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Phytochemical Screening and Antibacterial Activity of Leaf and Steam Bark Extracts of Baobab (*Adansonia Digitata*) Against Methicillin-Resistant *Staphylococcus Aureus* Isolate

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ABSTRACT

The Methicillin-resistant Staphylococcus aureus (MRSA) is a pathogenic bacterium that causes infection and is resistant to several classes of commonly available antibiotics. The rise of resistance of microorganisms to commonly used antibiotics calls for the need to investigate the use of medicinal plants for developing new alternative antibacterial. The present study was carried out to assess the phytochemical content, antibacterial activity, minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), and preliminary toxicity of extracts of leaves and stem barks of Adansonia digitata against MRSA. Extraction was carried out using water, methanol, and ethanol as solvents for the plant parts. The phytochemical analysis was done to establish the type of secondary metabolites present, while the antibacterial activity of the extracts was assessed using the agar well diffusion technique. MIC and MBC were estimated. The brine shrimp lethality test was used for assessing the preliminary toxicity of the extracts. The results revealed the presence of alkaloids and saponins in all extracts, while other phytochemicals such as flavonoids, tannins, and terpenoids were found at different levels. The highest antibacterial activity was exhibited by the ethanolic leaf extract with an inhibition zone of 23.0 mm at a concentration of 400 mg/mL, whereas the lowest antibacterial activity was shown by the aqueous stem bark extract with an inhibition zone of 11.0 mm. The lowest MIC (25 mg/mL) and MBC (50 mg/mL) values were exhibited by the ethanolic leaf extract, showing higher antibacterial activity compared to other extracts. The preliminary test for brine shrimp lethality indicated relatively low toxicity, having LC_{50} value more than 500 µg/mL for all the extracts. The bioactive constituents in the most potent ethanolic leaf extract, as determined by GC–MS analysis, included hexadecanoic acid methyl ester, phytol, 9,12-octadecadienoic acid methyl ester, oleic acid methyl ester, squalene, vitamin E, β-sitosterol, and stigmasterol. The study concluded that A. digitata is a potential antibacterial agent against MRSA infection due to the presence of phytochemical constituents in the ethanolic leaf extract.

Keywords: *Adansonia digitata*; MRSA; antibacterial activity; phytochemicals;

Introduction

Medicinal plants remain one of the most important sources of therapeutic agents used in modern and traditional medicine. Over 80% of the world's population relies partly on plant-derived medicines for primary healthcare due to their accessibility, affordability, and perceived safety compared to synthetic drugs. Many plant species contain bioactive phytochemicals such as alkaloids, flavonoids, tannins, terpenoids, and phenolic compounds that possess antimicrobial, antioxidant, and anti-inflammatory properties. In recent years, research interest in medicinal plants has increased significantly because of the growing resistance of pathogenic microorganisms to conventional antibiotics (Adeyemi and Ogundele, 2021; Kumar *et al*., 2022).

Antibiotic resistance has become a major global public health concern. Bacteria have developed various mechanisms to evade the action of antimicrobial agents, making infections increasingly difficult to treat. Among these resistant pathogens, Methicillin-resistant *Staphylococcus aureus* (MRSA) has gained considerable attention due to its ability to cause severe infections and its resistance to multiple antibiotics. MRSA infections are commonly associated with hospital-acquired infections, community-acquired infections, and increased morbidity and mortality worldwide (World Health Organization, 2023; Turner *et al*., 2021). *Staphylococcus aureus* is a Gram-positive bacterium that normally inhabits the skin and mucous membranes of humans but can become pathogenic when it invades tissues or enters the bloodstream. It is responsible for a wide range of infections including skin infections, pneumonia, endocarditis, and septicemia. The emergence of methicillin-resistant strains has significantly complicated treatment options, as these strains are resistant to β-lactam antibiotics including penicillin and methicillin (Chambers and DeLeo, 2020; Tong *et al*., 2021).

The increasing prevalence of MRSA has stimulated the search for alternative antimicrobial agents, particularly from natural sources such as medicinal plants. Plant extracts have been widely investigated for their antimicrobial activities against resistant pathogens. These extracts contain complex mixtures of phytochemicals that may act synergistically to inhibit microbial growth or disrupt microbial cellular processes. Therefore, exploring medicinal plants for potential antibacterial compounds is considered a promising approach in combating antibiotic resistance (Owolabi *et al*., 2022; Ibrahim and Musa, 2023).

