



Evaluation of the phytochemical content and antibacterial activity of aloe vera gel on *Staphylococcus aureus* and *Escherichia coli*: An Economic Perspective

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Abstract

The antimicrobial activity of the ethanol extract of aloe vera gel was evaluated using agar well diffusion method. The zones of inhibition were 20 mm and 15 mm for *S. aureus* and *E. coli* respectively. The results obtained showed that the ethanol extract of Aloe vera gel has antimicrobial effect on both *Staphylococcus aureus* and *Escherichia coli*. This suggests that the ethanol extract of Aloe vera gel can be beneficial in developing antibacterial agents that can be used in treatment of infections associated with *S. aureus* and *E. coli*, an important economic development since Aloe vera is readily available in farms and can also be cultivated domestically. The phytochemical content of the extract was also evaluated. The result of this work also gives credence to the ethnomedical use of the plant.

Keywords: Aloe vera, Ethanol, Antimicrobial, Phytochemical and Economic plant

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Introduction

Plants have been and will continue to be valuable natural treasures, providing an important source of nutrients and therapeutic agents; and have evolved a high diversity of secondary metabolites that are toxic to microorganisms and animals. In recent years, multiple drug resistance have developed due to indiscriminate usage of commercial antimicrobial drugs for the treatment of infectious diseases (Arbab *et al.*,2021).This has led to the search for new antimicrobial products from sources such as medicinal plants. Aloe vera is a plant that has been used as an alternative drug and is reputed to have medicinal properties for a myriad of treatments such as mild fever,burns,gastrointestinal disorders and various skin infections. Aloe vera (*Aloe barbadensis miller*) is a cactus like xerophyte plant cultivated in tropical areas of the world. The peeled spineless leaves of the plant are referred to as aloe vera gel.The gel is a watery thin, viscous, colorless liquid that contains anthraquinone glycosides, g gammalanoline acid, prostaglandins and mucopolysaccharides that are mainly responsible for the antibacterial, antifungal as well as it's antiviral activity (Shahzad *et.al*,2009).Herbal medications have a revival of interest due to a perception that there is a lower incidence of adverse reactions to plant preparations compared to synthetic pharmaceuticals coupled with the reduced cost of plant preparation, this makes the search for natural therapeutics an attractive option (Arbab *et al*,2021).The aims and objectives of this research therefore, are to determine the phytochemical content of Aloe vera gel and it's antimicrobial effect on *Staphylococcus aureus* and *Escherichia coli* as an important economic development.

Materials and Methods

The Aloe vera (*Aloe barbadensis*) used for the research was purchased from Eke market, Oko, Orumba North Local Government Area, Anambra State.

Test organisms.

The microorganisms used were *Staphylococcus aureus* (Gram positive) and *Escherichia coli* (Gram negative).They were obtained from the National Agency for Food Drug Administration and Control (NAFDAC)laboratory at Agulu Town in Anambra State.

Sample Preparation

The Aloe vera leaves were washed, fresh Aloe vera gel removed and dried in the oven at 80°C and then ground to powered form. The powered samples were stored in sterile airtight bottles.

Ethanolic Extraction

10g of the powdered sample was dissolved in 100ml of ethanol and left for 24hrs. The contents were filtered using Whatmans filter paper and the filtrate was evaporated to dryness. The dried extract was further powdered and dissolved in 10ml of distilled water. The resultant solution was refrigerated at 4°C and used as stock solution (Chatterjee *et al*, 2013).

Antimicrobial Susceptibility Testing

The antimicrobial assay was performed by agar well diffusion method. Mueller Hinton agar was the media used to study the bacteria susceptibility. The bacteria strains were grown in nutrient broth. The broth cultures were grown for 24 hrs and then serially diluted. The 24 hrs broth culture contained approximately 1.7×10^7 cfu/ml and 8.0×10^7 cfu/ml colonies for *Staphylococcus aureus* and *Escherichia coli* respectively, as determined by plate count method. Sterile swab stick was used to inoculate the media by dipping it in the diluted culture and spreading over the surface of the agar.

Wells (10 mm diameter) were made with the aid of a sterilized cork borer on the surface of the agar plates. About 0-1ml of the gel extract was delivered into each of the wells. Those were incubated at 37°C for 24 hours. The diameter of the zones of inhibition was measured using meter rule. The aqueous extract was prepared by dissolving 10g of the powdered sample in 100ml of distilled water. A small quantity of the sample was used for phytochemical analysis.

Results

The results of the antimicrobial screening of the ethanolic extract of aloe vera gel shows that the extract inhibited the growth of the test organisms.

Antimicrobial effect of aloe vera gel (ethanol extract): zone of inhibition in mm.

Organisms	Control(Chloranphenicol)	ethanol extract
<i>Escherichia coli</i>	35	15
<i>Staphylococcus aureus</i>	30	20

Antimicrobial effect of aloe Vera gel (aqueous extract):zone of inhibition in mm

Organisms	control	aqueous extract
<i>Escherichia coli</i>	35	5
<i>Staphylococcus aureus</i>	30	8

Qualitative phytochemical properties of aloe Vera gel

Test	acetone	ethanol extract
Alkaloids		
Water reagent	-	-
Simon's test	+	-
Carbohydrates		
Molish's reagent	++	++
Starch(iodine test)	-	-
Benedict test Proteins	++	++
Protein test	-	+
Aminoacid (ninhydrin test)	-	+
Saponins	+	++
Tannins	+	++
Flavonoids	+	+
Steroids	++	+
Terpenoids	-	-
Glycosids	+	+
Phenols	+	+
Oils and resins	+	+

Key:

++=highly positive

=slightly positive

-negative

Discussion

Aloe vera gel has been proven to contain alkaloids, saponins, tannins, flavonoids, quinones and phenolic compounds. These compounds are antimicrobials. Alkaloids and flavonoids interfere with nucleic acid synthesis in microorganisms, saponins denature microbial proteins and tannins inhibit extracellular enzymes and interfere with cell walls synthesis. Quinones inhibit protein synthesis in microorganisms. Based on the result of agar well diffusion method, the ethanol extract of aloe vera gel was proven to have antibacterial effect against *Staphylococcus aureus* and *Escherichia coli*.

Aloe vera gel contains antimicrobial compounds which are soluble in ethanol; evident by the zones of growth inhibition produced by the extracts. This shows that this plant (aloe vera) has medicinal properties and can be used for ailments such as staphylococcal skin infections and gastroenteritis. Its availability and reduced cost can be exploited in its use as a raw material for the production of economically feasible drugs. Numerous studies report the effectual use of this plant for healing of burns, inflammatory skin disorders and wounds (Dal' Belo *et al.*, 2006). A similar kind of study showed that the ethanol extract of aloe vera has great antimicrobial effect on *S.aureus*, *E.coli*, *Klebsiella pneumoniae* and *Shigella* (Rudranshu *et al.*, 2015). Medicinal plants offer a great variety of chemical substances that can be harnessed for use in the treatment of human and animal ailments if they are thoroughly characterized and purified. Thus, aloe vera can be used for the development of antibiotics.

Conclusion

This study showed that the ethanol extract of aloe vera gel has an antimicrobial effect on *Staphylococcus aureus* and *Escherichia coli*. Thus plant extracts could be used for the treatment of microbial infections ; an important economic development. The antimicrobial activity is due to phytochemical compounds isolated from the plant exudates.

Recommendations

More work is recommended on the characterization and isolation of the active ingredient. This may result in a compound with better therapeutic activity.

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