Research Article

An in vitro study to assess the effect of *Aloe barbadensis* Miller against oral microbes *Staphylococcus aureus* and *Candida albicans*.

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ABSTRACT

Aloe barbadensis miller (*Aloe vera*) is a medicinal plant that contains numerous nutrients useful to treat infectious diseases. *Aloe Barbadensis* Miller has been recognised for centuries for its remarkable health- enhancing properties. The primary objective of this study was to prove the antibacterial and antifungal activity of *Aloe barbadensis* miller. *Staphylococcus aureus* and *Candida albicans* are common organisms causing oral diseases. This study was done to determine whether *Aloe vera* juice has antibacterial effect against *Staphylococcus aureus* and antifungal activity against *Candida albicans*. The antibacterial and antifungal activity of *Aloe barbadensis* miller gel extract was tested using Agar Well Diffusion Technique. Antimicrobial activity in terms of zones of inhibition was recorded in millimeters after respective time of incubation. The antagonistic action of extracts of Aloe vera gel was also compared with positive controls. *Staphylococcus aureus* was compared with Gentamicin and *Candida albicans* with Clotrimazole. After incubation, results were analyzed using antimicrobial susceptibility testing. Results showed that the *Aloe vera* juice had least inhibitory effect against *Staphylococcus aureus* and *Candida albicans* was found to be the most sensitive strain.

Keywords: *Staphylococcus aureus; Candida albicans*; oral microbes; dental caries; Agar well diffusion.

INTRODUCTION

The use of herbal medicine for the treatment of many infectious diseases has been a tradition in many parts of the world.[1] *Aloe vera* (*Aloe barbadensis Miller*) is a succulent plant that belongs to Liliaceae family. Aloe vera was grown as an ornamental plant earlier. This species has been widely cultivated around the world.

Aloe vera consists of 75 nutrients and 200 active compounds, including vitamins, enzymes, minerals, sugars, lignin, anthraquinones, saponins, salicyclic acid, sterols and amino acids.[1] In dentistry it is used in various conditions like lichen planus,[2] apthous stomatitis,[3] oral submucous fibrosis,[4] pulpotomy of primary teeth,[5] prevention of dry sockets,[6] obturation of primary teeth,[7] bleeding and painful gums,[8] burning mouth syndrome[9] and in radiated head and neck cancer patients.[10] Actions of Aloe vera are healing properties, anti-inflammatory action, effects on the immune system, antibacterial property, antifungal property, antiviral property.[11] Aloe vera gel's ability to kill and remove harmful microorganisms is due to compounds called anthraquinones, which are anti-inflammatory.[12]

Many studies have proved the efficacy of Aloe vera in oral infections. *Staphylococcus aureus* and *Candida albicans* are common organisms causing oral diseases. *Staphylococcus aureus* is a gram-positive organism that is a member of the Firmicutes. The exact role of *Staphylococcus aureus* in caries is still not clear. *Candida albicans* is a dimorphic fungus. It has shown a high acidogenic potential and biofilm formation. Candida is the pathogen that causes infectious mucosal diseases like candidiasis, mucormycosis, histoplasmosis,etc.. Biofilm formation is a major virulence factor in the pathogenicity of Candida, and Candida biofilms are difficult to eradicate especially because of their very high antifungal resistance.[13] The main objective of this study was to determine whether Aloe vera juice has antibacterial effect against *Staphylococcus aureus* and antifungal activity against *Candida albicans*.

MATERIALS AND METHODS

The present study was designed to evaluate the antibacterial and antifungal activity of Aloe vera by using its leaf and gel extract. The study was performed at FSA laboratories private limited, Poonamalee, Chennai.

The Aloe vera gel and leaves were collected naturally. Plants were washed with distilled water and were subjected to surface sterilization with 70% ethyl alcohol followed by 0.1% Mercury chloride. The parenchymatous covering of the leaves were peeled and the gel was drained out. Slurry was formed with the help of pestle and mortar.

The bacterial strains were obtained from Microbial Type Culture Collection (MTCC), Haryana. Bacterial strains were preserved in glycerol stock solution at -70° C.[14] The medium used was *Staphylococcus aureus* in Mueller Hinton agar and *Candida albicans* in Sabouraud Dextrose Agar (SDA). Growth Conditions of *Staphylococcus aureus*

was at 370^{0}C for 24-48 hours and *Candida albicans* at 300^{0}C for 6 days.

