

A REVIEW ON MEDICINAL PROPERTIES OF ALOEVERA PLANT AND IT'S PROFILE

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ABSTRACT

Aloevera is a succulent plant, originated in South Africa but grows world wide. It is a wonder plant having medicinal and ornamental value. It has more than 200 different biologically active compounds. The medicinal properties associated with Aloe species are due to inner gel of the leaves. There are about 400 species of genus Aloe with some species like Aloe ferox, and Aloe arborescens, are globally used for variety of purposes. Aloevera is good source of anthraquinones, minerals, enzymes, amino acids, natural sugars, carbohydrates, proteins, vitamins and fatty acids which are vary beneficial for human health. It has various medicinal properties such as antitumor, antihelminthic, antibacterial, antioxidant, antiarthritic, antirheumatoid, anticancer, antiulcer, and antidiabetic properties. In addition, A. vera is used for constipation, gastrointestinal disorders, and for immune system deficiencies. This review focuses on the detailed medicinal properties along with botany of the plant.

Keywords: Aloevera, Taxonomic classification, distribution, description, medicinal uses.

I. INTRODUCTION

The name A. vera derives from the Arabic word "Alloeh" meaning "shining bitter substance," while "vera" in Latin means "true." It is also known as Aloe barbadensis. A. vera develops water-storage tissue in the leaves which allow to survive in dry areas with low or erratic rainfall. It grows well in bright sun light and every type of soil. This plant undergoes Crassulacean acid metabolism (CAM) metabolic pathway but can also shifts to CAM-idling (a dampened form of CAM). From many years aloevera is used as medicine in many countries. It had high water content of 99.5% and 0.5 % of solid material. The structural components of A. vera plant leaf portions contain 70-80% pulp and 20-30% of rind of the whole leaf. There are many linear changes of mannose and glucose present in polysaccharides of aloevera.

Occurrence

A. vera probably originated in northern Africa and found in India, Mexico, Europe, Pacific Rim countries, South America, Central America, the Caribbean, Australia and Africa. It has been widely cultivated throughout the world for commercial purposes. In India, it is found in Rajasthan, Haryana, Panjab, Andhra Pradesh, Gujarat, Uttar Pradesh, Maharashtra and Tamil Nadu.

Botanical description

Aloevera is a perennial, xerophytic, succulent plant with turgid green leaves. It is a stemless or very short stemmed plant growing up to 60 to 100 cm tall, spreading by offsets. The leaves of aloevera plant are elongated pointed and joined in rosette pattern. The flowers of A. vera comes out in summer on a spike up to 90 cm tall, each flower being pendulous, with a yellow tubular corolla and 2 to 3 cm long.

Taxonomic classification

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Monocots

Order: Asparagales

Family: Asphodelaceae

Subfamily: Asphodeloideae

Genus: Aloe

Species: vera²¹⁻²²

Synonymous

Aloe barbadensis Mill.

Aloe barbadensis var. chinensis Haw.

Aloe chinensis (Haw.) Baker
Aloe elongata Murray
Aloe flava Pers.
Aloe indica Royle
Aloe lanzae Tod.
Aloe maculata Forssk. (illegitimate)
Aloe perfoliata var. vera L.
Aloe rubescens DC.
Aloe variegata Forssk. (illegitimate)
Aloe vera Mill. (illegitimate)
Aloe vera var. chinensis (Haw.) A. Berger
Aloe vera var. lanzae Baker
Aloe vera var. littoralis J.Koenig ex Baker
Aloe vulgaris Lam.

It is known by many other names such as Aloe barbadensis, First Aid Plant, True Aloe, African Aloe, Burn Plant, and Miracle Plant. It's so popular that it often gets called a single name "Aloe".

II. LITERATURE

Agarry OO, Olaleye MT, Machael CO (2005). Comparative antimicrobial activities of Aloe vera gel and leaf. In this the authors utilized the extraction of the leaf gel from aloevera plant and the antimicrobial impact was estimated by the presence of zones of hindrance. Antimicrobial weakness test demonstrated that both the gel and the leaf repressed the development of *S. aureus* (18.0 and 4.0 mm, individually). Just the gel hindered the development of *T. mentagrophytes* (20.0 mm), while the leaf has inhibitory consequences for both *P. aeruginosa* and *C. albicans*. The consequences of this investigation will in general offer confidence to the well known utilization of both Aloe vera gel and leaf.