One of the medicinal plants gaining attention for its therapeutic properties is *Adansonia digitata*, commonly known as the baobab tree. The plant belongs to the family Malvaceae and is widely distributed in tropical regions of Africa. Different parts of the plant including leaves, bark, fruit pulp, and seeds have been used traditionally to treat various ailments such as fever, diarrhea, infections, and inflammation. The medicinal potential of *A. digitata* has been attributed to the presence of diverse phytochemical constituents with biological activities (Ngoma *et al*., 2022).

Materials and Methods

Study Area

The study was conducted at the Microbiology Laboratory, Aliko Dangote University of Science and Technology (ADUSTECH), Wudil, Kano State, Nigeria. Kano State is located in the Northwestern region of Nigeria (Latitude: 12.00220 N and Longitude: 8.59190^0N), it is characterized by tropical savanna climate suitable for the natural growth of Baobab tree (*Adansonia digitata*) widely distributed across the region. The relative humidity averages 30–60%, providing suitable conditions for the growth of medicinal plants such as *Adansonia digitata* (Abubakar and Haque, 2020; Mohammed *et al*., 2021). The ADUST laboratory is

equipped with standard instruments for plant extraction and microbiological analysis, including autoclaves, incubators, laminar flow cabinets, centrifuges, and rotary evaporators. These facilities provide controlled experimental conditions essential for reproducible and reliable evaluation of phytochemical and antibacterial properties of plant extracts (Chaves-López *et al*., 2022; Pandey *et al*., 2021).

Collection and Authentication of Plant Materials

Fresh leaves and stem bark of *Adansonia digitata* was collected from Bebeji Local Government Area of Kano State. Approximately 2 kg of leaves and 2 kg of stem bark was harvested using sterilized pruning shears to prevent contamination. The collected plant parts was placed in sterile polythene bags and transported immediately to the laboratory for further processing (Sasidharan *et al*., 2020).The plant was authenticated by a plant taxonomist at the Department of Biological Sciences, Bayero University Kano (BUK) Nigeria. With the authentication number BUKHAN0036 to ensures the correct species identification, which is critical because closely related species may vary in phytochemical composition and biological activity (Heinrich *et al*., 2018; Owolabi *et al*., 2022). A voucher specimen was deposited at the department herbarium for future reference.

Preparation of Plant Materials

The collected leaves and stem bark was washed thoroughly with 1 L of distilled water per 500 g of plant material to remove dust, soil, and other contaminants. The plant materials was air-dried under shade at room temperature (25–28°C) for approximately 14 days until a constant weight is achieved. Shade drying is preferred to avoid photodegradation of sensitive phytochemicals such as flavonoids and phenolic compounds (Altemimi*et al*., 2017; Azwanida, 2019). The plant materials was grounded into a fine powder using a sterile electric grinder. The resulting powdered samples was stored in airtight amber glass containers at 4°C until extraction. Approximately 500 g of powdered leaves or stem bark was used for each solvent extraction batch.

Extraction of Plant Materials

Extraction of phytochemicals was performed using the maceration method. For each solvent extraction, 50 g of powdered leaves and stem bark was placed in a sterile conical flask containing 500 mL of solvent (ethanol, methanol, and distilled water). The mixtures were sealed with aluminum foil and allowed to stand at room temperature (25–28°C) for 72 hours, with intermittent shaking every 6 hours to improve solvent penetration and maximize extraction of bioactive compounds (Sasidharan *et al*., 2020; Salehi *et al*., 2020).After maceration, the mixtures were filtered using Whatman No. 1 filter paper. The filtrates was then be concentrated using water bath at 70°C to remove the solvents, yielding crude extracts. The crude extracts was weighed and stored in sterile airtight bottles at 4°C until further use. Ethanol and methanol are used because they effectively dissolve a broad spectrum of secondary metabolites, while aqueous extraction simulates traditional medicinal preparations (Azwanida, 2019).

Qualitative Phytochemical Screening

The crude extracts of leaves and stem bark of *Adansonia digitata* was subjected to qualitative phytochemical screening and detected the presence of major secondary metabolites including alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds. These phytochemicals are often associated with antimicrobial and therapeutic activities in medicinal plants (Pandey *et al*., 2021; Gupta *et al*., 2019).

Antibacterial Activity of the Plant Extracts Using Agar Well Diffusion Method

The antibacterial activity of the plant extracts was evaluated using the agar well diffusion method. Mueller-Hinton agar (MHA) plates were prepared, and 100 µL of standardized MRSA inoculum (0.5 McFarland standard; approximately 1×10^8 CFU/mL) was evenly spread on the agar surface using a sterile swab. Wells of 6 mm diameter was punched into the agar using a sterile cork borer.

