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PHYTOCHEMICAL PROFILING AND ANTIBACTERIAL ACTIVITY OF THE METHANOLIC LEAF EXTRACT OF *SECURIDACA LONGIPEDUNCULATA* AGAINST CLINICALLY ISOLATED BACTERIAL PATHOGENS

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ABSTRACT

Securidaca longipedunculata is an important medicinal plant widely used in traditional medicine for the treatment of infectious diseases owing to its rich phytochemical composition. This study investigated the phytochemical constituents and antibacterial activity of the methanolic leaf extract of *Securidaca longipedunculata* against selected clinically isolated bacterial pathogens. Qualitative phytochemical screening was carried out using standard analytical procedures. The antibacterial activity of the methanolic leaf extract was evaluated against clinically isolated bacteria using the agar well diffusion method at different concentrations. Antibacterial efficacy was assessed by measuring the zones of inhibition (ZOI), while the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined using standard microbiological techniques. Phytochemical screening revealed the presence of alkaloids, flavonoids, saponins, tannins, glycosides, cardiac glycosides, terpenoids, and phenolic compounds. The methanolic leaf extract exhibited concentration-dependent antibacterial activity against all tested bacterial

isolates. Bacillus subtilis was the most susceptible organism, producing the largest inhibition zone (16 mm) at 200 mg/mL, followed by Staphylococcus aureus (14 mm), while Escherichia coli showed the least susceptibility with an inhibition zone of 12 mm at the same concentration. The MIC and MBC results further confirmed the inhibitory and bactericidal potential of the extract against the tested organisms. The methanolic leaf extract of *Securidaca longipedunculata* possesses diverse bioactive phytochemicals and demonstrates promising antibacterial activity against clinically important bacterial pathogens. These findings support the ethnomedicinal use of the plant and suggest its potential as a natural source of antimicrobial agents for future pharmaceutical development.

KEYWORDS: *Securidaca longipedunculata*; methanolic leaf extract; phytochemicals; antibacterial activity; clinically isolated bacteria; MIC; MBC.

INTRODUCTION

Securidaca longepedunculata, commonly known as the violet tree or violet plant in English, is a plant species found in various regions of Africa. In Nigeria, the Hausa people call it Uwar agunguna while the Ibos call it Ezeogwu, Fulani name is 'aalali', Yoruba call it ipeta. *Securidaca longipedunculata* is a medium size tree measuring 8 to 9 m height with visible violet or white flowers, pale smooth bark, common in North-Central Nigeria and is generally widespread in hot temperate part of Africa. When in flower the plant is distinctly ornamental. The fruits are round, with a characteristic membranous wing up to 45 mm, purplish green when young, becoming pale straw colored between April and August (Alqasim, 2013). It has a long history of traditional use in African medicine systems for treating various ailments, such as skin cancer, skin infections, flu; they are also used for contraceptive purposes, abortion, constipation, coughs and fever. Other uses include sexual boost, toothache, tuberculosis, rheumatism, pneumonia and as blood purifier (Mongalo *et al.,* 2015). It is used in treating infections related to nervous and circulatory system, dysentery, malaria, typhoid and frequent stomach ache (Maroyi, 2013; Mustapha, 2013). The aqueous root and ethanol extracts yielded alkaloids, cardiac glycosides, flavonoids, saponins, tannins, volatile oils, terpenoids and some steroids (Haruna *et al.,* 2013; Auwal *et al.,* 2012) while chloroform and ethanol extracts indicated flavonoids, saponins, coumarins, tannins and alkaloids (Haruna *et al.,* 2013; Auwal *et al.,* 2012). Furthermore, extracts have antimicrobial, antioxidant, antiparasitic, anti-diabetic, anti-inflammatory, antimalarial, insecticidal, pesticidal, and anticonvulsant properties (Hedimbi and Chinsembu, 2012). Preliminary phytochemical

screening revealed the presence of alkaloids, cardiac glycosides, flavonoids, saponins, tannins, volatile oils, terpenoids, carbohydrates, phenolic compounds and steroids in different extracts of leaf, root bark and stem bark of the violet tree (Auwal *et al*., 2012). However, antimicrobial activities against specific strains of bacteria is limited, especially.

