



Aloe vera: A multipurpose industrial crop



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ABSTRACT

Aloe vera is a well known medicinal plant which thrives in varied agro-climates. It was native to Northern Africa, but now it is widely distributed throughout the world. The chemistry of the plant reveals the presence of diverse biologically active compounds associated with curing different ailments such as wound, inflammations, cancer, diabetes, ulcer, microbial diseases, skin diseases, acquired immune deficiency syndrome (AIDS), liver problems, dental problems, cardiovascular problems, hyperlipidmia and others. The plant also shows anti-aging, laxative, antioxidant and immunomodulatory activities. Most of the biological activities are contributed by the wide varieties of compounds present in the sap and gel of *A. vera*. Various scientific investigations have proved that anthraquinones and glycosides present in the sap of *A. vera* are responsible for minimizing the severity of cancer, free radicals activity, diabetes, inflammation, microbial diseases, tyrosinase activity, spermatogenic activity, β -secretase inhibitory activity and proliferative activity. It also affects estrogen status and intestinal absorption of the cell along with laxative activities. In addition to the therapeutic properties, the gel is used as an important ingredient of various cosmetic formulations. Though few reports have cited the side effects of anthraquinones, but it is negligible compared to its medicinal properties. This review article also describes about the various factors affecting the chemical composition of *A. vera* such as different existing varieties of *A. vera*, annual season rainfall, temperature, incident solar radiation, harvest date, climate, land and cultivation methods. In view of high interest shown by the people of different countries for its medicinal value and commercial uses, it is quite worthy to review the active constituents and clinical effectiveness of *A. vera*.

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1. Introduction

Traditional medicines are the integral part of human civilization to cure various ailments. According to the World Health Organization (WHO), up to 80% of the people of the world are dependent on herbs as traditional remedy to cure various ailments since the beginning of civilization (Arunkumar and Muthuselvam, 2009). Natural products act as a leading source for the discovery of new drugs from the origin of Ayurveda (Bhutani and Gohil, 2010). Among the reported medicinal plants, *Aloe vera* is used as a popular folk medicine throughout the world (Arunkumar and Muthuselvam, 2009). It was known as 'Universal Panacea' by the Greek scientist 2000 years ago. Egyptians have designated *A. vera* as a 'Plant of immortality' (Sikarwar et al., 2010). Egyptian book of 550 B.C.E has described that skin diseases can be cured by using *A. vera*. 'De Materia Medica', a book of 74 C.E which was written by a Greek physician, mentioned that *A. vera* can treat wounds by healing the skin (Coats and Ahola, 1979). In 1200 C.E., for Eczema treatment Aloe leaves were used (Cole and Chen, 1943). The name of *A. vera* was originated from both Arabic and Latin language. Alloeh is the Arabic word which means shining bitter substance from which Aloe word was generated and vera means true which was derived from Latin language (Basmatker et al., 2011).

It is a succulent plant with triangular fleshy green leaves bearing white teeth at the margins. It grows 60–100 cm tall. The plant can survive at 40 °C temperature and also below freezing temperature depending on the root health (Grindlay and Reynolds, 1986). It was native to Northern Africa, but now it is found to grow in Aruba, Bonaire, Haiti, India, South Africa and Venezuela also (OAU/STRC, 1985; Yeh et al., 2003; Grundmann, 2012). The leaf of *A. vera* contains latex and gel. The juice or sap of *A. vera* is the latex present beneath the epidermis layer, which occupies approximately 20–30% weight of the whole leaf whereas inner part of the leaf bears tasteless and colourless gel in the form of pulp or mucilage from the parenchyma cells (Eshun and He, 2004; Klein and Penneys, 1988; Reynolds and Dweck, 1999). Approximately 420 species of Aloe are available among which *A. vera* is considered to be the most active plant for medicinal purposes (Grindlay and Reynolds, 1986; Atherton, 1998). In western countries, mainly in the USA, *A. vera* is cultivated for supply of the latex component of the leaf to pharmaceutical industries (Lee et al., 2000c). Many investigators have tried to analyse the active principles of *A. vera* gel which has been used in various centuries for its curative and therapeutic properties. Moreover 75 active ingredients from the inner gel have been identified but it was proved that its therapeutic effects have not been related to each individual component (Habeeb et al., 2007). Various beneficial effects of Aloe leaf have been attributed by the polysaccharides found in the leaf (Ni et al., 2004). However it was reported that biological activities have been associated with

synergistic action of various compounds present in the plant rather than a single compound (Avijgan et al., 2014).

1.1. Taxonomic hierarchy and nomenclature

The taxonomic description of *A. vera* is as follows:

Kingdom: Plantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Asparagales

Family: Xanthorrhoeaceae

Genus: *Aloe* L

Species: *Aloe vera* (L.) Burm.f

Aloe barbadensis Mill., *A. elongata* Murray., *A. officinalis* Forsk., *A. chinensis* Bak., *A. perfoliata* L., *A. rubescens* DC., *A. indica* Royle, *A. vera* L. var. *littoralis* König ex Bak., *A. vera* L. var. *chinensis* Berger., *A. vulgaris* Lam. *Aloe barbadensis* is referred as *Aloe vera* by the taxonomist and *Aloe vera* (L.) Burm.f is the synonym and legitimate name for the species according to International Rules of Botanical Nomenclature (Sahu et al., 2013; Shelton, 1991).

2. Aloe vera leaf

2.1. Anatomy and morphology

The leaf of *A. vera* consist of mainly the outer thick green rind with white teeth at the margins, viscous jelly like mucilage layer in the inner side of the rind and the fillet fluid which is the water storage area for the plant (Fig. 1) (Chandegara and Varshney, 2013).

2.2. Chemical composition

The leaf of *A. vera* composed of mainly three layers. Rind is the outer thick layer containing of 15–20 cells which synthesizes carbohydrates and proteins. Inside the rind, vascular bundles are present such as xylem and phloem. Xylem helps in the transportation of water whereas phloem involves in transportation of sucrose and other small organic molecules. The middle layer contains bitter yellow sap having anthraquinones and glycosides. The innermost layer composed of gel having 99% water and rest is made of amino acids, lipids, sterols etc (Tyler, 1993). Details of compounds (1–43) occurring in *A. vera* are described in (Fig. 2) and (Table 1).

2.2.1. Influential factors in the chemical composition of *A. vera*

Several studies have reported about the various factors which influence the chemical composition of the plant: (1) different existing varieties of *A. vera* (Saccu et al., 2001; Li et al., 2003), (2) annual season rainfall and temperature, (3) incident solar radiation, (4)

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