Each well was filled with 100 µL of plant extract at concentrations of 400, 300, 200, and 100 mg/mL. Plates was incubated at 37°C for 24 hours, and zones of inhibition measured in millimeters using a ruler. Positive control Ciprofloxacin (30 µg/mL) was used, and negative control was the respective solvent used for extraction. The experiment was conducted in triplicate to ensure reproducibility. Larger zones indicate stronger antibacterial activity (Gupta *et al*., 2019; Pandey *et al*., 2021).

Determination of Minimum Inhibitory Concentration (MIC)

MIC was determined using the broth microdilution method. Serial dilutions of the extracts was prepared in sterile nutrient broth to obtain concentrations of 200, 100, 50, 25, 12.5, and 6.25 mg/ml. 100 µL of bacterial suspension (1×10^8 CFU/mL) was added to each tube. Tubes was incubated at 37°C for 24 hours.The MIC is defined as the lowest concentration of extract that shows no visible bacterial growth. Turbidity was assessed visually by measuring optical density at 600 nm using a spectrophotometer. All tests was performed in triplicate (Cheesbrough, 2022; Salehi *et al*., 2020).

Determination of Minimum Bactericidal Concentration (MBC)

The MBC was determined by sub-culturing 100 µL from tubes showing no visible growth during MIC testing onto fresh Mueller-Hinton agar plates. Plates was then incubated at 37°C for 24 hours. The MBC is defined as the lowest concentration of extract that completely prevents bacterial growth on the agar plates, indicating bactericidal activity. The ratio of MBC to MIC was used to determine whether the extract is bacteriostatic (MBC/MIC >4) or bactericidal (MBC/MIC ≤4) (Cowan, 2019; Ibrahim *et al*., 2023).

Brine Shrimp Lethality Assay (Toxicity Profile)

The toxicity of the plant extracts was evaluated using the brine shrimp (*Artemiasalina*) lethality assay, a standard preliminary cytotoxicity test (Meyer *et al*., 1982; Rahman *et al*., 2022). Artificial seawater was prepared by dissolving 38 g of sea salt in 1 L distilled water, and 50 mg of brine shrimp eggs was hatched at 28°C under constant aeration for 48 hours and obtained active nauplii.

10 active nauplii was transferred into each test tube containing 5 mL seawater and plant extract at concentrations of 25, 50, 100, 200 mg/mL. Negative control was contained seawater only. After 24 hours of exposure, surviving nauplii was counted, and percentage mortality calculated. The lethal concentration (LC_{50}) was determined using probit analysis. Extracts with LC_{50} ≤100 µg/mL are considered highly toxic, 100–500 µg/mL moderately toxic, and >500 µg/mL non-toxic (Rahman *et al*., 2022).

GC–MS Analysis of the Most Active Extracts

The most active extracts, as determined by agar diffusion and MIC/MBC assays, was subjected to Gas Chromatography–Mass Spectrometry (GC–MS) analysis to identify bioactive compounds (Singh *et al*., 2023). About 5 mg of dried extract was dissolved in 1 mL HPLC-grade methanol and filtered through a 0.22 µm syringe filter.The sample was injected into a GC–MS system equipped with a capillary column. The oven temperature was programmed from 50°C to 280°C at a rate of 10°C/min, with helium as the carrier gas at 1

mL/min flow rate. Mass spectra was recorded in electron impact mode at 70 eV. Compounds was identified by comparing retention times and mass spectra with the NIST mass spectral library (Singh *et al*., 2023; Salehi *et al*., 2020).

Results and Discussion

Physical Properties of Crude Extracts of *Adansonia digitata*

The extraction process yielded varying quantities of crude extracts depending on the plant part and solvent used. The highest yield (15.6 g) was obtained from the ethanolic leaf extract, while the lowest yield (0.6 g) was recorded for the aqueous leaf extract. Methanolic stem bark extract yielded 14.8 g, indicating that organic solvents extracted more phytoconstituents than water. In terms of physical appearance, methanolic and ethanolic leaf extracts appeared green and gummy, whereas aqueous extracts were brown and powdery. The differences in colour and texture suggest variation in the chemical constituents extracted by each solvent Table 1.

