

Twenty years of research on *Aloe vera*

Nuriye Akev^{*1}, Ayşe Can¹, Nurhayat Sütlüpnar², Eda Çandöken¹, Nurten Özsoy¹, Tuğba Yılmaz Özden¹, Refiye Yanardağ³, Erdal Üzen⁴

¹Department of Biochemistry, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

²Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

³Department of Chemistry, Faculty of Engineering, Istanbul University, Istanbul, Turkey

⁴Department of Biology, Faculty of Sciences, Istanbul University, Istanbul, Turkey

Abstract: *Aloe vera*, sometimes referred as a “miraculous” or “wonder” plant, has been used by mankind for centuries for the treatment of different disorders due to the inner gel of its succulent leaves. Medical usage and applications of the main species, namely *Aloe vera* (L.) Burm. f. are mainly attributed to immunomodulatory or antioxidant activities.

Our work on *A. vera* has begun with the separation of anthraquinones and continued with the purification and characterization of the lectins. In another study, hypoglycemic effect of *A. vera* leaf extracts was assayed *in vivo*, followed by the effect of the extracts on several tissues in diabetic rats. *A. vera* has shown a significant prophylactic effect on *Ehrlich ascites* tumour cells when given before tumour inoculation in mice. This effect was also seen with the purified lectin and attributed to the immunomodulatory effect of the plant.

Assuming that its benefit could also be attributed to the antioxidant activity, the antioxidant potential of the leaves aqueous extract was evaluated. The leaf skin extract showed good antioxidant capacity in all tests while the inner gel did not exhibit any activity.

Our work on *A. vera* continues on the research of the potential use of the plant leaves as anticancer and enzyme inhibitory agent.

Key words: *Aloe vera*, antioxidant, antitumour, antidiabetic, immunomodulatory

History

Aloe vera, sometimes referred as a “miraculous” plant, has been used by mankind during centuries, for the treatment of mainly skin conditions but also for different disorders like constipation, stomach disease, hair loss, kidney disease and more (Park & Lee, 2006). From the ecological nature of the plant, *Aloe* originated from Africa and the history of its use dates back to almost 6000 years (Table 1).

The plant

Formerly alternatively placed in the Liliaceae and Aloaceae families, *Aloe* genus is nowadays counted between the members of the Xanthorrhoeaceae (Upton 2012), subfamily Asphodeloideae (Wikipedia). The *Aloe* genus counts over 400 species in the world. Among them, *A. vera* (L.) Burm. f. (= *A. barbadensis* Mill., = *A. chinensis* Bak., = *A. vulgaris* Lam. = *A. elongata* Murray, = *A. officinalis* Forsk; Curaçao aloe, the true aloe); *A. arborescens* Mill. var. *natalensis* (Japan), *A. perryi* Bak. (India), *A. ferox* Mill. (Cape Aloe, Cape), *A. africana* Mill. (Africa), *A. saponaria* Haw. (Africa and Middle East) are the most popular ones.

Aloe species are perennial succulent xerophytes with thick fleshy leaves which permits the water storage in the form of the famous gel. *Aloe* species prefer semi-desert regions with warm climates and grow best on dry, sandy and calcareous terrain. *Aloe* however, is not a cactus. The homeland of *Aloe* is Africa, the Arabian Peninsula, Madagascar and Indian Ocean Islands. *Aloe* species are also distributed to the Mediterranean region, Canary Islands, Mexico, India, the Caraibes. In the USA, *A. vera* is cultivated in South Texas (Rio Grande), Florida and Southern California.

The etymology of *Aloe* comes from “alloeh(k)” (Arabic) or “allal” (Hebrew) or “alsos” (Greek); which means bitter (Park & Lee, 2006; Shrestha et al., 2015); “vera” means, true veritable. The Arabic name of the plant “saber” (sword) is due to the shape of the enlarged leaves in the form of a sword. The Turkish name of the plant “sarısabır” is derived from the Arabic name probably combined to the color of its yellow flowers. The name “sabir” in Persian was attributed to the fact that this plant relaxes man and soforth that *Aloe* is planted on the graves to relax the family of the deceased (Sharrif Moghadassi, 2010).