The antibacterial and antifungal activity of Aloe vera gel extract was tested using Agar Well Diffusion Technique as described by Agarry et al.[15] In this technique wells of 5 millimeter in diameter were cut on sterile nutrient agar plates and swabbed with an overnight broth culture of the organism. About 0.1ml of the Aloe vera gel extracts were filled into each of the wells and incubated at respective temperature. Antimicrobial activity in terms of zones of inhibition was recorded in millimeters after respective time of incubation. The antagonistic action of extracts of Aloe vera gel were tested against test organisms in triplicates. The antagonistic action of extracts of Aloe vera gel also compared with positive controls. *Staphylococcus aureus* was compared with Gentamicin and *Candida albicans* with Clotrimazole. After incubation, results were analyzed using antimicrobial susceptibility testing.

RESULTS

The antibacterial and antifungal test results of Aloe vera juice is shown in fig.1 and fig.2. Table 1 shows the zone of inhibition of Aloe vera and positive controls against oral microorganisms. The antifungal activity of Aloe vera on *Candida albicans* was intermediate but had no inhibitory effect on *Staphylococcus aureus*. In general Aloe vera had inhibitory activity against gram positive bacteria with exception of *Staphylococcus aureus*.

Figure 1a:

Figure 1b:

Figure 1c:

Figure 1: Antimicrobial activity on *Candida albicans*: a.) Aloe vera extract; b.) Positive control (Clotrimazole); c.) Negative control

Figure 2a:

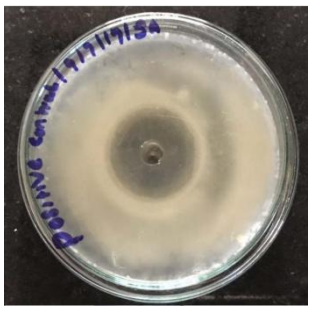

Figure 2b:

Figure 2c

Figure 2: Antimicrobial activity on *Staphylococcus aureus* a.) Aloe vera extract; b.) Positive control; c.) Negative control

Table 1: Zone of inhibition of Aloevera and controls against study organisms

	ZONE OF INHIBITION	
	Aloe vera juice (mm)	**Gentamicin (mm)**
Staphylococcus aureus	9±1	33±4
	Aloe vera juice	Clotrimazole
Candida albicans	12±1	27±3

DISCUSSION

Aloe vera gel extracts has been used in health, foods and beverages, and moisturizing cosmetics, began during the 1970s, starting in the USA and parts of Europe.[16] Historically, Aloe vera was used topically to heal wounds and for various skin conditions, and orally as a laxative.[17]

Aloe Barbadensis Miller has been recognised for centuries for its remarkable health-enhancing properties and useful in dentistry. George D et al(2009) conducted an in vitro investigation that compared the antimicrobial effectiveness of Aloe vera tooth gel with two other commercially available tooth pastes and the preliminary results showed that Aloe vera tooth gel and the tooth pastes were equally effective.[18] The National Cancer Institute has included Aloe vera in their recommendations for increased testing because of the apparent cancer fighting properties.

Wide range of researches have been done to prove the antimicrobial activity of Aloe vera species.[2] This study highlights about *Staphylococcus aureus* and *Candida*

albicans organisms as they cause common oral infections and studies have shown that *Staphylococcus aureus* had least inhibitory effect and *Candida albicans* had most sensitive effect. *Staphylococcus aureus* is present in patients with periodonitis, individuals with failing dental implants, aseptically opened root canals, dento-alveolar infections, odontogenic infections.[19] *Candida albicans* causes pseudomembranous and erythematous candidiasis, angular chelitis, median rhomboid glossitis, hyperplastic candidiasis, HIV associated candidiasis.[20]

The disc diffusion method was used to determine the anti microbial activity of Aloe vera juice. Positive controls were chosen for each of them. Clotrimazole for *Candida albicans* and Gentamicin for *Staphylococcus aureus*. Clotrimazole is highly effective in treating oral candidiasis.[21] Gentamycin was proved to be the best antibacterial agent that was effective against *Staphylococcus aureus*.[22] According to the results of this test it can be suggested that *Staphylococcus aureus* shows (Inhibitionzone : 9±1mm) and *Candida albicans*(Inhibition zone: 12±1 mm). Thus, *Staphylococcus aureus* had no inhibitory action and *Candida albicans* showed intermediate result against Aloe vera.

It is hoped that this study would lead to the development of Aloe vera compounds that could be used to formulate new and more potent antimicrobial drugs against oral microbes.

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