Table 1: Physical Properties of Crude Extracts of *Adansonia digitata*

	Methanol		Ethanol		Aqueous	
Parameter	Leaf	Bark	Leaf	Bark	Leaf	Bark
Weight Extracted (g)	6.9	14.8	15.6	3.8	0.6	1.3
Colour	Green	Brown	Green	Dark Green	Brown	Brown
Texture	Gummy	Powdery	Gummy	Gummy	Powdery	Powdery

Phytochemical Composition of *Adansonia digitata* Leaf and Stem Bark Extracts

The phytochemical screening revealed the presence of several bioactive compounds in both leaf and stem bark extracts of *Adansonia digitata*. Alkaloids and saponins were detected in all extracts irrespective of solvent or plant part. Flavonoids were present in all leaf extracts and in aqueous stem bark extract but absent in methanolic and ethanolic stem bark extracts. Tannins and terpenoids were consistently detected in leaf extracts but absent in most stem bark extracts. Overall, the leaf extracts contained a broader spectrum of phytochemicals than the stem bark extracts Table 2.

Table 2: Phytochemical Components of *Adansonia digitata* Extracts

	Methanol		Ethanol		Aqueous	
Phytochemical	Leaf	Bark	Leaf	Bark	Leaf	Bark
Alkaloids	+	+	+	+	+	+
Flavonoids	+	-	+	-	+	+
Saponins	+	+	+	+	+	+
Tannins	+	-	+	-	+	-
Terpenoids	+	-	+	-	+	-

Keys: + = presence - = absence

Antibacterial Activity of Methanolic, Ethanolic and AqueousLeaf and Stem Bark Extracts against MRSA

The methanolic extracts exhibited concentration-dependent antibacterial activity against MRSA isolates. The leaf extract demonstrated greater antibacterial potency than the stem bark extract at all concentrations tested. At 400 mg/mL, the leaf extract produced the highest inhibition zone of 20.0 mm, while the stem bark extract produced an inhibition zone of 15.0 mm. Ciprofloxacin, used as the positive control, exhibited the highest activity with a mean inhibition zone of 28.0 mm. The ethanolic extracts demonstrated appreciable antibacterial activity against MRSA isolates. Similar to the methanolic extracts, the leaf extract showed greater inhibitory activity than the stem bark extract. The highest inhibition zone (23.0 mm) was recorded at 400 mg/mL for the leaf extract, while the bark extract produced a maximum inhibition zone of 17.0 mm. Overall, ethanolic extracts exhibited stronger antibacterial activity than methanolic extracts. The aqueous extracts from the table 4.6 exhibited antibacterial activity against MRSA isolates, although the activity was lower than those observed for methanolic and ethanolic extracts. The aqueous leaf extract produced inhibition zones ranging from 7.0 mm to 15.0 mm, while the aqueous bark extract produced inhibition zones ranging from 5.0 mm to 11.0 mm. increased extract concentration resulted in increased antibacterial activity. The aqueous leaf extract consistently demonstrated higher antibacterial activity than the corresponding bark extractTable 3.

Table 3: Methanolic, Ethanolic and Aqueous Extract Activity against Methicillin-resistant *Staphylococcus aureus*

	Methanol		**Ethanol**		**Aqueous**	
Concentration (mg/mL)	Leaf	Bark	Leaf	Bark	Leaf	Bark
100	11.0	8.0	13.0	9.0	7.0	5.0
200	14.0	10.0	16.0	12.0	9.0	7.0
300	17.0	12.0	19.0	14.0	12.0	9.0
400	20.0	15.0	23.0	17.0	15.0	11.0

Keys: mg/mL= Milligramper mil

Minimum Inhibitory Concentration (MIC) and (MBC) of *Adansonia digitata* Extracts against MRSA

The MIC values obtained revealed variations in antibacterial potency among the different extracts. The ethanolic leaf extract recorded the lowest MIC value of 25 mg/mL, indicating the highest antibacterial activity against MRSA. Conversely, the aqueous bark extract recorded the highest MIC value of 200 mg/mL, indicating comparatively weaker antibacterial activity. Overall, leaf extracts demonstrated lower MIC values than stem bark extracts, while ethanolic extracts performed better than methanolic and aqueous extracts. While The MBC values obtained revealed that the ethanolic leaf extract possessed the strongest bactericidal activity, with an MBC value of 50 mg/mL. The aqueous bark extract exhibited the weakest bactericidal effect, requiring 400 mg/mL to achieve complete bacterial killing. In general, MBC values followed a trend similar to the MIC values, with ethanolic extracts exhibiting stronger antibacterial activity than methanolic and aqueous extracts Table 4.