Babaei A, Manafi M, Tavafi H (2013). Study on Effect of Aloe vera leaf extracts on growth of *Aspergillus flavus*. The point of this investigation is to assess and analyze the antifungal movement of various concentrates of Aloe vera plant on the development of *Aspergillus flavus*. Considering the wide dispersal of *Aspergillus flavus* across the globe and its monstrous defilement on feed and food stuff of creature and individuals, it is unavoidable to discover an answer for repress the development of this parasite. Six various solvents, for example, CH₃)₂CO, ethanol, water, methanol, chloroform and ethyl ether were utilized for extraction from Aloe Vera fresh leaves. Antifungal action of the concentrates was assessed by Agar Plate Diffusion Plate technique.

Calvin J (2008). Aloe vera: Plant history uses and benefits. There has been an expansion popular for the phytopharmaceuticals everywhere on the world. A. vera is well referred to for its restorative impacts and as a powerful medication for treating persistent illnesses. The current investigation shows the customary, pharmacological and phytochemical properties of different bioactive compounds present in aloevera.

De Witte P (1993). Metabolism and pharmacokinetics of anthranoids pharmacology . In this the authors worked on various bioactive compounds in aloevera and observed the most purgative impacts of Aloe vera latex, nonetheless, regardless of whether the latex is more viable than regular diuretic medicines has not yet been resolved, and the anthraquinones in the latex are related with impressive dangers. The effective application of Aloe vera gel is likely protected and exhibits in general adequacy in recuperating consume wounds, though some encouraging primer proof recommends that the oral utilization of the gel may have helpful impacts in bringing down blood glucose levels in sort 2 DM, balancing out metastatic disease, and getting mellow moderate ulcerative colitis. Further examination in people is needed to affirm these impacts.

Cooke W (1981). Laxative abuse. Acta. Gastroenterol is perhaps the most widely recognized sicknesses of the oral depression with no known powerful therapy up until this point, which could cause extreme uneasiness in patients. Aloe vera (A.V.) is a tropical plant with calming and immunostimulant impacts, which could be of advantage in a variety of wound recuperating conditions. The point of this examination is to assess topically

regulated A.V. gel on oral pit minor aphthous recuperating. It appears to be likely that A.V. 2% oral gel isn't just viable in diminishing the intermittent aphthous stomatitis patients' torment score and wound size yet in addition diminishes the aphthous wound recuperating period.

Chithra R, Sajithlal GB, Chandrakasan G (1998). Influence of Aloe vera on collagen characteristics in healing dermal wounds in rats. The basic idea of this paper is to decide the impacts of Aloe vera-inferred items (for instance dressings and effective gels) on the mending of intense injuries (for instance slashes, careful cuts and consumes) and constant injuries (for instance contaminated injuries, blood vessel and venous ulcers).

Seven preliminaries were qualified for incorporation, involving an aggregate of 347 members. Five preliminaries in individuals with intense injuries assessed the impacts of Aloe vera on consumes, haemorrhoidectomy patients and skin biopsies. Aloe vera adhesive didn't expand consume recuperating contrasted and silver sulfadiazine (hazard proportion (RR) 1.41, 95% certainty stretch (CI) 0.70 to 2.85). A decrease in mending time with Aloe vera was noted after haemorrhoidectomy (RR 16.33 days, 95% CI 3.46 to 77.15) and there was no distinction in the extent of patients totally recuperated at follow up after skin biopsies. In individuals with constant injuries, one preliminary found no factually critical distinction in weight ulcer mending with Aloe vera (RR 0.10, 95% CI - 1.59 to 1.79) and in a preliminary of careful injuries recuperating by optional goal Aloe vera altogether deferred mending (mean contrast 30 days, 95% CI 7.59 to 52.41). Clinical heterogeneity blocked meta-investigation. The low quality of the included preliminaries shows that the preliminary outcomes should be seen with outrageous alert as they have a high danger of inclination and finally conclude that utilization of Aloe vera skin specialists or Aloe vera dressings as therapies for intense and constant injuries.