Table 1. History of the use of *Aloe* species during centuries (Park & Lee, 2006; Akev et al., 2011; Upton, 2012)

Date	Description/use of <i>Aloe</i>
4000 B.C	<i>Aloe</i> figures in Egyptian temples, “sanctuary plant of immortality” in ancient Egypt, given as funerary gift to pharaohs.
2200 B.C.	Earliest description of medical use of <i>Aloe</i> in Sumerian clay tablets.
1550 B.C.	Ebers Papyrus in Egypt describes healing benefits of <i>Aloe</i> for internal and external use.
356-323 B.C.	Used by Alexander the Great to treat the wounds of his soldiers. Alexander the Great has invaded Socotra Island to take <i>A. perryi</i> trade into security.
51 B.C.	Named as “Cleopatra’s plant” in ancient Egypt for its use for beauty.
27 B.C.- 14 A.C.	<i>Aloe</i> is introduced into Greco-Roman medicine during the reign of Augustus.
First Century A.C.	“ <i>Aloes</i> ” are mentioned in the Holy Bible as the substance used to anoint the body of Jesus Christ.
41-68	First large report on the pharmacological effects <i>Aloe</i> in the Herbal Pharmacopeia: “De Materia Medica” of Dioscorides.
23–129	Pliny the Elder, in “Naturalis Historica” reported many internal and topical uses of <i>Aloe</i> particularly in leprosy wounds.
618-907	<i>Aloe</i> , use for dermatitis and orally reported in China.
960-1279	The use of <i>A. vera</i> leaves for fever, sinusitis and dermatological disorders was explained in Chinese Song Dynasty, Materia Medica.
14-16 Centuries	<i>Aloe</i> , described in English and European medicine as purgative and as topical medicine for wounds and several dermatological disorders.
1492	<i>Aloe</i> was introduced by Christopher Columbus to the New World. He wrote on the boats wings “Everything in order <i>Aloe</i> is on boat”.
1650-1742	<i>Aloe</i> was imported to London for the first time and took place in London Pharmacopeia as “Barbados aloë”.
1720	The botanical name <i>Aloe vera</i> is created by Carl von Linne.
1768	Nicolaas Laurens Burman establishes <i>A. vera</i> as a separate species. About ten days later Philip Miller independently classifies it as <i>A. barbadensis</i> ; precedent is given to the earlier publication establishing the nomenclature as <i>Aloe vera</i> (L.) Burm. f.
1810-1820	<i>A. vera</i> preparations in United States Pharmacopoeia (U.S.P.) as purgative and skin protectant.
1851	Edinburgh chemists Smith and Smith extract a cathartic principle from <i>Aloe</i> and name it aloin.
1867	<i>A. barbadensis</i> (<i>A. vera</i>) “juice” enters the British Pharmacopeia.
1912	First <i>A. vera</i> commercial culture begins in Florida (USA).
1935	Collins & Collins (1935) described <i>A. vera</i> for the therapy of radiation burns and reported its potential efficacy in several dermatological problems.
1959	<i>Aloe</i> takes place in the US FDA list as food supplement.
1975	<i>Aloe</i> “juice” was added to European Pharmacopeia.
Present	<i>A. vera</i> preparations certified for therapeutic purposes in Australia, Canada, India, Korea and many other countries.

Botanical description and chemical composition

A. vera has triangular, fleshy leaves (Fig. 1) with serrated edges, yellow tubular flowers (Fig. 2) and fruits containing numerous seeds. The leaf is mainly composed of three layers with different chemical composition (Fig. 3) and thus showing different pharmacological activities (Reynolds, 2004; Shrestha et al., 2015). The transversal section of *A. vera* leaf showed well defined limits, enabling the separation of the hydrenchyma in the median zone from the mesophyll associated with the abaxial and adaxial epidermis. The **outer green rind (leaf skin, leaf peel)** is the outer most thick layer of *A. vera* leaves which is having protective function and also contains carbohydrates and proteins. The succession of tissues to the abaxial surface included an epidermis with a thick external cell wall covered by a layer of cuticle, followed by two cell layers that could be called an exodermis except that they contained chloroplasts and thus were considered an assimilating tissue or chlorenchyma. There is a gradual increase of the cell size, which reached a maximum in the median zone of the mesophyll which is the **middle layer** and then diminished towards the interior, forming about four compact cell layers. The middle layer contains **the latex** which is the bitter, yellow-brown exudate arising from the cells adjacent to the vascular bundles, it is also called ***A. vera* juice, leaf exudate, sap or aloes** (Vogler & Ernst, 1999). When dried the latex, named “aloe lucida” as the drug, is almost black, glittering as glass and hard (Fig. 4). The latex which is the bittering agent and have given the name of the plant is rich in anthraquinone glycosides and is a violent purgative. These layers ended in the vascular bundles of **the inner layer** which represented the limit separating the mesophyll from the hydrenchyma gel. The inner layer contains **the inner gel** called ***A. vera* gel or pulp** which is the clear, mucilagenous gel arising from the parenchymatous cells, contains 99% water, mucopolysaccharides, glucomannans, glycoproteins (lectins), enzymes, hormones, amino acids, sterols, lipids, vitamins and minerals (Fig. 5). This part of the leaves, likely to be the water storage tissue of the plant, is responsible for the immunomodulatory, anti-inflammatory, skin emollient and wound and burn healing effects of the plant. Thus analyzing and understanding the chemical composition of the leaves parts is of great importance for the understanding of the biological effects of the plant as well as for the standardization of *Aloe* products.



