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Preliminary Investigation of the Antibacterial Activity of *Psidium guajava* Extracts

Iroha Ifeanyichukwu[1], Ejikeugwu Chika[2*], Nwakaeze Emmanuel[1], Oji Anthonia[1], Afiukwa Ngozi[1] and Nwuzo Agabus[1]

[1]Department of Pharmaceutical Microbiology and Biotechnology, Nnamdi Azikiwe University, P.M.B 5025, Awka, Nigeria.
[2]Department of Applied Microbiology, Ebonyi State University, P.M.B 053, Abakaliki, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors II and NE designed the study and wrote the protocol. Author EC wrote the first draft of the manuscript and took care of all correspondence. Authors OA, AN and NA managed the analyses of the study and the literature searches. All authors read and approved the final manuscript for publication.

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ABSTRACT

Psidium guajava (guava tree plant) is widely used in Nigerian communities as food and for medicinal purposes to treat some bacterial and non-bacterial related diseases. Increase in the rate at which pathogenic bacteria develop resistance to some available synthetic drugs calls for urgent action to turn the search lights on natural products such as plants for bioactive compounds needed to develop novel antimicrobials. This study evaluated the antibacterial activity of ethanolic and methanolic crude leaf and bark extracts of *P. guajava* against pathogenic strains of *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa and Streptococcus pneumoniae* by the agar well diffusion technique. Ethanolic and methanolic leaf extracts of *P. guajava* produced inhibitory zones of 15-22 mm and 13-20 mm against the test bacteria

**Corresponding author: E-mail: ejikeugwu_chika@yahoo.com;*

respectively. Inhibitory zones of 16-19 mm and 13-23 mm was recorded against the test bacteria for methanolic and ethanolic bark extracts respectively. The observed antibacterial activities of *P. guajava* further explain the use of guava tree plant for medicinal purposes in this part of the world. And further research is necessary to characterize the bioactive compounds of *P. guajava*.

Keywords: Extracts of Psidium guajava; antibacterial activity; microorganisms.

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1. INTRODUCTION

Psidium guajava plant possesses diverse medicinal values, and it has been used since time immemorial to manage several human ailments including stomach problems, diarrhea and other bacterial related diseases [1]. In many rural parts of Africa and even in some metropolitan towns in Nigeria, natural products especially those of plant origin (including *P. guajava*) are often resorted to for medicinal purposes. *P. guajava* belongs to the plant genus *Psidium* and family *Myrtaceae*; and its leaves contain numerous essential oils rich in phytochemicals such as tannins, mineral salts, fats and flavonoids amongst others [1]. Though considered to have originated from Central and Southern America, *P. guajava* is now grown in virtually all parts of the world (Nigeria inclusive). *Psidium guajava* commonly known as the guava tree plant is a widespread plant (native to Tropical America); and it is used for culinary and medicinal purposes, and its fruits are eaten for nutritional purposes. Guava peels are chewed in most parts of the world to freshen-up breath and treat some oral-related ailments; and the phytochemicals present in guava plant gives scientific credibility to its usage in traditional medicine or folk practices across the globe. The biological and antimicrobial activities of *P. guajava* include antioxidant properties, anti-diarrheal effect, antibacterial and anti-cough activity [2]. It is one of the plants used in folk medicine for the management of various disease conditions and is believed to be active against various infections such as malaria, gastroenteritis, coughs, and sore throat [1,3,4,5]. Guavas are rich in dietary fiber, vitamin, potassium, copper and manganese; and these compounds are vital for the body's metabolic activities [6,7,8,9,10,11]. Antibiotics and other antimicrobial agents have always played significant roles in the treatment and management of many infectious diseases but the emergence and spread of some resistant microbial strains have compromised the antimicrobial activity of some antimicrobial drugs. This preliminary study was undertaken to evaluate the antibacterial activity of ethanolic and methanolic crude extracts of *P. guajava* leaves and bark against some selected pathogenic bacteria.

2. MATERIALS AND METHODS

2.1 Collection of Plant and Preparation

The *Psidium guajava* leaves and bark were collected from a garden at Amike-Aba community in Ebonyi Local Government Area of Ebonyi State, Nigeria between January and March, 2014; and identified by the Applied Biology Department of Ebonyi State University Abakaliki, Nigeria. The leaves and bark of *P. guajava* collected were cleaned, washed and dried in shade at room temperature for 2 weeks. Upon drying, the plant material was pounded using mortar and pestle into smaller particles and then blended to powder with an electric blender. Powered samples of the plant were stored in an air tight container until use.

2.2 Extraction

Twenty grams (20 g) each of the dried *Psidium guajava* sample was used for solvent extraction, and these were percolated in 200 ml methanol and ethanol and allowed for two days. The resulting extract was filtered through Whattman filter paper No 2 and evaporated to give crude extract. The extracted compound of *P. guajava* was used for the antimicrobial assay.

2.3 Test Organisms

The selected bacterial pathogens used in this study include *Staphylococcus aureus*, *Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Streptococcus pneumoniae*; and they were collected from the culture preservation unit of the Microbiology laboratory of Ebonyi State University Abakaliki, Nigeria.

2.4 Determination of Antibacterial Activity

The methanol extracts of *Psidium guajava* were screened for antibacterial activity by agar well diffusion method as was previously described

[6,7]. Briefly, 100 mg/ml crude extracts of the plant were each tested on 6 mm punctured wells or holes on Mueller Hinton agar plates (Oxoid, UK) that were previously swabbed with the test bacteria. Zones of inhibition were recorded to the nearest millimeter (mm) after 24 hrs of overnight incubation at 37°C. Chloramphenicol was used as the positive control drug.

