

Research Paper: The Antibacterial Activity of Aloe vera: An in-vitro study



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ABSTRACT

Introduction: The aim of this study was to identify the antibacterial components in the ethanol extraction of Aloe vera against four clinically frequent pathogenic bacteria.

Materials and Methods: In this in-vitro study, Aloe vera extraction was prepared by dissolving 500 grams of the powder in 5L of 95% ethanol. The antibacterial activity of the extraction against Staphylococcus aureus, Streptococcus, Escherichia coli and Salmonella was tested using Agar well diffusion technique. The antibacterial activity was assessed using chromatography to determine Minimum Inhibitory Concentration (MIC) and Minimum Bacterial Concentration (MBC).

Results: The Acetoacetate component of Aloe vera extraction inhibited the growth of studied bacteria. And other components had no inhibitory activity. The Acetoacetate component of Aloe vera extraction had more inhibitory effect on gram-positive bacteria compared to the gram-negative bacteria. (P=0.001)

Conclusion: Aloe vera has anti-bacterial activity and can be an alternative to pharmaceutical medicines. Also, it can be an adjacent approach to maintain and improve oral health.

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Introduction

Herbal medicines such as green tea, Aloe vera and etc. are gaining popularity worldwide as they have fewer complications and lower cost compared to non-herbal medicines.(1-3) Aloe barbadensis Mill, is a short succulent herb resembling a cactus, with green dagger shaped fleshy, spiny and marginated leaves, filled with a clear viscous gel.(1,3)

Aloe vera has potent antibacterial, antifungal, and antiviral properties.(2,3)

The antimicrobial effects of Aloe vera have been attributed to the plant's natural anthraquinones which have demonstrated in vitro inhibition of *Mycobacterium tuberculosis* and *Bacillus subtilis*.(1,3,4)

Aloe juice has been found to be bacteriostatic against *Staphylococcus aureus*, *Streptococcus pyogenes* and also *Salmonella*.(4-6)

Choonhakarn et al. claimed that Aloe vera was effective in the treatment of oral lichen planus.(7)

According to previous studies Aloe vera can be considered a safe alternative treatment for patients with recurrent aphthous stomatitis, radiation-induced oral mucositis, gingivitis, periodontitis and alveolar osteitis.(7-14)

If the anti-bacterial activity of Aloe vera is proven, it can be an alternative to pharmaceutical medicines and can be an adjacent approach to maintain and improve oral health. This study aimed to determine the anti-bacterial component of Aloe vera extraction.

Materials and methods

In this in-vitro study, Aloe vera extraction was prepared as following; The leaves of the plant were washed with distilled water, cut opened, and fresh pulp was collected. The gel was dried in an oven at 80°C for 48 hours and then powdered. An ethanol extract was obtained by dissolving 500 grams of the powder in 5L of 95% ethanol. The extract was evaporated for dryness and was turned to suspension using distilled water, Chloroform, Acetoacetate and

Dimethyl sulfoxide (DMSO).

The antibacterial activity of the extraction was tested using Agar well diffusion technique. The reference strains of four bacteria (*Staphylococcus aureus*, *Streptococcus*, *Escherichia coli* and *Salmonella*) were obtained from the microbiology department and were cultured overnight in thioglycolate broth, and then the culture was streaked on a plate of blood agar. Wells of 6 mm × 6 mm measure were made with the help of a template on the surface of the agar plates. About 0.1 ml of the extract was delivered into the wells using a micropipette. The plate was then incubated at 37°C for 24 hours.

The antibacterial activity was assessed using chromatography to determine Minimum Inhibitory Concentration (MIC) and Minimum Bacterial Concentration (MBC).

MIC determines the lowest concentration of an antibacterial agent necessary to inhibit visible growth, and MBC defines the minimum concentration of an antibacterial agent that results in bacterial death.

To analyze the data, SPSS version 22.0 (IBM Corp, Armonk, NY, USA) was used and independent T-test and ANOVA were applied at the significance level of 0.05.

