



## Pharmacological and Phytochemical Potential of *Aleo Barbadensis* (A Comprehensive Review)

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**ABSTRACT:** *Aloe vera* contains 99-99.5% water; the remaining (0.5- 1.0%) solid material is comprised of minerals, water & fat-soluble vitamins, amino acids, phenolic compounds, simple and complex polysaccharides and organic acids. Aloe gel contains different elements like B, Be, Al, P, Si, Ca, Mg, Na and Fe. On the basis of dry-weight, the rind and pulp contain only a minor fraction of proteins and lipids. Gel polysaccharides of *Aloe vera* are comprised of linear chains of glucose and mannose molecules. *Aloe vera* consists of more than 200 different biological and medicinal active ingredients which are highly beneficial for human health. The plant demonstrates the antibacterial and antifungal, anti-helmenthic, purgative, anti-inflammatory, aphrodisiac, antispectic, anti-oxiant and laxative properties and is also used to treat skin infections, skin cancer, minor cuts and even sunburns; it is also effective against piles, jaundice, cough, dyspnea and asthma. The plant is commonly used at local level in Pakistan, for the treatment of numerous human diseases. *Aloe vera* also finds very important applications in cosmetics, dermatological industry, beauty products, sun block lotions, skin smoothening moisturizers, skin tonics against pimples and also have the ability to transport healthy substances through the skin and removal of dead skin cells. The present study was aimed to review the phytochemical composition and medicinal potential of *Aloe barbadensis* (*Aloe vera*) which is a very famous plant all over the world.

**Keyword:** *Aloe vera*, Medicinal, Human Diseases; Curative; Cosmetics, Beauty, Skin

## INTRODUCTION

Plants find an immense significance in today's research due to their important nutritional and pharmacological contents (Rehman et al., 2018; Farhat et al., 2020; Kamran et al., 2020; Yaqoob et al., 2021). *Aloe Vera* is a plant which was originated in South Africa; it belongs to one of 400 species of *Aloe* which belong to the Liliaceae family. The plant is indigenous in dry tropical and subtropical climates. It is two to three feet in height with large thick leaves (Reynolds and Dweck, 1999) and can survive even in low freezing temperature (Lee et al., 2000). It takes almost four years until it is ready for harvesting. Like any vegetable juice, it should be stabilized before it starts to oxidize and loses its goodness. For commercial importance, few species of *Aloe* have been suggested including *Aloe vera* which has been considered most powerful species (Eshun and He, 2004). However, it is most popular and common plant in research field (Kiran et al., 2019). In Venezuela, Aruba, India, Bonaire, United States of America, *Aloe vera* is cultivated on commercial scale. On the other hand, in South California deserts, it is grown in best quality (Sofowora, 1996; Yeh et al., 2003). For over 2000 years, *Aloe vera* has been

used in folk medicines and remained as a mandatory component of many traditional medicines in India, China, Japan and West Indies (Benzie and Wachtel-Galor, 2011).

Keeping in view the great nutritional and medicinal importance of plants (Naseer et al., 2019; Butt et al., 2021; Riaz et al., 2021), the current studies were performed to overview the phytochemical and pharmacological potential of *Aloe vera*.

## DISCUSSION

### Phytochemical composition

*Aloe vera* belongs to succulent plants which are xerophytes and have adaptations to survive in the areas having lower accessibility of water. They can store a large proportion of water which may rise up to the range of 99-99.5% (Hamman, 2008). The remaining solid (0.5- 1.0%) portion contains about 75 potentially active compounds which include minerals, water & fat-soluble vitamins, phenolic compounds, simple and complex polysaccharides and organic acids. Leaf portion of *Aloe vera* contains 20-30% rind and 70-80% pulp of whole leaf. On the basis of dry-weight, the rind and pulp contain only a minor fraction of proteins (6.3% and 7.3%, respectively) and lipids (2.7% and 4.2%, respectively). Gel polysaccharides of