AIM AND OBJECTIVES

The aim of the study is to evaluate the phytochemical constituents and antibacterial activity of methanolic leaf extract of *Securidaca longipedunculata* against selected clinically isolated bacterial pathogens.

The specific objectives of the studies are to:

i. qualitatively screen the methanolic leaf extract of *Securidaca longipedunculata* for the presence of major bioactive phytochemicals.

ii. evaluate the antibacterial activity of the methanolic leaf extract against selected clinically isolated bacterial pathogens using the agar well diffusion method.

iii. determine the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the methanolic leaf extract against the test bacterial isolates.

MATERIALS AND METHODS

Materials

Sulfuric acid (H_2SO_4), Sodium Hydroxide (NaOH), Chlorofom, Hydrochloric acid (HCl) copper sulphate dehydrate ($CuSO_4.5H_2O$), methanol and the leave extract. All the chemical reagents to be use in this experiment would be of analytical grade.

Methods

The leaf of *Securidaca longepedunculata* plant sample were collected from Gashaka Gumti National Park in Serti, Taraba State, Nigeria. The leaf samples were dried at room temperature and grounded into powder using iron mortar and pestle. The powdered plant material was labelled and soxhlet extractor was employed for solvent extraction.

Phytochemical Screening, Qualitative Analysis of the Leaf Extract of *Securidaca longipedunculata*

Phytochemical Analysis

The phytochemical screening of the plant extract was carried out using the method adopted by Trease and Evans (2002) with some modifications.

Test for Alkaloid

About One mill (1ml) of extract was taken and put into a test tube. Then 1ml of potassium mercuric iodide solution (Mayer‟s reagent) is added and shaken. Emergence of whitish or cream precipitate implies the presence of alkaloids.

Test for of Steroids

This was carried out using the method described by Akinyeye *et al*., (2014).Two milliliters of acetic anhydride was added to 5 mg of the extract, thereafter, 2 ml of conc. H_2SO_4 was added. The colour changed from violet to blue or green in some samples which indicates the presence of steroids.

Test for Tannins

Two milligrams of the extract was added to 5ml distilled water, followed by addition of 2ml of $FeCl_3$. Tannin was indicated by a brownish green or blue-black precipitate.

Test for Terpenoids

This is carried out using the method described by Adamu *et al.,* (2025). Five milligrams of the methanolic leave extract were mixed with 2 ml of chloroform and conc. H_2SO_4. 3ml was carefully added to form a layer. The reddish brown colour in inner face indicated the presence of terpenoids.

Test for Anthraquinones

About 0.5g was shaken with 10ml of benzene and then filtered. 5ml of ammonium solution was added to the filtrates. The mixture was then shaken and appearance of a pink, red or violet colour in the ammonical (lower) phase was taken as an indicator for the presence of free anthraquinones.

Test for Saponin

About 0.5g of the extract was shaken with 5ml of distilled water and heated to boiling point. The filtrate from the extract was added to 3ml of paraffin oil and thoroughly shaken to form a stablseedse emulsion. This was left to stand for about 5minutes, the presence of stable emulsion indicates the presence of saponin.

Test for phenol

About 1ml of the extract was added and put into a test tube. Then 1% sodium chloride is added and shaken. Formation of bluish-black color indicates the presence of phenols.

Test for Flavonoid

About 2ml of dilute sodium hydroxide (NaOH) was added to 2ml of the extract. The appearance of a yellow color indicates the presence of flavonoids.

Test for cardiac glycoside

About 1m of the extract, 2ml of 3.5% ferric chloride solution was added and allowed to stand for one minute and is carefully poured down the test tube so as to form a lower layer. A reddish-brown ring, the interface indicates the presence of cardiac glycoside.