Figure 1. *Aloe vera* in our laboratory (20.04.2006)



Figure 2. *Aloe vera* flowers (Courtesy of Dt. Canan Akkaya, June 2011)

A. vera leaves contain a diverse array of 75 compounds, including anthraquinones (e.g. aloe-emodin), anthrones and their glycosides (Aloin A and B), chromones, carbohydrates, proteins, glycoproteins, amino acids, organic acids, lipids, saponins and minerals (Vogler & Ernst, 1999; Choi & Chung, 2003; Nandal & Bhardwaj, 2012; Upton, 2012; Raksha et al., 2014; Shrestha et al., 2015), which are summarized in Table 2.

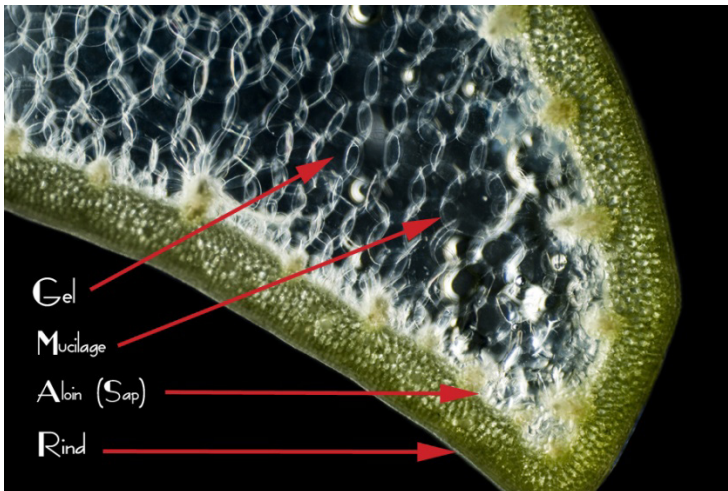


Figure 3. Three layers of *A. vera* leaf http://www.aloeveragarden.com/images/aloe_leaf_description.jpg



Figure 4. *Aloe vera* sap or latex and dried latex (*aloe lucida*) www.mypersonaltrainer.it; italian.alibaba.com



Figure 5. *Aloe vera* gel. www.svijetokonas.net; en.wikipedia.org

Table 2. Composition of *Aloe* species

General Name	Components	Use, activity
Amino acids	20 of the 22 human required amino acids required for nutrition	7 of the 8 essential amino acids required for nutrition
Anthraquinones	Aloin (A and B), aloe emodin, barbaloin, anthranol, emodin, resistannol etc.	Laxatives Antibacterial Cancer (?)
Enzymes	Alliinase, alkaline phosphatase, amylase, carboxypeptidase, bradykinase, catalase, peroxidase, cellulase, lipase etc.	Digestion Free radical neutralization etc. Topical antiinflammatory
Hormones	Auxins and gibberellins	Wound healing and antiinflammatory effect
Minerals	Ca, Cr, Cu, Fe, Mg, Mn, K, Na, Zn	Nutritional additives
Vitamins	A, C, E, B, choline, B ₁₂ , folic acid	Nutritional additives Antioxidants
Carbohydrates	Monosaccharides, mucopolysaccharides (glucomannans, acemannan, polymannose)	Antiinflammatory Antiviral (AIDS?) Immunostimulatory Cancer (?)
Sterols	β -Sitosterol, lupeol, campesterol, cholesterol	Antiinflammatory Antiseptic
Lectins	Aloctin I and II	Immunostimulatory
Saponins		Antiseptic, foaming and cleansing
Lignin		Included in topical preparations enhances the penetrative effect of other ingredients into the skin