*Aloe vera* are comprised of linear chains of glucose and mannose molecules, from which mannose molecules possess comparatively higher concentration; therefore these molecules are termed as polymannans (Ni et al., 2004). These chains range from few to several thousand molecules (Lee et al., 2000). *Aloe* gel contains different elements like B, Be, Al, P, Si, Ca, Mg, Na and Fe (Choi et al., 2001). The inner leaf of parenchymatous tissue contains polysaccharides. The medicinal effects of *Aloe vera* leaf extract have been well recognized (Ni et al., 2004, Hamman, 2008, Avijgan et al., 2014).

### **Pharmacological Value**

*Aloe vera* has been grown for pharmaceutical industry specifically in western societies of USA. Nevertheless over last few decades, several species of *Aloe* have gained an immense importance as therapeutic plant so

consequently, a large industry has been established employing its biological properties (Lee et al., 2000). Because of its therapeutic and curative properties as well as 75 potentially active ingredients from inner gel, the plant has been used over centuries (Choi et al., 2001)..

*Aloe ferox* consists of several combinations of glucose and galactose as principal monosaccharides but *Aloe vera* just gives mannose (O'Brien et al., 2011). Many *Aloe* species extracts are used conventionally to cure arthritis, skin, cancer, burns, eczema, digestive problems, psoriasis, diabetic and high blood pressure. It acts powerfully to prevent from different skin problems such as injury of epithelial tissue, plays an important role in skin healing, cures acne, acts as potent laxative and give shiny fresh glowing skin. Fig. 1 displays numerous important uses of *Aloe vera*.



**Fig. 1. Various uses of *Aloe vera***

<https://www.pinterest.com/pin/476044623118597416/>

It is also termed as silent healer because it possesses the property of wound healing (Choi and Chung, 2003). Because of different environmental conditions, the *Aloe* species contain different phytochemicals. Polysaccharides which are present in its pulp have been proved to be best and beneficial for many different applications (Suga and Hirata, 1983, Bunyapraphatsara et al., 1996, Yongchaiyudha et al., 1996, Rabe and Van Staden, 1997). The plant is effective against piles, jaundice, cough, dyspnea and asthma (Joseph and Raj, 2010). Its gel (a clear pulp) finds an tremendous importance in

neutraceutical, cosmetic, medical applications.

Different studies have shown that rind part of this plant possesses higher anti-oxidative activities (Hossain et al., 2013). World Health Organization suggested that a number of drugs can be extracted from medicinal plants (Sahu et al., 2013). *Aloe chinensis bak*, *Aloe indica Royle*, *Aloe rubescens DC*, *Aloe elongata Murray* and *Aloe vera L. var. littoralis König ex Bak* are synonyms; however, *Aloe vera (L.) Burm. f.* is the authorized name of the plant (Sofowora, 1996). Table 1 shows various constituents of *Aloe vera* and their activities.

**Table 1: Constituents of Aloe Vera and their activities**

(Nandal and Bhardwaj, 2012)

Constituents	Activities
Sugars	Immune modulating and Anti-viral
Seponins	Anti-septic and cleansing
Vitamins	Anti-oxidant
Enzymes	Anti-viral and anti-fungal at specific Concentration
Minerals	Mandatory for good health
Amino acids	Fundamental building blocks for proteins
Salicylic Acid	Analgesic
Steroids	Anti-inflammatry, Analgesic, Antiseptic

*Aloe vera* is used for curing, preventing and suppressing of a wide range of diseases, as described below:

