

Antibacterial Activity of *Aloe vera* Against Skin Pathogens

Udgire M.S.¹ and Pathade G.R.²

¹Department of Microbiology, Rishi Biotech, Mumbai, India.

²Department of Biotechnology, Fergusson College, Pune, India.

ABSTRACT

Plants play a major role in all the traditional systems of medicine. Plants contain the rich source of natural products like vitamins, minerals and other immunomodulators. Most of which have been used without any side effects for human welfare especially to cure diseases caused by pathogenic microorganisms. The aim of the present study was to investigate the antimicrobial activity of *Aloe vera* extract in different solvents. Hexane, ethyl acetate, petroleum ether and ethanol were used to extract the bioactive compounds from the leaves of *Aloe vera* to screen the antimicrobial activity against the selected human skin pathogens by agar diffusion method. The antimicrobial analysis was completed against Gram positive bacteria (*Staphylococcus aureus*, *Staphylococcus epidermidis*), Gram negative bacteria (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Proteus mirabilis*). The disc diffusion method was used to test the antimicrobial activity. The maximum antimicrobial activity was observed in methanol extract with maximum against *S. aureus* and *S. epidermidis* with a zone of inhibition of diameter of 12 and 11 mm, respectively which is followed by 10 mm zone of inhibition against *E. coli* and *P. vulgaris* and the minimum zone of inhibition was shown by *P. aeruginosa* 9 mm, followed by *K. pneumoniae*, and *P. mirabilis* which was observed to be 7mm in diameter. This *in vitro* analysis demonstrated that folk medicine could be as effective as modern medicine to combat pathogenic microorganisms apart from their applications in cosmetics.

Keywords- Antibacterial, Skin Pathogens, *Aloe vera*, Methanol extract

INTRODUCTION

Aloe barbadensis Miller, commonly known as *Aloe vera*, belongs to the family *Liliaceae*.¹ *Aloe vera* is a typical xerophyte with thick fleshy, strangely cuticularized

spiny leaves. It has been endorsed for large variety of conditions and has come to play a prominent role as a contemporary folk medicine.² The peeled, spineless leaves of the plant contain mucilaginous jelly from the parenchyma cells which is referred as *Aloe*

vera gel. The gel is a watery-thin, viscous, colorless liquid that contains anthraquinone glycosides, glycoprotein, gamma-linolenic acid, prostaglandins and mucopolysaccharides that are essentially responsible for the medicinal properties including antibacterial, antifungal and its antiviral activity.³

Aloe vera is mainly known as Kumari, Grihakanya and Ghritakumari in Sanskrit.

Aloe vera: कुमारी

कुमारीगृहकन्याचकन्याघृतकुमारिका। कुमारीभेदनीशीतातिक्तानेन्यारसायनी।

मधुराबृहणीबल्यावृष्यावातविषप्रणुत्। गुल्मप्लीहयकृद्वृद्धिकफज्वरहरीहरेत्॥

गन्धग्निदग्धविस्फोटपित्तरक्तत्वगामयान्॥

भावप्रकाशनिघण्टु-गुडुच्यादिवर्ग 4

It is a natural coolant which is bitter-sweet in taste. Therefore in Ayurveda, it is believed to subside the vitiated (destructive) pitta and kapha doshas. It has purgative, growth enhancer or promoter, aphrodisiac, and anti-inflammatory properties. It is also a good blood purifier, uterine tonic. *Aloe vera* is widely used in liver- spleen inflammatory conditions, skin diseases and ophthalmic disorders. Due to its anti-inflammatory and wound healing properties it is especially used in abscess, boils, blisters, ulcers and infected burn wounds.⁵

Many studies have demonstrated so far the presence of many biologically active phytochemicals in the various solvent extracts of *Aloe vera* gel⁶, which may be responsible for its hypoglycemic and anti-oxidant properties⁷. Therefore, the present study was conducted to evaluate the antimicrobial activity of different solvent extracts of *Aloe vera* against common skin pathogens of public health significance.

MATERIALS AND METHODS

Chemicals

Methanol and Ethanol and petroleum ether used for extractions were of HPLC grade, and were purchased from M/S Merck Ltd. Mumbai

Microorganisms used

The bacterial organisms included in the study were obtained from National Chemical Laboratory (NCL), Pune, and Microbial Type Culture Collection (MTCC) Chandigarh, India. Gram positive (*Staphylococcus aureus*, *Staphylococcus epidermidis*) and Gram Negative (*Escherichia coli*, *Klebsiella pneumonia*, *Proteus mirabilis*, *Proteus vulgaris*, and *Pseudomonas aeruginosa*) The cultures were grown in Erlenmeyer flasks (250 mL) containing 100 mL nutrient broth and were maintained on nutrient agar medium slants at 4 °C. A loop full of bacterial cultures were inoculated individually in the medium and incubated under agitation (150 rpm) at 37° C for 24 h prior to the assay.