Biological and pharmacological activities of *A. vera*

The use of *A. vera* extracts as herbal medicine depends on folklore and by experiences of people over a long period of time (Raksha et al., 2014). Many of the health benefits associated with *A. vera* include mainly,

wound healing (Hegggers et al., 1995; Chitra et al., 1998; Rajendran et al., 2007), hypoglycemic or antidiabetic (Agarwal, 1985; Ghannam et al., 1986; Ajabnoor, 1990; Beppu et al., 1993; Bunyapraphatsara et al., 1996; Yongchaiyudha et al., 1996; Rajasekaran et al., 2006; Rajendran et al., 2007; Abuelgasim et al., 2008; Kumar et al., 2011; Mogale et al., 2011), hepatoprotective (Nayak et al., 2011) antiinflammatory (Saito, 1993; Vázquez et al., 1996; Ndhllala et al., 2009), immunomodulatory (Capasso et al., 1998; Kwon et al., 2011; Im et al., 2010), anticancer (Winters et al., 1981; Gribel & Pashinskiĭ, 1986; Tsuda et al., 1993; Saito, 1993; Corsi et al., 1998) and gastroprotective (Koo, 1994) effects. Antioxidant (Miladi & Damak, 2008; Nejatizadeh-Barandozi, 2013), antimicrobial (Agarry et al., 2005; Habeeb et al., 2007; Cock, 2008; Alemdar & Agaoglu, 2009; Pandey & Mishra, 2010), antiviral (Saoo et al., 1996) and antifungal (Ali et al., 1999; Rosca-Casian et al., 2007; Kwon et al., 2011; Nejatizadeh-Barandozi, 2013) properties have also been reported (Hamman, 2008).

Many of the medicinal effects have been attributed to the polysaccharide found in the inner gel, but it is believed that synergistic action of the compounds contained in the whole leaf extracts is responsible for the multiple and diverse beneficial properties of the plant (Eshun & He, 2004). Vogler & Ernst (1999) have compared and scored 10 clinical trials conducted on patients and reported that *A. vera* might be valuable for lowering cholesterol and glucose and as topical agent against herpes or psoriasis, nevertheless at the time they have claimed that data were not sufficient to draw firm conclusions. Research on *A. vera* clinical effectiveness was mainly conducted as *in vivo* trials on animals and *in vitro* studies, and there are few trials on humans. In 2007, in an evidence-based systematic research conducted by The Natural Standard Research Collaboration, it was reported that there is strong evidence in support of the laxative properties of aloe latex, based on the well established cathartic properties of the anthraquinone glycosides. However, aloe's therapeutic value compared with other approaches to constipation remains unclear. There is also a promising support from *in vitro*, animal and human studies that topical aloe gel has immunomodulatory properties that may improve wound healing and skin inflammation (Ulbricht et al., 2007).

Research on *A. vera* in our laboratory

The first *A. vera* specimens in our Faculty were collected and identified by one of us (Prof. Dr. N. Sütülpınar), from Kale (Demre; Antalya) in May 1993. A voucher specimen was deposited in the Herbarium of the Faculty of Pharmacy, Istanbul University (ISTE 65118). The plant was cultivated in the Greenhouse of Istanbul University Faculty of Pharmacy for 6 years and transported after the big Marmara earthquake (1999) in the Greenhouse of Istanbul University, Faculty of Sciences, Alfred Heilbronn Botanical Garden.

General preparation of *A. vera* leaf aqueous extracts in our laboratory

The leaves of *A. vera* were weighed, washed and put vertically in a Becher for removal of the bitter sap (exudate) containing anthraquinones. After the removal of the exudate, the leaves were cut from the middle, the gel was separated by scratching with a spoon (Fig. 6). The leaf gel was homogenized in phosphate buffered saline (PBS; pH 7.0, 600 ml), filtered through cloth and lyophilized. The leaves without the gel (skin) were cut in small pieces and homogenized with PBS (Fig. 7). The extract was kept at 4°C overnight, then filtered through cloth and the filtrate centrifuged at 45,700 g for 30 minutes at 2°C in a refrigerated centrifuge. The green pellet was discarded and the clear yellow supernatant was taken, concentrated or lyophilized. *A. vera* leaf skin extract was thus obtained.