**Anti-cancer activity of *Aloe vera***

In human population, Hepatocellular carcinoma (HCC) is the

most fatal malignancies with almost 550,000 new cases and many deaths per year. For HCC prevention, locally available plants can provide best feasible sources. *Aloe vera* and *calligonum comosum arta* are plants of Egypt which are being used as medicinal source in rural areas. *Aloe vera* contains many potentially active constituents which include barbalion, aloin, anthranol, emodin anthraquinones, cinnamic acid, aloetic acid, chrysophanic acid, enzymes and many other compounds including proteins, minerals, amino acids and saccharides. Anthraquinone aloin which is the main ingredient of *Aloe vera* plant, contains powerful therapeutic action for cancer. Vascular endothelial growth factor (VEGF), is the important proangiogenic cytokines that acts as inducer of tumor neovascularization so treatment by aloin prevents angiogenic response of VEGF induced in human endothelial cells and results in prevention of proliferation/migration of these cells (Pan et al., 2013). Another active compound is aloe emodin that also has been used because of its several biological activities including anti-cancer function. It is extracted from *Aloe vera* leaves (Sahu et al., 2013). It demonstrates anti proliferation effects on lungs, glioma, squamous and neuroectodermal cancer

cells (Masaldan and Iyer, 2014). Aloin was also studied to possess anti-cancer activity because of inhibition of angiogenesis and growth of tumor by blocking activator of transcription 3 activation (Jackson et al., 2014).

#### **Anti-diabetic activity of *Aloe vera***

Diabetes is a chronic metabolic disorder which is characterized by a decrease of insulin in body. These abnormalities of diabetic patients cause mitochondrial superoxide over production. This leads to the complications in both microvascular and cardiovascular activities. In mice with type -2 diabetic the five phytosterols including cycloartenol, lophenol, 24-methyl- lenecycloartanol, 24-ethyl-lophenol and 24-methyl-lophenol gave best anti-diabetic effects. Recent studies have shown that new treatment procedures of diabetes only focus on insulin production but also on the antioxidant protection of the beta-cells. Polysaccharides present in *Aloe vera* exhibit hypoglycemic properties and rise level of insulin (Yagi et al., 2006). Treatment of diabetes through different medicinal plants such as *Gymnema slyvestre*, *Trigonella foenum graecum*, *Aloe vera* and *Syzigium cumini* was reported (Ramanathan and Krishnamoorthy, 1973). In diabetic rats, the aloe gum's extract has been found to

increase the tolerance against glucose (Al-Awadi and Gumaa, 1987). Sugar level is reduced in diabetes by using *Aloe vera* gel (Yeh et al., 2003). These explanations suggested the antidiabetic effects of *Alo vera* because it increases the insulin level in blood and is also helpful against oxidative stress during pancreatic beta cells damage (Abo-Youssef and Messiha, 2013; El Sayed et al., 2016).

### **Anti-bacterial activity of *Aloe Vera* gel**

*Aloe vera* improves the wound healing by its anti-bacterial effects (Heggers et al., 1995). *Aloe vera* gel exhibits bactericidal effects against the bacteria like *Pseudomonas aeruginosa* (Cera et al., 1980; Azghani et al., 1995) and *Candida albicans* (Heggers et al., 1979). This gel is comprised of 99.3% of water and 0.7% solid and helps in stimulating the immune system of body (Davis, 1997, El-Shemy et al., 2010) and also inhibits *Streptococcus faecalis* and *Streptococcus pyogenes* (Robson et al., 1982). Anti-bacterial and activating macrophases actions have been shown by acemannan and glucomannan components of of *Aloe vera* (Visuthikosol et al., 1995). According to a study using rat model, process of wound healing was improved by *Aloe vera* which removed the inflammation

causing bacteria (Heggers et al., 1995). Extracts of *Aloe vera* work well against *E. coli* and *S. aureus* as anti-bacterial agent and against *M. tuberculosis* as anti-mycobacterial agent (Kantam and Rai, 2016).

### **Hepatoprotective activity of *Aloe vera***

Many important functions are regulated by liver but hepatic injury causes the distortion of these functions. Down-regulation and up-regulation of fatty acids are induced by lophenol and cycloartanol in liver. This results in intra-abdominal fat reduction and promotion of hyperlipidemia and decreased ratio of peroxisome proliferator activated receptor (Misawa et al., 2012). The *Aloe* formula has effect on obesity induced insulin resistance and hepatic steatosis. By suppressing mRNA expression of lipogenic genes, *Aloe vera* gel extract inhibits the ethanol induced by fatty liver. Cholesterol level and cardiovascular disease can be decreased by therapeutic potential of *Aloe vera* gel (Sudheer et al., 2011; Kumar et al., 2013).