Plant Material and Extraction

The *Aloe vera* plant leaves were collected from the local medicinal plant nursery, Mumbai. The plant leaves were cleaned and disinfected with 15% H₂O₂. The leaves were sliced across the width with a sharp knife and the inner exposed surfaces revealed a transparent glutinous gel was obtained. The gel was homogenized with the blender aseptically and 25 g of gel was extracted with 250 mL of each solvents methanol, ethanol and diethyl ether. For successive extraction, each of the solvent with gel allowed to soxhlet at 40°C for 8 h. The liquid extracts so obtained were subjected to rotary evaporator and subsequently concentrated under reduced pressure (in vacuum at 40°C). Each test sample was again resuspended in respective solvents, and filtered with membrane filter

(0.45 µm pore diameter). All the filter sterilized test samples were stored at -20°C in air tight sterile bottles and used within one week.⁸

Screening of Antibacterial activity

The antibacterial activity of the three test samples was determined by the agar well-diffusion method on Nutrient agar (Hi Media, India) medium. Using a cork borer, wells (6 mm in diameter) were punched out in the agar medium and inocula containing 10⁶cfu/mL of the each test bacteria were spread onto the surface of the medium with a sterile spreader. 50µl of the extract was pipette into the wells, whilst 50µl of ethanol, methanol and diethyl ether were served as a control. The agar plates were incubated at 37°C for 24 h and the diameter of the zone of inhibition surrounding the wells was measured after incubation. The diameters of zone of inhibition due to extracts were compared with those produced by the commercial control antibiotics, Cephalosporin (30mg/ml). Antibacterial tests were performed in triplicates and observed values of zone of Inhibition were expressed as average value.⁹

RESULTS AND DISCUSSION

Antibacterial activity

The antibacterial activity of different solvent extracts of the *Aloe vera* gel preparations was investigated against common skin pathogens by the agar well diffusion method and the results are presented in table 1. It was found during the present study that the methanol extract exhibited maximum zone of inhibition against *S. aureus* and *S. epidermidis* with a zone of inhibition of diameter of 11 and 10 mm respectively which is followed by 9 mm zone of inhibition against *E. coli* and *P. vulgaris* and *P. aeruginosa* respectively. The minimum zone of inhibition was shown by

K. pneumonia, and *P. mirabilis* which was observed to be 8 mm in diameter.

The ethanol extract demonstrated the moderate antibacterial activity with the diameter of zone of inhibition 9 mm against *S. aureus*, and *S. epidermidis*, 8mm against *P. vulgaris* and 7mm against *K. pneumoniae*, *P. aeruginosa*, and *P. mirabilis* respectively. The least inhibition zone was observed with 4mm diameter against *E. coli*.

With the diethyl ether extract, only *K. pneumonia* was showed the least susceptibility with diameter of zone of inhibition 4mm. Remaining all pathogens under present research observed to be resistant to the diethyl ether *Aloe vera* gel extract.

In the last decade *Aloe vera* has been used extensively in healthcare product including topical creams, cosmetics, and health drinks. All products available in the market claim for the beneficial properties based on the extensive research carried out across the world on different species of *Aloe* including its antimicrobial properties.¹⁰

Our study results showed that the methanol gel extract preparation had stronger retardation effect on gram positive test organisms (*S. aureus*, and *S. epidermidis*) as compared to the gram negative bacteria (*E. coli*, *K. pneumonia*, *P. aeruginosa*, *P. vulgaris* and *P. mirabilis*). Similarly results were documented, in an earlier study,¹¹ where the gram-positive test organisms were found to be more susceptible to the sterile *Aloe vera* gel preparation and the antimicrobial susceptibility testing of *Aloe vera* gel has a greatest inhibitory effect on the *S. aureus* with 18.0 mm diameter of zone of inhibition. Results of the present research also correlates with the earlier findings by Kaithwas *et al.*¹² as well as studies conducted by Mangena¹³ where it was demonstrated that the *Aloe vera* gel being rich in a wide variety of secondary metabolites, such as polysaccharides, anthraquinone glycosides, glycoproteins,

gamma-linolenic acid, prostaglandins which was found to be very effective against Gram positive in particular against *S. aureus*.