Misawa E, Tanaka M, Nomaguchi K, et al. (2012) Oral ingestion of Aloe vera phytosterols alters hepatic gene expression profiles and ameliorates obesity associated metabolic disorders in Zucker diabetic fatty rats. Aloe vera is notable for its therapeutic properties which lead to its application in treating different illnesses. Although, orderly surveys on aloe vera and its concentrates have been done before, yet according to oral infections this is the primary efficient audit. The point of the present methodical survey was to gather proof put together examinations with respect to the viability of Aloe vera in treatment of different oral infections. Fifteen examines fulfilled the incorporation standards. Populace of test study went from 20 patients to 110 patients with clinically analyzed oral mucosal injuries. Out of 15 examinations, five were on patients with oral lichen planus, two on patients with oral submucous fibrosis, different investigations were carried on patients with consuming mouth disorder, radiation prompted mucositis, candida related dental replacement stomatitis, xerostomic patients and four were on minor repetitive aphthous stomatitis. Most investigations indicated factually huge outcome showing the viability of Aloe vera in treatment of oral illnesses. Although there are promising outcomes however in future, more controlled clinical preliminaries are needed to demonstrate the adequacy of Aloe vera for the board of oral illnesses.

III. MEDICINAL PROPERTIES

- 1. Wound healing :** The extract of aloe vera increases cell proliferation and thus healing of wounds occur at high rate through synthesis of collagen and contraction of wound area. Glucomannan, a polysaccharide found in aloe vera gel is very beneficial to heal wounds.
- 2. Intestinal absorption :** The aloin present in Aloe vera increases the bioavailability of many drugs and vitamins and thus boost their absorption in the intestine.
- 3. Boosts Immunity:** The phytochemicals along with enzymes, vitamins and proteins present in aloe vera all together boost our immune system and thus prevent from various diseases.
- 4. Anti - Inflammatory :** The phytochemicals present in aloe vera inhibit Cyclogenase pathway and arachidonic acid pathway which results in decreased production of prostaglandin E2 from arachidonic acid thus prevents inflammation and inflammatory bowel disease.

5. Hepatoprotective Effect : Lophenol and Cycloartanol are two phytosterols present in aloe vera plant and induces downregulation of fatty acid synthesis along with upregulation of fatty acid oxidation in liver, thus reducing intraabdominal fat and improve hyperlipidemia.

6. Antidiabetic affect : Aloe vera is safe antihypercholesterolemic and antihyperglycemic agent for type 2 diabetic patients. The gel of aloe vera reduce insulin resistance in obese prediabetes patients by enhancing carbohydrate metabolism and thus improving glucose transport. Phytosterols are not extensively absorbed from intestine which reduce plasma cholesterol concentration including atherogenic low density lipoprotein (LDL), thus controlling diabetes.

7. Antimicrobial Agent : Aloe vera acts as antibacterial agent. The Aloe protein exhibited a potent antifungal activity against *Candida parapsilosis*, *Candida krusei*, and *Candida albicans*. The anthraquinones present in aloe vera inhibits bacterial protein synthesis by blocking the translation.

8. Anti Cancer : Aloin, an anthraquinone being a natural compound and the main ingredient of Aloe, inhibit the secretion of VEGF in cancer cells thus VEGF-induced angiogenic response of human endothelial cells, causing an inhibition of proliferation and migration of endothelial cells. Aloe-emodin (AE), is also a subtype of anthraquinone, a natural compound which also prevent tumor formation.

9. Antioxidant affect : Several antioxidants like ascorbic acid, Tocopherol, Carotenoids, flavonoids, and tannins are present in aloe vera which help to treat various disorders. Also, phenolic compounds like Aloe Barbadensis, Aloe emodin, aloe chryson, present in aloe vera has potent antioxidant activity.

10. Effect on estrogen status : Breast cancer cell proliferation is inhibited by emodin present in aloe vera gel through suppression of estrogen receptor. The gel also maintain estrogen to testosterone ratio.

11. Anti ulcer : Aloe vera is widely used for a variety of illnesses and also promoted for digestion and are used in the treatment of peptic ulcer. Also, natural agent for combination with antibiotics for the treatment of *H. pylori* gastric infection and effective in topical management of minor recurrent aphthous stomatitis and was superior in decreasing ulcer size, erythema, and exudation.