### **Antioxidant potential and radical scavenging effects of *Aloe vera***

The antioxidant potential of plant is well recognized according to various investigations (Hussain et al., 2021;

Rasheed et al., 2021; Siddiqua et al., 2021). *Aloe vera* possesses considerable quantity of ascorbic acid (vitamin C), tannins,  $\alpha$ -tocopherol (vitamin E) and flavonoids which act as anti-oxidants (Hamman, 2008). Patients with diabetes mellitus may have increased oxidative stress and oxidative cellular injury due to the contribution of free radicals in development of diabetes mellitus. Antioxidant enzymes can scavenge these oxygen species. Activity of the antioxidant enzymes are changed by diabetes. Extract of *Aloe vera* plant significantly reduces the glucose level in streptozotocin induced diabetic rats. 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfated fonic acid) (ABTS), 2,2-diphenyl-1-picrylhydrazyl (DPPH) and nitric oxide free radicals can be scavenged by *Aloe vera* gel (Nwajo, 2006, Saini and Saini, 2011). Potential glycation of enzymes and free radical formation can be reduced by administration of ethanolic extract of *Aloe vera* gel on anti-oxidant tissue (Aber et al., 1993; Nwajo, 2006, Kammoun et al., 2011).

### **Effect on Estrogen status of *Aloe vera***

Breast cancer can be prevented or reduced by emodin and aloe-emodin separated from the *Aloe vera* gel by targeting stability of estrogen receptor- $\alpha$

protein *via* defined mechanism, this is the feature characteristic of anthraquinones to reduce proliferation of breast cancer cells. *Aloe vera* gel has important role in sustaining ovarian steroid status during polycystic conditions during which estrogen:testosterone ratios are varied by steroidogenesis (Maharjan et al., 2010; Huang et al., 2013).

### **Antimicrobial activity of *Aloe vera***

As an antimicrobial agent *Aloe vera* has potent activity. *Aloe vera* gel contains 14kDa which can be isolated and purified to exhibit powerful antifungal activity against *Candida krusei* (Pandey and Mishra, 2010). Ribosomal A site can be blocked by anthraquinones. So, in presence of *Aloe vera* extract bacteria cannot grow (Ferro et al., 2003). Pyrocatechol which is an hydroxylated phenol of *Aloe vera*, has toxic effects on microorganisms (Cowan, 1999).

### **Antiseptic activity of *Aloe vera***

Six agents including lupeol, cinammonic acid, salicylic acid, sulphar, phenol and nitrogen urea are collectively termed as antiseptic agents of *Aloe vera* and are responsible for the antiseptic action. These agents play a crucial role in inhibition of viruses, fungi and bacteria (Zawahry et al., 1973;

Surjushe et al., 2008). *Aloe vera* therapy is used as an effective, reliable and alternative treatment to cure the first phase of genital herpes in men (Syed et al., 1997).

### **Anti-aging activity of *Aloe vera***

Presently, utmost dermatologically valuable products are made from *Aloe vera* because it contains moisturizing properties. Astringent and amino acids which are present in it, help in tightening of pores and softening of hard skin cells, respectively by cohesive action. According to the study of skin treatment, *Aloe vera* gloves are helpful in decreasing the skin wrinkle and erythema and increasing skin integrity (West and Zhu, 2003). *Aloe vera* creates a cooling effect and plays a *vital* role in rejuvenation of aging skin and used as a skin tonic. Because of all these amazing features, it is used exponentially in cosmetics.