The chemical composition of anthracene derivatives of *A. vera* leaves was determined in a master thesis presented in 1994 (İpek, 1994; İpek & Sütülpınar, 1997).



Figure 6. Preparation of *Aloe vera* leaves and removal of the gel with a spoon (Courtesy of Msc. Eda Çandöken)



Figure 7. Separation of *Aloe vera* leaf skin and gel in our laboratory (Courtesy of Msc. Eda Çandöken)

The lectins from *A. vera*

Lectins are known to be proteins or glycoproteins of plant or animal origin, binding to specific sugar moieties on the cell surfaces (Sharon & Lis, 1972) with many interesting properties as tools for biochemistry. Many biological and pharmacological activities of *A. vera*, like antiinflammatory (Saito, 1993), mitogenic (Koike et al., 1995), burn healing (Yagi et al., 1985) and immunomodulatory (Imanishi, 1993) have been attributed to the lectin. The first record in literature is on two lectins purified from

A. arborescens Mill. (Suzuki et al., 1979). The lectins present in *A. vera* leaf skin and gel extracts were purified by affinity chromatography and characterized in several studies conducted in our laboratory (Akev et al., 1997; Akev & Can, 1999; Akev et al., 2002-2003) and master thesis (Malkoç, 1997; Çandöken, 2008). Two lectin peaks (named Aloctin I and Aloctin II) were obtained for the leaf skin and one peak for the leaf gel extract upon hydroxylapatite chromatography. Aloctin I has an apparent molecular weight of 45000 kDa and a subunit molecular weight of 15000 kDa, thus is composed of three subunits. Aloctin I was a glycoprotein and its specific inhibitor sugar of was found to be N-acetyl galactosamine.

In further studies antitumour (Akev et al., 2007b) and antioxidant (Ozsoy et al., 2012) activities of the lectin named Aloctin I was researched. It was found that Aloctin I has protective antitumour activity against *Ehrlich ascites* tumours in mice similar to that of the leaf skin extract and that it did not exhibit antioxidant effect as assessed by the DPPH radical-scavenging assay. In an early study Aloctin A was also reported to inhibit methylcholantrene-induced fibrosarcoma in mice (Imanishi et al., 1981). Recently, a mucin-specific lectin, with approximately the same molecular weight with the lectin purified by us, was isolated from *A. vera* leaf pulp aqueous extract by Kaur et al. (2011) and reported to inhibit the proliferation of colon and lung cancer cell lines.

Enzyme purification from *A. vera* leaves

There are a few studies on enzyme purification from *A. vera* leaves, most of them deals with antioxidant enzymes like glutathione peroxidase (Sabeh et al., 1993; Esteban-Carrasco et al., 2002) and superoxide dismutase (Sabeh et al., 1996). Partial purification and characterization of a b-glucosidase from *A. vera* leaves was achieved in a master thesis undertaken in our laboratory (Yılmaz, 2005; Yılmaz & Can, 2008-2009).

Antidiabetic activity of *A. vera* leaves

Two different type of studies namely acute and chronic, were undertaken in our laboratory, in order to establish the effect of *A. vera* in experimental diabetes. Moreover, in acute studies we have worked with to types of experimentally induced diabetes Type I and Type II, which in turn was

induced by injection of a high dose of streptozotocin to neonatal rat pups. In acute studies, *A. vera* leaf skin extract was found more effective than the known hypoglycemic drug glibenclamide in both types of diabetes (Okyar et al., 2001a). In the contrary during chronic studies in which only Type II diabetic rats were used, the decrease in blood glucose levels was not found significant (Okyar et al., 2001b).

After chronic studies, blood and organs were taken from Type II rats and the protective effect of *A. vera* on several tissues. Histological evaluation was made and liver, kidney, heart, skin, lens, pancreas tissues were evaluated separately for lipid peroxidation and antioxidant activity.

