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Antibacterial Effects of Aloe Barbedensis Miller (Aloe Vera) Leaf Extract on Some Common Human Pathogens

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Abstract:
The antimicrobial activities of acetone, ethanol and methanol extracts of Aloe vera gel against some common human pathogens namely Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi and klebsiella pneumonia were investigated using the agar well diffusion method. The ethanol and methanol extracts showed higher antimicrobial activity compared to the acetone extract with lower or no antimicrobial activity against the tested pathogens. The differences between the maximum and minimum antibacterial activity of the various extracts on the test organisms were statistically significant. P < 0.05.

Keywords: *Antibacterial, aloe vera, human, pathogens*

1. Introduction

Aloe vera (*Aloe barbadensis miller*) is a plant, which belongs to the family of Liliaceae of which there are about 360 species and is mostly succulent with a whorl of elongated, pointed leaves. The name is derived from the Arabic word 'alloeh' which means 'bitter', referring to the taste of the liquid contained in the leaves. *Aloe vera* is believed to have originated in Northern Africa, Sudan. *Aloe vera* grows in arid climates and is widely distributed in Africa, India and other arid areas. (Akinyele and Odiyi, 2007). The species is frequently cited as being used in herbal medicine. *Aloe vera*is a perennial, drought resisting, succulent plant. It is a cactus-like plant that grows readily in hot, dry climates and currently because of demand; it is cultivated in large quantities (Suleyman and Sema, 2009). The succulent *Aloe vera* plant almost sessile perennial herb, has leaves 30-35cmm long and 10cm broad at the base, colour pea-green (when young), bright yellow tubular flowers 25-35cm in length arranged in a slender loose spike, stamens frequently projected beyond the perianth tube. It has stiff green, lance-shaped leaves containing clear gel in a central mucilaginous pulp. Its thick leaves contain the water supply for the plant to survive long periods of drought (Foster,1999).The leaves have a high capacity of retaining water also in very warm dry climates and it can survive very harsh circumstances. The gel of *Aloe vera* is contained in the leaves. The gel contains 99.3% of water, the remaining 0.7% is made up of solids with carbohydrates constituting a large component (Foster, 1999).

Many scientific studies of the use of *Aloe vera* have been undertaken, some of them conflicting. Despite these limitations, there is some preliminary evidence that *Aloe vera* extracts may be useful in the treatment of wound and burn healing, minor skin infections, sebaceous cyst, diabetes, and elevated blood lipids in humans.

The efficacy of Aloe liquid as an antibacterial agent is shown to have a wide range against Gram positive and Gram-negative bacteria. The antimicrobial agents of *Aloe vera*gel was reported to effectively kill or greatly reduce or eliminate the growth of *Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus pyogenes, Pseudomonasaeruginosa, Escherichia coli, Propionibacterium acne, Helicobacter pylori*and *Salmonella typhi*(Lawless and Allan 2000; Pugh et al 2001; Urch 1999) . Whole leaf components are proposed to have direct antibacterial properties include anthraquinones and saponin (Urch 1999). While polysaccharides have been attributed within direct bacterial activity through the stimulation of phagocytic leucocytes to destroy bacteria (Lawless and Allan 2000; Pugh et al 2001) .Due to the increasing development of antibiotic resistance, the emphasis of the present study is on the use of *Aloe vera* as a natural remedy for the inhibition of various infections.

2. Materials and Methods

2.1. Collection of Samples

Fresh and healthy*Aloe vera* leaves were collected from Uncle Ray's Horticulture in Owerri. Pure cultures of the bacterial isolates namely, *Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, Escherichia coli*and *Salmonella typhi* were obtained from the laboratory of the department of Microbiology, Imo State University Owerri, Imo State.

2.2. Preparation of Aloe vera Gel

The fully expanded leaves of *Aloe vera* were selected from the plants, washed with distilled water and were subjected to surface sterilization with 70% ethyl alcohol followed by 0.1% $HgCl_2$. The parenchymatous covering of the leaves were peeled and the gel drained out. Slurry was formed with the help of pestle and mortar.

2.3. Preparation of the Extracts

For the preparation of ethanol and methanol extracts, fresh leaf gel was dried in the oven at 80 0C for 48 h. and then powdered. Twenty grams of this powder was soaked in200ml. of each of the solvents namely ethanol and methanol for 24 h. The contents were then filtered through Whattmanfilter paper no. 1 and the filtrate was evaporated to dryness. This dried extract was further powdered and then dissolved in distilled water. Acetone extract was prepared in a similar manner except that the extracted powder was dissolved in0.15N NaOH and was further neutralized with 0.15N HCl (Pawer *et al* 2005).