CONCLUSION

In summary this study confirms the better understanding of the in vitro antibacterial activity of *Aloe vera* gel against skin pathogens. From our results it can be concluded that *Aloe vera* gel methanol extract possesses several bioactive compounds with antimicrobial properties which can be used as antimicrobial agents in new drugs formulations of infectious diseases in humans.

Thus, the results of the present study successfully demonstrated the use of this plant in folk medicine for the treatment of various skin diseases. Moreover *Aloe vera* is also well known for its wound and burn healing properties.¹⁴ Results of the present research confirms its promising applications in wound and burn infections.

Aloe vera gel represents an alternative source of natural antimicrobial substances in prevention of such infections. However, further analysis of the promising extract could be done to isolate the bioactive components present in it and respective skin toxicity should be analyzed thoroughly so that they can be used as bioactive antimicrobial ingredients in various topical skin formulations.

ACKNOWLEDGEMENT

The authors are thankful to Dr. Ashwini Borate, Lecturer in Dravygunvidnyan, SVNHT's Ayurvedic Medical college, Ahmednagar, India, for providing the information related to *Aloe vera* and its therapeutic significance available in Ayurveda literature.

REFERENCES

1. Ali Mohammad, *Aloe vera*. Textbook of Pharmacognosy. 2003; 111-115.
2. Tan BK, Vanitha J., Immunomodulatory and antimicrobial effects of some traditional Chinese medicinal herbs. Current Medicinal Chemistry 2004; 11:1423-1430.
3. Shafi N, Khan L, Khan GA., Commercial extraction of gel from *Aloe vera* leaves. Journal of Chemical Society of Pakistan 2000; 22(1):47-8.
4. Shree B. Mishra; Bhavprakash Nighantu-Guduchyadi varga; Chaukhambha Sanskrit Sansthan Varanasi (Publication) 11th edition ; 2004 :p 419.
5. Choi S.W., Son B.W., Son Y.S., et al., The wound healing effect of a glycoprotein fraction isolated from *Aloe vera*. British Journal of Dermatology 2001; 145(4):535.
6. Rajasekaran S., Sivagnanam K., Sivagnanam K., Subramanian S., Antioxidant effect of *Aloe vera* gel extract in streptozotocin-induced diabetes in rats. Pharmacology Republic 2005a; 57:90-96.
7. Rajasekaran S., Sivagnanam K., Ravi K., Subramanian S., Hypoglycemic effect of *Aloe vera* leaf gel on streptozotocin-induced diabetes in rats. Journal of Medicinal Food 2004; 7:62-67.
8. Yadav RNS and Agarwala M.; Phytochemical analysis of some medicinal plants; Journal of Phytology ; 3(12) 2011: 10-14
9. Parekh J., and Chanda S.; Antibacterial and phytochemical studies on twelve species of Indian medicinal plants; African Journal of Biomedical Research; (10) 2007; 175 – 181
10. Alemdar, S. and Agaoglu, S. (2009): Investigation of *In vitro* Antimicrobial Activity of *Aloe vera* Juice. *J. Animal and Veterinary Advances*. 8(1): 99-102.
11. Agarry OO, Olaleye MT, Bello-Micheal CO., Comparative activities of *Aloe vera* gel and leaf. African Journal of Biotechnology 2005; 4(12):1413-1414.
12. Kaithwas G, Kumar A, Pandey H, et. al., Investigation of comparative antimicrobial activity of *Aloe vera* gel and juice. *Pharmacologyonline* 2008; 1:239-243.

13. Mangena T., Comparative evaluation of the antimicrobial activities of essential oils of *Artemisia afra*, *Pteronia incana* and *Rosmarinus officinalis* on selected bacteria and yeast strains. *Lettent . Applied Microbiology* 1999; 28(4):291-296.
14. Grindlay D., Reynadds T., The Aloe vera Phenomenon. A review of the properties and modern uses of the leaf parenchyma gel. *J. Ethnopharmacol.* 1986; (16) 117-151.

Table 1. Antibacterial Activity of various extracts of *Aloe vera* Gel

Sr No	Extract	Zone of Inhibition (mm) Average of triplicate test results						
		<i>S. aureus</i>	<i>S. epidermidis</i>	<i>E.coli</i>	<i>K. pneumoniae</i>	<i>P.aeruginosa</i>	<i>P.vulgaris</i>	<i>P.mirabilis</i>
1	Ethanol	9	9	4	7	7	8	7
2	Methanol	11	10	9	8	9	9	8
3	Diethyl ether	NZI	NZI	NZI	4	NZI	NZI	NZI

NZI: No zone of Inhibition