12. Laxative : Latex of aloe vera contain anthraquinone glycosides, present between gel and outer leaf surface is very beneficial to treat constipation and increases intestinal water content thus also treats intestinal peristalsis.

13. Skin Protection: Metallothionein (antioxidant protein) scavenges hydroxyl radicals and inhibit superoxide dismutase thus prevent skin from UV radiations and also the application of its gel on the skin, keeps our skin glowy appearance.

14. Moisturizing and anti aging Effect : Aloe vera has a wonderful moisturizing activity as it contains mucopolysaccharides which help to bind moisture into the skin. The amino acids present in aloe vera also soften hardened skin cells and zinc acts as an astringent to tighten the pores and improve the skin integrity, decrease in appearance of fine wrinkle and decrease erythema.

IV. CONCLUSION

Aloe vera is a medicinal plant used as a medicine now and also traditionally to cure a wide range of health complications including skin problems, stomach problems, immune system problems, various lungs and heart diseases and many more, thus referred as a wonder plant. The analysis of phytochemistry of aloe vera shows the presence of proteins, amino acids, hormones, fatty acids, vitamins, anthraquinones, antioxidants and other minerals which are beneficial for maintaining human health and thus it has high significant value for bio-

technology purposes to make medicines. Along with pharmaceutical industries, aloe vera is also used widely used in food and cosmetology industries.

V. REFERENCES

- [1] Agarry OO, Olaleye MT, Machael CO (2005). Comparative antimicrobial activities of Aloe vera gel and leaf. *Afr. J. Biotechnol.* 4:1413-1414.
- [2] Ajabnoor MA (1990). Effect of Aloe on blood glucose levels in normal and alloxan diabetic mice. *J. Ethnopharmacol.* 28:215-220.
- [3] Akinyele BO, Odiyi AC (2007). Comparative study of the vegetative morphology and the existing taxonomic status of Aloe vera L. *J. Plant Sci.* 2:558-563.
- [4] Amador B, Matson MV, Espinoza JA, Montiel LG, Troyo E, Garcia JL (2014). Mineral Content and Biochemical Variables of Aloe vera L. under Salt Stress. *Plos One* 9(4):1-9.
- [5] Atherton P (1998). Aloe vera: magic or medicine? *Nurs. Stand.* 12:49-54.
- [6] Babaei A, Manafi M, Tavafi H (2013). Study on Effect of Aloe vera leaf extracts on growth of *Aspergillus flavus*. *Ann. Rev. Res. Biol.* 3:1091-1097.
- [7] Balasubramanian J, Narayanan N (2013). Aloe vera: nature's gift. *Species* 2:11-13.
- [8] Bensky D, Gamble A, Kaptchuk TJ (1993). *Chinese herbal medicine: Materia Medica*. Seattle, Eastland Press. pp. 2-6.