Test for Glycosides

About 50% of H_2SO_4 was added to 5ml of the extract in a test-tube. The mixture is heated in a boiling water for 15mins cool and neutralize with 10% NaOH, 5ml of Fehling‟s solution is added and the mixture was boiled again. Presence of a brick-red precipitate indicates the presence of glycosides.

Antimicrobial Activity of *Securidaca longipedunculata* Leaf Extract

The evaluation of antimicrobial activity of the synthesized Copper Oxide nanoparticles against some clinically isolated bacteria which include, Salmonella typhimurium, Escherichia coli, and Staphylococcus aureus, Bacillus subtilis) by following standard agar well diffusion method. The Zone of Inhibition (ZOI) and minimum inhibition concentration is recorded as descried by Khan *et al*. The antimicrobial activity is determined. Individual microorganisms would be cultured in 100 mL of mature broth culture for 24 h on nutrient agar plates. Sterile cork borer is used to produce 6mm diameter wells in a petri dish. 20 mg Ml^{-1} of the extracts is use to assess the activity. The zone diameter was measured in millimeters after the cultures were incubated at 37 °C for 24 hours (Dulta *et al*., 2022).

RESULT AND DISCUSSION

Phytochemical screening

Phytochemicals are secondary metabolites responsible for many observed bioactivity of plant extract which is known to possess antioxidant, anti-inflammatory, antibacterial, immune modulatory and anti-sickling activities (Okagu *et al.,* 2021*).*

Table 1 Qualitative Analysis of Methanolic Leaf Extract of *Securidaca longipedunculata.*

Phytochemicals	Leave extract		
Alkaloids	+		
Flavonoids	+		
Phenols	+		
Terpenoid	+		
Tannin	+		
Saponins	+		
Glycoside	+		
Cardiac Glycosides	+		

Keys: + = Detected, - = Not detected

These secondary metabolites (alkaloids, saponins, tannins, anthraquinones and flavonoids) are known to have activity against several pathogens and therefore aid the antimicrobial activities of *Securidaca longipedunculata* plant extract and support their traditional use for the treatment of various illness (Sharma *et al.,* 2012). The flavonoids which is also present have been reported to exert multiple biological effects including antimicrobial, antidiarrheal, antioxidant, free radical scavenging abilities, anti-inflammatory etc. (Okagu *et al.*, 2021). The results of phytochemical screening from Table 1 above indicated that the plant extracts contain the bioactive compounds which show antimicrobial activity which is attributed to the presence of the secondary metabolites in the plant extracts.

The results of phytochemical screening for leaf extracts of *Securidaca longipedunculata* leaf extract in the Table 1 reveals the present of some of bioactive compounds of the plant extract. The report is in agreement with the study conducted by Chapter (2020). These secondary metabolites (alkaloids, saponins, tannins, anthraquinones and flavonoids) are known to have activity against several pathogens and therefore aid the antimicrobial activities of *Securidaca longipedunculata* plant extract and support their traditional use for the treatment of various illness (Sharma *et al.,* 2012; Usman and Osuji, 2007). Tannins containing herbs have been reported in treating intestinal disorders such as diarrhea and dysentery and also It has been observed that tannins have anticancer activity and can be used in cancer prevention (Sharma *et al.,* 2012). Thus suggesting that the plant extract has important bioactive compounds for the treatment and prevention of cancer which also supports the traditional medicinal use of this plant in the treatment of different ailments where by these phytochemicals are known to exhibit medicinal activity as well as pharmacological activity (Chapter *et al*, 2020). They also have a wide range of pharmacological activities including antimalarial (e.g., quinine), anticancer (e.g.,homoharringtonine) due to the present of alkaloid and the present of Cardiac glycoside in the leaf extract is also used in the treatment of congestive heart failure (Medicine *et al*., 2019). The flavonoids which is also present have been reported to exert multiple biological effects including antimicrobial, antidiarrheal, antioxidant, free radical scavenging abilities, anti-inflammatory and other conditions (Okagu *et al.*, 2021). The results of phytochemical screening from Table 1 indicate that the plant extracts contain the bioactive compounds which suggest antimicrobial activity which is attributed due to the presence of the secondary metabolites in the plant extracts (Okagu *et al.,* 2021*).*