Results

According to Table 1, only the Acetoacetate component of Aloe vera extraction inhibited the growth of studied bacteria (*Staphylococcus aureus*, *Streptococcus*, *Escherichia coli* and *Salmonella*) and other components had no inhibitory activity. ($P < 0.001$) The Acetoacetate component of Aloe vera extraction had more inhibitory effect on gram-positive bacteria compared to the gram-negative bacteria. ($P = 0.001$)

According to the chromatography, the most anti-bacterial agent in the Acetoacetate component of Aloe vera extraction was fumaric acid. The results showed that fumaric acid had more inhibitory activity on gram-positive bacteria compared to the gram-negative bacteria. (Table 2)

Table 1: The anti-bacterial activity of four components of Aloe vera extractions.

Bacteria	Chloroform	Acetoacetate	Distilled water	DMSO (Control solution)
Gram Positive	Staphylococcus aureus	-	18	-
	Streptococcus	-	19	-
Gram Negative	Escherichia coli	-	10	-
	Salmonella	-	10	-

Table 2: The anti-bacterial activity of Acetoacetate Aloe vera extraction.

Micro-organisms	Fumaric acid (mg/ml)		
	MBC	MIC	
Gram Positive	Staphylococcus aureus	100	50
	Streptococcus	100	50
Gram Negative	Escherichia coli	1560	780
	Salmonella	780	780

Discussion

Aloe vera is a promising plant material with numerous biological activities.(1-3) Various solvents were used for extraction of bioactive compound from Aloe vera and the extract yields were measured.(5,8)

According to previous studies, the ethanol-based extraction of Aloe vera contains more bioactive compounds.(14-18) The results of these studies shed light into the antimicrobial abilities of Aloe vera, potentially providing ground for natural alternatives to pharmaceutical antibiotics medication. This study has consistently demonstrated the effectiveness of the ethanol extraction of Aloe vera as an anti-bacterial agent against Staphylococcus aureus, Streptococcus, Escherichia coli and Salmonella. Also, according to the results the ethanol extraction of Aloe vera has more inhibitory activity on gram-positive than gram-negative bacteria.

Similarly, Jothi et al.(14) conducted a study to evaluate the antibacterial activity of ethanol and chloroform extract of Aloe vera. In their study, the ethanol extract of Aloe vera exhibited maximum inhibition against Staphylococcus aureus and Streptococcus pneumonia.

Also, Rudrangshu et al.(15) reported that the ethanol extract of Aloe vera showed the greatest effect on Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia and Shigella compared to pure Aloe vera extract. Their findings were in consistence with the current study.

In agreement to the current study, according to Arbab et al.(16) the ethanol extract of Aloe vera showed more efficacy and susceptibility against Gram-positive bacteria than gram-negative bacteria. Kaithwas et al.(17) showed that the Aloe vera was rich in variety metabolites, such as, anthraquinone, polysaccharides, glycoproteins, glycosides, gamma-linolenic acid and prostaglandins which are effective against gram-positive bacteria in particular against Staphylococcus aureus. Also, the study of Herman et al.(18)

reported the antibacterial activity of Aloe vera against Staphylococcus aureus and Pseudomonas aeruginosa. In addition, the antibacterial component of Aloe vera extract was reported to be effective against Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Pseudomonas aeruginosa, Helicobacter pylori and Propionibacterium acne.

Conclusion

Aloe vera has anti-bacterial activity and can be an alternative to pharmaceutical medicines. Also, it can be an adjacent approach to maintain and improve oral health.

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None

Authors'contributions

Bardia Vadiati Saberi: Conceptualization, Methodology, Writing - Review & Editing

Maryam Haddadian: Writing - Original Draft, Data Curation, Supervision **Niloufar Rasooli:** Resources, Investigation, Visualization

Conflict of Interests

The authors declare no conflict of interest.

Ethical declarations

Not applicable

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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