- [9] Bhattacharya M, Malik S, Singh A (2011). Aloe vera barbadensis: A review on its Ethanopharmacological value. *J. Pharm. Res.* 4:4507-4510.
- [10] Bhuvana KB, Hema NG, Patil RT (2014). Review on Aloe Vera. *Int. J. Adv. Res.* 2:677-691.
- [11] Bottenberg MM, Wall GC, Harvey RL, Habib S (2007). Oral Aloe vera induced hepatitis. *Ann. Pharmacother.* 41:1740-1743.
- [12] Boudreau MD, Beland FA (2006). An Evaluation of the Biological and Toxicological Properties of Aloe barbadensis (Miller), Aloe vera. *J. Environ. Sci. Health* 24:103-154.
- [13] Brusick D, Mengs U (1997). Assessment of the genotoxic risk from laxative senna products. *Environ. Mol. Mutagen.* 29:1-9.
- [14] Byeon S, Pelley R, Ullrich SE, Waller TA, Bucana CD, Strickland FM (1988). Aloe barbadensis extracts reduce the production of interleukin-10 after exposure to ultraviolet radiation. *J. Invest. Dermatol.* 110:811-817.
- [15] Calvin J (2008). Aloe vera: Plant history uses and benefits. P 356.
- [16] Chinnusamy K, Nandagopal T, Nagaraj K, Sridharan S (2009). Aloe vera induced oral mucositis: A case report. *Internet J. Pediatr. Neonatol.* 9:2-10.
- [17] Chithra R, Sajithlal GB, Chandrakasan G (1998). Influence of Aloe vera on collagen characteristics in healing dermal wounds in rats. *Mol. Cell Biochem.* 181:71-76.
- [18] Choche T, Shende S, Kadu P (2014). Extraction and Identification of Bioactive Components from Aloe barbadensis Miller. *Res. Rev. J. Pharmacogn. Phytochem.* 2:14-23.
- [19] Collins E, Collins C (1935). Roentgen dermatitis treated with fresh whole leaf of Aloe vera. *Am. J. Roentgenol.* 33:396-397.
- [20] Cook NC, Samman S (1996). Flavonoids: Chemistry, metabolism, cardioprotective effects and dietary sources. *J. Nutr. Biochem.* 7:66-76.
- [21] Cooke W (1981). Laxative abuse. *Acta Gastroenterol. Belg.* 44:448-458.
- [22] Coronado GD, Thompson B, Tejeda S, Godina R (2004). Attitudes and beliefs among Mexican Americans about type 2 diabetes. *J. Health Care Poor Underserved* 15(4):576-88.
- [23] Cosmetic Ingredient Review Expert Panel (CIREP) (2007). Final report on the safety assessment of Aloe Final report on the safety assessment of Aloe andongensis Extract, Aloe andongensis Leaf Juice, Aloe arborescens Leaf Extract, Aloe arborescens Leaf Juice, Aloe arborescens leaf protoplasts, Aloe barbadensis flower extract, Aloe barbadensis leaf, Aloe barbadensis Leaf Extract, Aloe Barbadensis Leaf Juice, Aloe barbadensis leaf polysaccharides, Aloe barbadensis leaf water, Aloe ferox leaf extract, Aloe ferox leaf juice, and Aloe ferox leaf juice extract. *Int. J. Toxicol.* 26 Suppl 2:1-50.
- [24] Dagne E, Bisrat D, Viljoen A, Van BE (2000). Chemistry of Aloe species. *Curr. Org. Chem.* 4:1055-1078.