### **Wound Healing and Burn**

*Aloe vera* is also termed as silent healer because of its effects on wounds and burns. Wound healing process occurs in three different stages. Inflammation, hyperaemia and leukocyte infiltration occurs in the first stage. In second stage, dead cells are removed. In third stage fibrous tissue are formed with cell proliferation

(Kumar and Debjit, 2010; Reddy et al., 2011). Crosslinking of collagen is increased by using aloe gel that leads to the contraction of wounds and finally breaks down the tissues (Chithra et al., 1998). It has been proved by cumulative evidence that first to second degree burns can be healed effectively by use of *Aloe vera* because it possess mannose-6-phosphate (Davis et al., 1994; Maenthaisong et al., 2007). It contains *Acemannan* which is formed of long chains of acetylated mannose (Femenia et al., 1999; Lee et al., 2001). The use of *Aloe vera* may provide full healing in cases of radiation burn patients (Syed et al., 1997).

### **Stress Releaser**

Functions of the human body can be carried out more smoothly by proper use of *Aloe* juice (Saroj et al., 2004). The physiological and biochemical processes as well as the processes of cell damaging are effectively reduced by use of this aloe juice. Chemical reactions take place in oxidative stress which leads to changes in oxidative state. Protection from oxidative stress can be achieved by proper use of *Aloe vera* in food (Joseph and Raj, 2010).

### **Skin Care**

*Aloe vera* finds very important applications in cosmetics and

dermatological industry. It is used in more than 95% of the dermatologically important extracts throughout the world and is considered one of the most valuable ingredients in cosmetics. It improves the ability of skin to hydrate itself and keeps the skin moist in dry and harsh weather and is also used as a moisturizer for oily skin. Aloin and its gel find significance as skin tonics against pimples. Due to its important penetrating ability, *Aloe vera* assists in the transport of healthy substances through the skin and also plays an important role in the removal of dead skin cells (Reddy et al., 2011). *Aloe vera*

when mixed with some essential oils, forms an important value in a large range of beauty products, sun block lotions and skin soothing moisturizers. Due to its cooling and soothing properties, it is used to address many skin issues (Joseph and Raj, 2010). Many extracts of *Aloe vera* have been investigated to treat minor skin infections because they possess antibacterial and antifungal potential (Shamim et al., 2004). Fig. 2 and 3 display the beneficial effects of *Aloe vera* and its gel, respectively on skin and beauty.



**Fig. 2. Benefits of *Aloe vera* for skin**

<https://www.bebeautiful.in/all-things-skin/everyday/benefits-and-use-of-aloe-vera-gel-for-face>



Fig. 3. Uses of *Aloe vera* gel for skin care and beauty

<https://mobile.twitter.com/BeBeautiful> In/status/1500690202918014981

## CONCLUSION

Aloe vera consists of more than 200 different biological and medicinal active ingredients which are highly beneficial for human health. The plant demonstrates the antibacterial and antifungal, anti-helmenthic, purgative, anti-inflammatory, aphrodisiac, antiseptic and anti-oxiant properties and also possesses vitamins, natural sugar, amino acids and other bioactive compounds. Aloe vera also finds very important applications in cosmetics, dermatological industry, beauty products, sun block lotions, skin smoothening moisturizers, skin tonics

against pimples and also have the ability to transport healthy substances through the skin and removal of dead skin cells. The plant is widely cultivated on commercial level because of its countless uses. It is conventionally used for the treatment of eczema, inflammation, fever, burn injuries, skin infections, skin cancer, minor cuts, for cancer and AIDS treatment. Being a wonderful plant, it is certainly a gift from nature to humanity. *A. vera* contains 99-99.5% water; the remaining (0.5- 1.0%) solid material is comprised of minerals, water & fat-soluble vitamins, phenolic compounds, simple

and complex polysaccharides and organic acids. On the basis of dry-weight, the rind and pulp contain only a minor fraction of proteins and lipids. Gel polysaccharides of Aloe vera are comprised of linear chains of glucose and mannose molecules.

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