Table 2 Antibacterial activity of the extract. (Zone of inhibition in millimeter)

Extract	Bacteria	Concentration (mg/ml) 200	100	50	25	12.5	6.25	Positive control(30ug)
Extract	*Escherichia coli*	10	06	04	00	00	00	24
	Salmonella typhi	08	04	02	00	00	00	26
	Bacillus subtilis	14	12	10	08	00	00	22
	Staphylococcus aureus	12	08	04	00	00	00	24

Table 3 Minimum inhibitory concentration of *Securidaca longepedunculata* Extract Against Test Bacteria.

Extract	Bacteria	200	100	50	25	12.5	6.25	MIC
Extract	*Escherichia coli*	_	*	+	+	+	+	200
	Salmonella typhi	_	_	*	+	+	+	100
	Bacillus subtilis	_	*	+	+	+	+	200
	Staphylococcus aureus	_	*	+	+	+	+	200

Key: + = Growth in tube, - = No growth in tube.

Table 4 Minimum bacteriacidal concentration of *Securidaca longipedungulata* extract against test bacteria.

Extract	Bacteria	200	100	50	25	12.5	6.25	MBC
Extract	*Escherichia coli*	+	+	+	+	+	+	>200
	Salmonella typhi	+	+	+	+	+	+	>200
	Bacillus subtilis	+	+	+	+	+	+	>200
	Staphylococcus aureus	+	+	+	+	+	+	>200

Key: = No growth on plate + = Growth on plate.

Antibacterial Activity of the Leaf Extract of *Securidaca longipedunculata*

The result of the antibacterial activity of extract is shown in Table 2 revealed that the extract exhibited antibacterial activity on the bacteria used in this study at concentration as low as 25 mg/ml. This is in line with the research carried out by Ndamitso *et al*., (2023), whose study had shown that all the bacteria tested were sensitive to the aqueous stem bark extract of *Securidac longipedunculata* as zones of inhibition were produced at the tested concentration. The inhibition was found to increase with increase in concentration extract. The antibacterial potential shown by the extract is a function of the phytochemical compounds present in the plant material. Many naturally-occurring compounds found in plants have been shown to possess antimicrobial functions and could thus serve as a source of both traditional and orthodox medicine (Mongalo *et al.,* 2015). Previous studies by Gbadamosi (2012); Junaidu *et*

al. (2015) revealed that Salmonella typhi and *P. aeruginosa* were resistant to the methanol root extract of the *Securidaca longipedunculata*, and this suggests that the leaf contains more antibacterial agents than the roots of *Securidaca longipedunculata.*

In Table 3, the Minimum Inhibitory Concentration (MIC) showed higher inhibitory was more effective in *Salmonella typhi* (MIC 100 mg/ml) than *Escherichia coli, Bacillus subtilis* and *Staphylococcus aureus* (MIC 200 mg/ml). In Table 4, all the test bacteria had Minimum Bactericidal Concentration (MBC) greater than 200 mg/ml.

CONCLUSION

The findings of this study demonstrate that the methanolic leaf extract of *Securidaca longipedunculata* is a rich source of biologically active phytochemicals with significant antibacterial activity against clinically isolated bacterial pathogens. The pronounced susceptibility of Bacillus subtilis and Staphylococcus aureus, together with measurable inhibitory effects against Escherichia coli, underscores the broad-spectrum antimicrobial potential of the plant extract. The MIC and MBC results further confirm its inhibitory and bactericidal properties. Overall, these findings provide scientific evidence supporting the traditional medicinal use of *Securidaca longipedunculata* and highlight its promise as a natural reservoir of bioactive compounds for the development of novel antimicrobial agents. Further studies involving compound isolation, toxicity assessment, and *in vivo* efficacy are recommended to facilitate its translation into safe and effective therapeutic products.

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