- [25] Darokar MP, Rai R, Gupta AK, Shasany AK, Rajkumar S, Sundaresan V, Khanuja SPS (2003). Molecular assessment of germplasm diversity in Aloe species using RAPD and AFLP analysis. *J. Med. Aroma. Plant Sci.* 25:354-361.
- [26] Davis RH (1997). *Aloe vera: A Scientific Approach*. New York: Vantage Press New York, 1st Ed. pp. 109-111.
- [27] De Witte P (1993). Metabolism and pharmacokinetics of anthranoids. *Pharmacology* 47:86-97.
- [28] Dweck AC (1996). Botanicals - research of actives. *Cosmet. Toiletries* 111:45-57.29 .
- [29] Ernst E (2000). Adverse effects of herbal drugs in dermatology. *Br. J. Dermatol.* 143:923-929.
- [30] Esua MF, Rauwald JW (2006). Novel bioactive maloyl glucans from Aloe vera gel: isolation, structure elucidation and in vitro bioassays. *Carbohydr. Res.* 27:355-364.
- [31] Farooqi AA, Sreeramu BS (2001). *Cultivation of Medicinal and Aromatic Crops*. Revised Ed. Orient Longman, India. P 25.
- [32] Liu Z, Ge X, Lu Y, Dong S, Zhao Y, Zeng M. Effects of chitosan molecular weight and degree of deacetylation on the properties of gelatine-based films. *Food Hydrocolloids.* 2012;26:311e317.
- [33] Im SA, Oh ST, Song S, et al. Identification of optimal molecular size of modified Aloe polysaccharides with maximum immunomodulatory activity. *Int Immunopharmacol.* 2005;5:271e279.
- [34] Picchiatti S, Bernini C, Belardinelli MC, et al. Immune modulatory effects of Aloe arborescens extract on the piscine SAF-1 cell line. *Fish Shellfish Immunol.* 2012;34:1335e1344.
- [35] Park MY, Kwon HJ, Sung MK. Evaluation of aloin and aloe-emodin as antiinflammatory agents in aloe by using murine macrophages. *Biosci Biotechnol Biochem.* 2009;73:828e832.
- [36] Langmead L, Makins RJ, Rampton DS. Anti-inflammatory effects of Aloe vera gel in human colorectal mucosa in vitro. *Aliment Pharmacol Ther.* 2004;19: 521e527.
- [37] Babaee N, Zabihi E, Mohseni S, Moghadamnia AA. Evaluation of the therapeutic effects of Aloe vera gel on minor recurrent aphthous stomatitis. *Dent Res J(Isfahan).* 2012;9:381e385.
- [38] Carien B, Alvaro V, Josias H. Modulation of drug efflux by aloe materials: an in vitro investigation across rat intestinal tissue. *Pharmacogn Mag.* 2013;9: 44e48.
- [39] Kang MC, Kim SY, Kim YT, et al. In vitro and in vivo antioxidant activities of polysaccharide purified from Aloe vera (Aloe barbadensis) gel. *Carbohydr Polym.* 2014;99:365e371.
- [40] Suboj P, Babykutty S, Valiyaparambil Gopi DR, Nair RS, Srinivas P, Gopala S. Aloe emodin inhibits colon cancer cell migration/angiogenesis by downregulating MMP-2/9, RhoB and VEGF via reduced DNA binding activity of NF-kB. *Eur J Pharm Sci.* 2012;45:581e591
- [41] Chen W, Lu Z, Viljoen A, Hamman J. Intestinal drug transport enhancement by Aloe vera. *Planta Med.* 2009;75:587e595.
- [42] Huseini HF, Kianbakht S, Hajiaghaee R, Dabaghian FH. Anti-hyperglycemic and anti-hypercholesterolemic effects of Aloe vera leaf gel in hyperlipidemic type 2 diabetic patients: a randomized double-blind placebo-controlled clinical trial. *Planta Med.* 2012;78:311e316.
- [43] Kumar R, Sharma B, Tomar NR, Roy P, Gupta AK, Kumar A. In vivo evaluation of hypoglycemic activity of Aloe spp. and identification of its mode of action on GLUT-4 gene expression in vitro. *Appl Biochem Biotechnol.* 2011;164:1246e1256.
- [44] Choi HC, Kim SJ, Son KY, Oh BJ, Cho BL. Metabolic effects of Aloe vera gel complex in obese prediabetes and early non-treated diabetic patients: randomized controlled trial. *Nutrition.* 2013;29:1110e1114.
- [45] Devaraj S, Jialal R, Jialal I, Rockwood R. A pilot randomized placebo controlled trial of 2 Aloe vera supplements in patients with pre-diabetes/metabolic syndrome. *Planta Med.* 2008;74:SL77.
- [46] Anand S, Muthusamy VS, Sujatha S, et al. Aloe emodin glycosides stimulates glucose transport and glycogen storage through PI3K dependent mechanism in L6 myotubes and inhibits adipocyte differentiation in 3T3L1 adipocytes. *FEBS Lett.* 2010;584:3170e3178.
- [47] Tanaka M, Misawa E, Ito Y, et al. Identification of five phytosterols from Aloevera gel as anti-diabetic compounds. *Biol Pharm Bull.* 2006;29:1418e1422.
- [48] Jain N, Vijayaraghavan R, Pant SC, Lomash V, Ali M. Aloe vera gel alleviates cardiotoxicity in streptozocin-induced diabetes in rats. *J Pharm Pharmacol.*2010;62:115e123.