Contradictory results came as the number of studies augmented. *A. vera*, showed no beneficial effect on lipid profile altered by diabetes in contrast a positive effect was seen on liver enzymes and liver tissue (Can et al., 2004), kidney parameters and kidney tissue (Bolkent et al., 2004). *A. vera*, increased lipid peroxidation in heart, skin (Ozsoy et al., 2008) and lens (Özsoy et al., 2002-2003) tissues whereas decreased it in liver and kidney tissues. In accordance with our studies (Bolkent et al., 2005), Noor et al. (2008) demonstrated the antidiabetic effect and reduction of degenerative changes in pancreatic tissues of rats fed with *A. vera*. The prevention of pancreatic islets destruction was attributed to the radical scavenging activity of *A. arborescens* (Kidachi Aloe) (Beppu et al., 2003). The protective effect of *A. vera* against acetaminophen mediated oxidative stress in rat liver (Patil, 2010) as well as the protective role of *A. vera* extracts in pancreatic β -cells of diabetic rats (Salem & El-Eraky El-Azab, 2014), were also reported in recent years.

Antitumour activity of *A. vera* leaves

As cancer continues to be one of the devastating illnesses of our century, plant kingdom with its diversity, is also researched in regard of cytotoxic and anticancer agents. Many studies were conducted earlier with *A. vera* since 1981 (Winters et al., 1981; Gribel & Pashinskiĭ, 1986; Tsuda et al., 1993; Saito, 1993; Corsi et al., 1998). In further studies, one of the major components, aloe-emodin was reported to behave both as antitumor and angiogenic agent (Cárdenas et al., 2006; Lee et al., 2006; Lin et al., 2006). Contrarily, in another study, it was claimed that the mechanism for growth

inhibitory action of a commercial cape aloe powder extract on *Ehrlich ascites* tumors was not due to aloe-emodin (Kametani et al., 2007) .

Three sorts of experiments were undertaken in our laboratory in order to assess the antitumour activity of *A. vera* leaf skin extract on *Ehrlich ascites* tumours in mice: *A. vera* leaf skin extract given prophylactically before tumour inoculation, *A. vera* leaf skin extract given simultaneously with tumour inoculation and *A. vera* leaf skin extract given therapeutically after tumour inoculation. Spectacular results were obtained when *A. vera* extract was given before tumour inoculation, very slow tumour development was observed and even in 6 mice no tumour was detected. In the two other groups of experiments, developed tumours were significantly smaller than the tumour control group (Akev et al., 2007a).

Our studies on the antitumour activity of *A. vera* continues with *in vitro* studies of the cytotoxic activity of the extracts on several cancer cell lines in comparison with aloe-emodin (Candoken et al., 2013; Candoken et al., 2014).

Antioxidant activity of *A. vera* leaves

In addition to its own stores of antioxidants, *A. vera* may also activate the body's endogenous antioxidant enzyme systems (Nwanjo, 2006) and play a vital role in the prevention and control of numerous diseases, especially those related to aging, such as cancer, coronary vascular disease and diabetes, as well as immune system enhancers and in the management of oxidative stress. It was reported that internal administration of *A. vera* leaf extract elevates liver levels of cellular antioxidant enzymes in mice (Singh et al., 2000). Controversely, induction of oxidative stress by *A. vera* leaf extracts was also reported (Sirdarta & Cock, 2010).

Antioxidant properties of *Aloe* extracts have been attributed to aloesin derivatives (Yagi et al., 2002) as well as polysaccharides (Wu et al., 2006; Chun-hui et al., 2007) or anthraquinones (Malterud et al., 1993). In some studies, modulation of antioxidant enzymes has been correlated with antitumour properties of *A. vera* leaf extract (El-Shemy et al., 2010)

The aqueous extract from *A. vera* leaves prepared in our laboratory, was shown to contain naturally occurring antioxidant components, including

total phenols, flavonoids, ascorbic acid, β -carotene and α -tocopherol. The extract exhibited inhibitory capacity against Fe^{3+} /ascorbic acid induced phosphatidylcholine liposome oxidation, scavenged stable DPPH \cdot , ABTS $^{+\cdot}$ and superoxide anion radicals, and acted as reductant. In contrast, the leaf inner gel did not show any antioxidant activity (Ozsoy et al., 2009).

Other pharmacological effects of *A. vera* leaf extracts

In another study undertaken along with colleagues of Adnan Menderes University, the protective effect of *A. vera* leaf gel extract in a rat peritonitis model was demonstrated *in vivo* (Bozkurt et al., 2010; Altincik et al., 2014).