3. RESULTS

Table 1 shows the results of the methanol and ethanol leave extracts against the test bacteria. Dimethyl sulphoxide (DMSO) was used as the solvent for the plant extracts, and as negative control. DMSO did not inhibit the test bacteria. It could be deduced from our result that the methanol and ethanol extracts showed considerable levels of antibacterial activities against the test pathogens. The diameter of inhibition zone of the methanolic leaf extracts against the test bacteria ranged between 13 mm-20 mm. The largest zone of inhibition (20 mm) was recorded against *Escherichia coli* while the least inhibition zone diameter (13 mm) was recorded for *Pseudomonas aeruginosa*. On the other hand, ethanolic leaf extracts inhibited the test bacteria at 18 mm (*E. coli*), 23 mm (*S. aureus*), 19 mm (*S. pneumoniae*), 15 mm (*K. pneumoniae*) and 22 mm (*P. aeruginosa*). The ethanolic leave extracts inhibited the growth of the test bacteria more than the methanolic leave extracts (Table 1).

The ethanolic and methanolic bark extracts of *P. guajava* had appreciable antibacterial effect against the test bacterial pathogens. Ethanolic bark extract inhibited the test bacteria at 19 mm (*E. coli*), 23 mm (*S. aureus*), 13 mm (*S. pneumoniae*), 14 mm (*K. pneumoniae*) and 20 mm (*P. aeruginosa*). For the methanolic bark extracts, the zones of inhibition recorded against the pathogenic bacteria were 19 mm (*E. coli*), 18 mm (*S. aureus*), 16 mm (*S. pneumoniae*), 18 mm (*K. pneumoniae*) and 19 mm (*P. aeruginosa*). Both Gram positive and Gram negative bacterial pathogens as used in our study were considerably inhibited by the methanolic and ethanolic leave and bark extracts of *P. guajava* (Tables 1 and 2).

4. DISCUSSIONS

Some plants contain many biologically active compounds which are widely used to meet certain primary healthcare needs especially in most rural communities. They could serve as sources of lead compounds for the development of putative antimicrobial agents especially now that some synthetic drugs are barely efficacious against some pathogenic bacteria. In this study, the ethanolic and methanolic leaf and bark extracts of *Psidium guajava* (commonly known as the guava tree plant) was investigated against

Table 1. Antibacterial activity of methanolic and ethanolic leaf extracts of *P. guajava* against pathogenic bacteria

	Zones of inhibition (mm)		
Test organisms	**Methanolic leaf extract**	**Ethanolic leaf extract**	**Chloramphenicol (10 mg)**
Escherichia coli	20	18	20
Staphylococcus aureus	19	23	28
Streptococcus pneumoniae	18	19	25
Klebsiella pneumoniae	16	15	26
Pseudomonas aeruginosa	13	22	24

Table 2. Effect of ethanolic and methanolic bark extracts of *P. guajava* against pathogenic bacteria

	Zones of inhibition (mm)		
Test organisms	**Ethanolic bark extract**	**Methanolic bark extract**	**Chloramphenicol (10 mg)**
Escherichia coli	19	19	16
Staphylococcus aureus	23	18	26
Streptococcus pneumoniae	13	16	23
Klebsiella pneumoniae	14	18	21
Pseudomonas aeruginosa	20	19	18

some selected pathogenic bacteria. The notable antibacterial activities of guava tree plant (as obtainable in this present study) have been previously reported [4,8,9,10,11,12,13]. Generally, the observed results in this study showed that both the methanolic and ethanolic leaf and bark extracts of *P. guajava* had considerable antibacterial activities against the test bacterial pathogens. The ethanolic leaf extracts of *P. guajava* had an inhibitory zone of 15-22 mm against the Gram positive and Gram negative bacteria when compare to the control drug (chloramphenicol) which produced similar antibacterial activity. Methanolic leaf extracts also showed inhibition zones against the test pathogens at 13-20 mm (Table 1). It has been previously reported that the ethanolic and methanolic crude extracts of *P. guajava* possess antimicrobial activity and inhibited both Gram positive and Gram negative bacteria [1,6]. This broad spectrum activity of *P. guajava* extracts against pathogenic microorganisms (as obtainable in our study) have been linked to the presence of bioactive compounds that they possess [6,8,10,12]. In a related development, the broad spectrum activities of *P. guajava* extracts have also been reported, and these studies opined that guava tree plant possess bioactive compounds that warrants their use for therapeutic measures [1,2,3,4]. The results of the methanolic and ethanolic bark extracts of *P. guajava* produced broad spectrum of antibacterial activities against *E. coli, S. aureus, S. pneumoniae, K. pneumoniae* and *P. aeruginosa*. The inhibitory zones recorded against the test pathogens for the methanolic bark extracts were in the range of 16-19 mm while the ethanolic bark extracts showed inhibition zones that were in the range of 13-23 mm. Ethanolic bark extracts showed better inhibitory effects against the Gram positive and Gram negative bacteria used in this study than the methanolic bark extracts (Table 2). The broad spectrum activity of the methanolic and ethanolic bark extracts of *P. guajava* reported in this study are similar to earlier reports that showed similar antibacterial activities of guava tree plant against pathogenic bacteria [6,8,10,13]. Our study provides a preliminary investigation of the antibacterial activities of *P. guajava* plants, and this gives credence to further determine and characterize by molecular studies the other pharmacological properties of the guava tree plant. Based on our findings, *P. guajava* (guava tree plant) possess antibacterial activities, and this justifies their use in most rural communities to meet certain healthcare needs.

5. CONCLUSION

Conclusively, the notable inhibitory activity showed by the ethanolic and methanolic leaf extracts of *P. guajava* against some Gram-positive and Gram-negative bacteria gives impetus to their use for solving some primary health care needs in some rural Nigerian communities.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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