- [49] Shin E, Shim KS, Kong H, et al. Dietary Aloe improves insulin Sensitivity via the suppression of obesity-induced inflammation in obese mice. *Immune Netw.* 2011;11:59e67.
- [50] Rahimifard M, Navaei-Nigjeh M, Mahroui N, et al. Improvement in the function of isolated rat pancreatic islets through reduction of oxidative stress using traditional Iranian medicine. *Cell J.* 2013;16:147e163.
- [51] Silva MA, Trevisan G, Hoffmeister C, et al. Anti-inflammatory and antioxidant effects of Aloe saponaria Haw in a model of UVB-induced paw sunburn in rats. *J Photochem Photobiol B.* 2014;133:47e54.
- [52] Saini DK, Saini MR. Evaluation of radioprotective efficacy and possible mechanism of action of Aloe gel. *Environ Toxicol Pharmacol.* 2011;31:427e435.
- [53] Rajasekaran S, Sivagnanam K, Subramanian S. Modulatory effects of Aloe vera leaf gel extract on oxidative stress in rats treated with streptozotocin. *J Pharm Pharmacol.* 2005;57:241e246.
- [54] Kammoun M, Miladi S, Ben Ali Y, Damak M, Gargouri Y, Bezzine S. In vitro study of the PLA2 inhibition and antioxidants activities of Aloe vera leaf skin extracts. *Lipids Health Dis.* 2011;10:30.
- [55] Lopez A, de Tangil MS, Vega-Orellana O, Ramirez AS, Rico M. Phenolic constituents, antioxidant and preliminary antimycoplasmic activities of leaf skin and flowers of Aloe vera (L.) Burm. f. (syn. A. barbadensis Mill.) from the Canary Islands (Spain). *Molecules.* 2013;18:4942e4954.
- [56] Misawa E, Tanaka M, Nomaguchi K, et al. Oral ingestion of Aloe vera phytosterols alters hepatic gene expression profiles and ameliorates obesity-associated metabolic disorders in Zucker diabetic fatty rats. *J Agric Food Chem.* 2012;60:2799e2806.
- [57] Kumar M, Rakesh S, Nagpal R, et al. Probiotic Lactobacillus rhamnosus GG and Aloe vera gel improve lipid profiles in hypercholesterolemic rats. *Nutrition.* 2013;29:574e579.
- [58] Hamiza OO, Rehman MU, Khan R, et al. Chemopreventive effects of aloin against 1,2-dimethylhydrazine-induced preneoplastic lesions in the colon of Wistar rats. *Hum Exp Toxicol.* 2014;33:148e163.
- [59] Pan Q, Pan H, Lou H, Xu Y, Tian L. Inhibition of the angiogenesis and growth of aloin in human colorectal cancer in vitro and in vivo. *Cancer Cell Int.* 2013;13:69.
- [60] Lin SY, Lai WW, Ho CC, et al. Emodin induces apoptosis of human tongue squamous cancer SCC-4 cells through reactive oxygen species and mitochondria-dependent pathways. *Anticancer Res.* 2009;29:327e335.
- [61] Muto A, Hori M, Sasaki Y, et al. Emodin has a cytotoxic activity against human multiple myeloma as a Janus-activated kinase 2 inhibitor. *Mol Cancer Ther.* 2007;6:987e994.
- [62] Lin ML, Lu YC, Su HL, et al. Destabilization of CARP mRNAs by aloemodin contributes to caspase-8-mediated p53-independent apoptosis of human carcinoma cells. *J Cell Biochem.* 2011;112:1176e1191.
- [63] Masaldan S, Iyer VV. Exploration of effects of emodin in selected cancer cell lines: enhanced growth inhibition by ascorbic acid and regulation of LRP1 and AR under hypoxia-like conditions. *J Appl Toxicol.* 2014;34:95e104.
- [64] Lin CC, Kao ST, Chen GW, Chung JG. Berberine decreased N-acetylation of 2-aminofluorene through inhibition of N-acetyltransferase gene expression in human leukemia HL-60 cells. *Anticancer Res.* 2005;25:4149e4155.
- [65] Lin JG, Chen GW, Li TM, Chouh ST, Tan TW, Chung JG. Aloe-emodin induces apoptosis in T24 human bladder cancer cells through the p53 dependent apoptotic pathway. *J Urol.* 2006;175:343e347.
- [66] Jackson TC, Verrier JD, Kochanek PM. Anthraquinone-2-sulfonic acid (AQ2S) is a novel neurotherapeutic agent. *Cell Death Dis.* 2013;4:e451.
- [67] Das S, Mishra B, Gill K, et al. Isolation and characterization of novel protein with anti-fungal and anti-inflammatory properties from Aloe vera leaf gel. *Int J Biol Macromol.* 2011;48:38e43.
- [68] Pandey R, Mishra A. Antibacterial activities of crude extract of Aloe barbadensis to clinically isolated bacterial pathogens. *Appl Biochem Biotechnol.* 2010;160: 1356e1361.
- [69] Ferro VA, Bradbury F, Cameron P, Shakir E, Rahman SR, Stimson WH. In vitro susceptibilities of Shigella flexneri and Streptococcus pyogenes to inner gel of Aloe barbadensis Miller. *Agents Chemother.* 2003;47:1137e1139.