In recent years the inhibitory effect of *A. vera* leaf extracts on different enzymes was reported (Djuv & Nielsen, 2011; Kammoun et al., 2011). In collaboration with other colleagues, the inhibitory potential of *A. vera* extracts on elastase, neuraminidase and α -amylase was demonstrated (Sacan et al., 2014).

Toxicity and side effects of *A. vera* leaves

There are several studies on the toxicity of *A. vera* extracts or products and extracts as well as isolated products were found safe in most of cases (Avila et al., 1997; Gupta & Flora, 2005; Matsuda et al., 2008; Sehgal et al., 2013). DNA-protective (Baechler et al., 2009) as well as genotoxic (Paes-Leme et al., 2005) activities were also demonstrated.

Topically, it may cause redness, burning and stinging sensation or allergic response (Ferreira et al., 2007). Allergic reactions are mostly due to anthraquinones (Surjushe et al., 2008). Systemic effects also due to anthraquinones, are abdominal cramps, diarrhea red urine, hepatitis (Srivastava et al., 2014). There are three case reports for aloe-induced toxic hepatitis (Rabe et al., 2005; Bottenberg et al., 2007; Yang et al., 2010).

***Aloe* in the industry**

In the food industry, *A. vera* has been utilized as a resource of functional food especially in the preparation of health food and drinks. In pharmaceutical industry we can find it in topical ointments, gel preparations

and available as tablets and capsules. The most effective use of *Aloe* is seen in cosmetic and toiletry industries where we can find it in creams, soaps, beauty lotions, ointments, sprays, shampoos and facial cleaners (Eshun & He, 2004) to name a few of the thousands of products available (Nandal & Bhardwaj, 2012). The volume of the industry for finished products containing *A. vera* is alleged to be around \$110 billion dollars (Ahlawat & Khatkar, 2011).

The International Aloe Science Council (IASC): is a non-profit trade organization for *A. vera* industry worldwide. *Aloe* growers, processors, finished good manufacturers, marketing companies, equipment suppliers, sales organizations, scientists and researchers are eligible and comprise the membership. This association serves as a liaison source of information for research, development and promotion of *A. vera* and associated products.

Products which does not have the quality seal (Fig. 8) were withdrawn from the US market by the IASC (Texas). Food and Drug Administration (FDA) regulated the use of the laxative component of aloe as a drug but its topical applications were not regulated or endorsed. *Aloe* is currently approved by the US FDA as food flavoring agent in accordance with good manufacturing practices (Ulbricht et al., 2007).



Figure 8. The quality seal and the logo of the IASC.

Award

November 5, 2010 - The International Aloe Science Council (IASC) is honored to present **the 10th Annual Yun-Ho Lee Award for Scientific Merit for 2009** to the following researcher for their significant contribution to scientific information on aloe: **Dr. Nuriye Akev, Ph.D.** published a total of 7 studies (listed on PubMed)

on the pharmacology of *Aloe vera*, dating from 1999 to 2009 (<http://www.iasc.org/yunho.html>).

Conclusion

Aloe vera contains many physiologically active substances that have effective anti-inflammatory, immunomodulatory and wound healing effects. In our 20 years studies hypoglycemic, tumour preventive, antioxidant activities of *A. vera* leaf skin and gel abstracts were demonstrated by *in vivo* and *in vitro* experiments. In all experiments, leaf skin and gel parts were tested separately and finally we can say that there was no important differences between the biological activities of both extracts. We presume that the whole leaf extract should in preference be used in further studies. Nevertheless the leaf exudate containing anthraquinones with cathartic effect should be first discarded.

We can conclude that many active components synergize, so that the final total activity of the extracts are better than the isolated components. Upon further understanding of individual components and their effects, many more effective uses of *Aloe* are likely to be developed and research is still needed on this area. *Aloe's* pharmacological benefits came probably from its immunostimulatory and antioxidant effects. *Aloe's* wound healing, moisturizing and emollient effect, due to the mucopolysaccharides, is sure. Nevertheless some hypersensitivity cases are claimed upon long use. The heterogenous nature of *A.vera* products may contribute to the diverse biologic and therapeutic activities that have been observed (Steenkamp & Stewart, 2007). For the moment, *A. vera* is still a cosmetic and dietary supplement and not a drug. We can postulate to say that *A. vera* with its amazing properties, is really a “wonder plant” and a gift to humanity by nature and that it will allways constitute an interesting research area for science and medicine.

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