proper ties against *Xanthomonas* species, (Satish *et al.*, 1999). The saponins perform strongly as anti-microbial against bacteria, viruses, fungi and yeasts, (Joerger *et al.*, 2001; Peter *et al.*, 2002; Moghadamtousi *et al.*, 2014; Shireen *et al.*, 2015; Ahmed *et al.*, 2016).

ADVERSE REACTIONS

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 anthraquinone stimulant laxatives can lead to hepatitis, (Beuers *et al.*, 1991) and electrolyte disturbances (hypokalaemia, hypocalcaemia), metabolic acidosis, malabsorption, weight loss, albuminuria, and haematuria, (Godding *et al.*, 1976; Muller *et al.*, 1993).

Secondary aldosteronism may occur owing to renal tubular damage after aggravated use. Weakness and orthostatic hypotension may be exacerbated in elderly patients when stimulant laxatives are repeatedly used, (Rockville *et al.*, 1992). 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, (Heizer *et al.*, 1968; Ernst *et al.*, 2000; Hajheydari *et al.*, 2014; Miroddi *et al.*, 2015; *et al.*, 2016).

SIDE EFFECTS

TOPICAL

It may cause redness, burning, stinging sensation and rarely generalized dermatitis in sensitive individuals. Allergic reactions are mostly due to *anthraquinones*, such as aloin and *barbaloin*. It is best to apply it to a small area first to test for possible allergic reaction, (Davis *et al.*, 1989; Hegggers *et al.*, 1995; Dhikav *et al.*, 2002; Sharma *et al.*, 2014; Ahluwaliaa *et al.*, 2016).

ORAL

Abdominal cramps, diarrhoea, red urine, hepatitis, dependency or worsening of constipation. Prolonged use has been reported to increase the risk of colorectal cancer. Laxative effect may cause electrolyte imbalances (low potassium levels), (Chinnusamy *et al.*, 2009; Salazar *et al.*, 2010; Sundarkar *et al.*, 2011; Kareman *et al.*, 2013; Akev *et al.*, 2015; Ahmada *et al.*, 2016).

CONCLUSION AND FUTURE ASPECTS

In recent years, ethnobotanical 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. They obviously deserve scrutiny on modern scientific lines such as physiochemical characterization, biological

evaluation, toxicity studies, investigation of molecular mechanism of action of isolated phytoprinciple and their clinical trials. These are necessary classical approaches in search of new lead molecule for management of various diseases.

Many Indian herbs are being used in traditional practices to cure various human ailments. *Aloe vera*, has an important place among such wound healing medicinal plants, it can also be used in treating inflammation, pain, ulcer and antihyperglycaemic agent. Furthermore, in future study, the isolated principles from *Aloe vera* needs to be evaluated in scientific manner using various innovative experimental models and clinical trials to understand its mechanism of action, in search of other active constituents, so that its other therapeutic uses can be widely explored.

Aloe vera is a medicinal plant and due to its extensive medicinal, nutraceutical and other uses it's enjoy a great demand in the market across the globe. The major markets for *Aloe vera* and its extracts are Australia, US and the entire Europe. Given the exponentially growing demand for it in the international market, *Aloe vera* presents the finest commercial opportunity among the various medicinal plants. India is among the few countries gifted with the unique geographical features essential for cultivation of *Aloe vera* and other high potential medicinal plants.

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