- [70] Lawless J, Allan J. The clinical composition of Aloe vera. In: Aloe vera: Natural Wonder Cure. London: Thorsons Publishing Ltd; 2000:161e171.
- [71] Pugh N, Ross SA, ElSohly MA, Pasco DS. Characterization of Aloeride, a new high molecular weight polysaccharide from Aloe vera with potent immunostimulatory activity. *J Agric Food Chem.* 2001;49:1030e1034.
- [72] Kametani S, Yuasa AK, Kikuzaki H, Kennedy DO, Honzawa M, Yuasa M. Chemical constituents of Cape Aloe and their synergistic growth inhibiting effect on Ehrlich ascites tumor cells. *Biosci Biotechnol Biochem.* 2007;71:1220e1229.
- [73] Cowan MM. Plant products as antimicrobial agents. *Clin Microbiol Rev.* 1999;12:564e582.
- [74] Cellini L, Di Bartolomeo S, Campi E, Genovese S, Locatelli M, Di Giulio M. In vitro activity of Aloe vera inner gel against *Helicobacter pylori* strains. *Lett Appl Microbiol.* 2014;59:43e48.
- [75] Li SW, Yang TC, Lai CC, et al. Antiviral activity of Aloe-emodin against influenza A virus via galectin-3 up-regulation. *Eur J Pharmacol.* 2014;27:125e132.
- [76] Olatunya OS, Olatunya AM, Anyabolu HC, Adejuyigbe EA, Oyelami OA. Preliminary trial of Aloe vera gruel on HIV infection. *J Altern Complement Med.* 2012;18:850e853.
- [77] Lowther W, Lorick K, Lawrence SD, Yeow WS. Expression of biologically active human interferon alpha 2 in Aloe vera. *Transgenic Res.* 2012;21:1349e1357.
- [78] Huang PH, Huang CY, Chen MC, et al. Emodin and Aloe-emodin suppress breast cancer cell proliferation through ERa inhibition. *Evid Based Complement Alternat Med.* 2013;2013:376123.
- [79] Maharjan R, Nagar PS, Nampoothiri L. Effect of Aloe barbadensis Mill. formulation on Letrozole induced polycystic ovarian syndrome rat model. *J Ayurveda Integr Med.* 2010;1:273e279.
- [80] Dana N, Javanmard SH, Asgary S, Asnaashari H, Abdian N. The effect of Aloe vera leaf gel on fatty streak formation in hypercholesterolemic rabbits. *J Res Med Sci.* 2012;17:439e442.
- [81] Dhingra D, Lamba D, Kumar R, Nath P, Gauttam S. Antihyperlipidemic activity of Aloe succotrina in rats: possibly mediated by inhibition of HMG-CoA reductase. *ISRN Pharmacol.* 2014;2014:243575.
- [82] Desai BN, Maharjan RH, Nampoothiri LP. Aloe barbadensis Mill. Formulation restores lipid profile to normal in a letrozole-induced polycystic ovarian syndrome rat model. *Pharmacognosy Res.* 2012;4:109e115.
- [83] Mansour G, Ouda S, Shaker A, Abdallah HM. Clinical efficacy of new Aloe vera and myrrh-based oral mucoadhesive gels in the management of minor recurrent aphthous stomatitis: a randomized, double-blind, vehicle-controlled study. *J Oral Pathol Med.* 2014;43:405e409.
- [84] Kwack SJ, Kim KB, Lee BM. Estimation of tolerable upper intake level (UL) of active Aloe. *J Toxicol Environmental Health A.* 2009;72:1455e1462.
- [85] Shah AH, Quereshi S, Tariq M, Ageel AM. Toxicity studies on six plants used in the traditional Arab system of medicine. *Phytother Res.* 1989;3:25e29.