2.4. Test for Sterility and Purity of Materials

The glass wares were washed carefully and packed into the autoclave for sterilization at 121^0C for 15minutes (Chessbroughh, 2000). The gel was exposed to ultraviolet rays for 24 hours and checked for sterility by streaking on a freshly prepared sterile nutrient agar and incubated for 24 hours at 37^0C.

2.5. Antibacterial Activity of the Aloe vera Gel Extracts

The antibacterial activity of *Aloe vera* gel extract was tested using Agar Well Diffusion Technique as described by Agarry *et al.* Wells of 5 mm diameter were cut on sterile nutrient agar plates and swabbed with an overnight broth culture of the organism. About 0.1ml of the *A. vera* gel extracts were filled into each of the wells and incubated at37°C ± 0.2°C. Antibacterial activity in terms of zones of inhibition (mm) was recorded after 24 h. of incubation.

2.6. Statistical Analysis

The data recorded during the course of investigation were statistically analyzed applying Analysis of Variance (ANOVA), two way classification and F-test at 5%significance level to calculate the significant difference between the organisms, solvents and the replicates.

3. Results and Discussion

3.1. Antibacterial Activity of Aloe Vera Gel Extract against Selected Pathogenic Bacteria

Zones of Inhibition (in mm)				
Organisms	**Ethanol Extract**	**Methanol Extract**	**Acetone Extract**	**Results**
S. aureus	15.5514.30	6.55		S, p< 0.05
E. coli	12.5514.10	6.10		S,p< 0.05
P. aeruginosa	23.00 10.66	0.00		S, p< 0.05
K. pneumonia	22.55 14.00	6.30		S, p< 0.05
S. typhi	14.65 9.65	0.00		S, p< 0.05
Results	**S, p< 0.05**	**S, p< 0.05**		**S, p< 0.05**

Table 1: Antibacterial Activity of Aloe vera gel extracts against selected Pathogenic bacteria

The antibacterial property of *Aloe vera* gel extracted using different solvents showed varying degree of response towards the selected pathogens (Table 1). Using ethanol extracts the zones of inhibition ranged from 12.55 to 23.00mm being maximum for *P. aeruginosa*and minimum for *E. coli*(p<0.05). Methanol extract showed highest antibacterial activity against *S. aureus* (14.30 mm) followed by *E. coli*(14.10 mm) and least for *S. typhi* (9.65 mm); the differences being statistically significant (p<0.05). Acetone extract gave lower values of zones of inhibition ranging from6.10 mm for *E. coli* to 6.55 mm for *S.aureus*while no response was observed for *P. aeruginosa* and *S. typhi*(p<0.05).Generally the extracts showed greater antibacterial activity against Gram-positive as compared to Gram-negative bacteria. With respect to individual pathogens, ethanol extract showed greater inhibition than methanol extract while, significantly lower inhibition was observed with acetone extract (p<0.05).

Other researchers have reported antibacterial properties of ethanol extracts of *Aloe vera* gel against the pathogens selected in the study (Agarry et al 2005; Reynolds and Dweck 1989). In the study conducted by Martinez *et al.* no antimicrobial activity was reported using, aqueous extract of *A. vera* leaves. As stated by Cowan 1999, nearly all of the identified components from plants active against micro-organisms are aromatic or saturated organic compounds and are most often obtained through initial ethanol or methanol extraction. This explains higher antimicrobial activity of ethanol and methanol extracts observed in the study. A lower antimicrobial action against Gram-negative bacteria as compared to Gram-positive organism could be explained to be due to the presence of additional lip polysaccharide layer in the former. This result conformed to the result of Cock, 2008 on similar study. The ethanol and aqueous extracts were active in inhibiting the growth of *Staphylococcus aureus*. This result conformed to the result of investigators on similar studies such as (Johnson, 2012).

The crude extracts of *Aloe vera* gel showed conspicuous degrees of antibacterial activity. The bacteria species was susceptible to the crude extract of *Aloe vera* gel but variations may occur depending on the type of extraction method used. For instance, methanol extraction method did not inhibit *Staphylococcus aureus*. This result conformed to the result of Cock, 2008 on similar study. The ethanol and aqueous extracts were active in inhibiting the growth of *Staphylococcus aureus*. The study carried out by Suleyman and Sema, 2009 on similar study also conformed to the result of this present investigation. The antimicrobial activity of the extracts and their potency was quantitatively assessed by the presence or absence of inhibition zone and zone diameter.

4. Conclusion

In the face of ever increasing microbial antibiotic resistance, it is becoming more imperative for studies which seek to identify natural antimicrobial compounds and the future development of this compound.

It was determined that *Aloe vera* gel had inhibitory effects against pathogenic bacteria, and can be an alternative to chemicals used in medication, food and cosmetics. It is hoped that this study would lead to the establishment to the formulation of new and more potent antimicrobial drugs of natural origin.

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