Table 4: Minimum Inhibitory Concentration and Minimum Bactericidal Concentration Values

Solvents	Extract	MIC (mg/mL)	MBC (mg/mL)
Ethanol	Leaf	25	50
	Bark	50	100
Methanol	Leaf	50	100
	Bark	100	200
Aqueous	Leaf	100	200
	Bark	200	400

Keys: MIC= Minimum Inhibitory Concentration, MBC= Minimum Bactericidal Concentration and mg/mL= Milligramper mil

Brine Shrimp Lethality Assay of *Adansonia digitata* Extracts

The brine shrimp lethality assay showed varying degrees of toxicity among the extracts. The ethanolic leaf extract exhibited the highest toxicity with 68% mortality and an LC_{50} value of 580 µg/mL, while the aqueous bark extract showed the lowest toxicity with 35% mortality and an LC_{50} value of 1450 µg/mL. Generally, ethanolic extracts demonstrated greater toxicity than methanolic and aqueous extracts. However, all extracts recorded LC_{50} values above 500 µg/mL, indicating relatively low toxicity levels Table 5.

Table 5: Brine Shrimp Lethality Assay

Extract	Mortality (%)	LC50 (µg/mL)
Ethanolic Leaf	68	580
Methanolic Leaf	61	720
Aqueous Leaf	42	1150
Ethanolic Bark	56	850
Methanolic Bark	49	980
Aqueous Bark	35	1450

GC–MS Analysis of the Most Active Extract

Eight major compounds were detected at retention times ranging from 8.23 to 23.84 minutes. Hexadecanoic acid methyl ester recorded the highest peak area (14.62%), followed by phytol (12.48%) and 9,12-Octadecadienoic acid methyl ester (11.37%). Other notable compounds indentified included Oleic acid methyl ester, Squalene, Vitamin E, β-Sitosterol, and Stigmasterol. The abundance of fatty acid esters, terpenoids, and phytosterols in the extrct suggests that these compounds may be responsible for the observed antibacterial activity against MRSA isolates and may contribute synergistically to the therapeutic potential of the *A. digitata*. The identified compounds are presented in Figure 1 and Table 6 respectively.

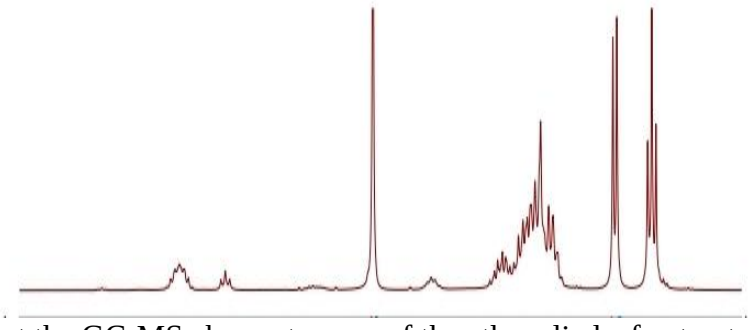


Figure 1: Represent the GC-MS chromatogram of the ethanolic leaf extract of *A. digitata*

GC–MS analysis of the ethanolic leaf extract revealed the presence of several biologically important compounds. Hexadecanoic acid methyl ester recorded the highest peak area percentage (14.62%), followed by phytol (12.48%) and 9,12-octadecadienoic acid methyl ester (11.37%). Other identified compounds included oleic acid methyl ester, squalene, vitamin E, β-sitosterol, and stigmasterol. These compounds are known to possess antimicrobial, antioxidant, anti-inflammatory, and pharmacological activities Table 6.

Table 6: GC–MS Compounds Identified

Retention Time	Compound	Formula	Peak Area (%)
8.24	Hexadecanoic acid methyl ester	C17H34O2	14.62
10.56	Phytol	C20H40O	12.48
12.31	9,12-Octadecadienoic acid methyl ester	C19H34O2	11.37
14.85	Oleic acid methyl ester	C19H36O2	9.84
17.26	Squalene	C30H50	8.56
19.13	Vitamin E	C29H50O2	7.91
21.47	β-Sitosterol	C29H50O	6.78
23.84	Stigmasterol	C29H48O	5.42

Discussion

The current research work established that *Adansonia digitata* leaves and stem bark extracts have phytochemical composition and antibacterial properties against MRSA. The outcomes of the extraction experiment revealed that there is variability in the quantity and physical attributes of the extracts depending on the part of the plant being used and the solvents. The highest yields were obtained from the ethanolic leaf extract (15.6 g) and methanolic stem bark extract (14.8 g), with the lowest being from the aqueous leaf extract (0.6 g). There was a difference in the yield because of the variation in the solvents used and plant part. The phytochemicals identified in the extracts include the presence of alkaloids and saponins in all the extracts, flavonoids in leaf and aqueous stem bark extracts, and tannins and terpenoids in the leaf extracts. This finding is consistent with other research findings such as the work done by Datsugwai and Yusuf (2018), who found the presence of alkaloids, saponins, flavonoids, tannins, and terpenoids in leaf and stem bark extracts of *A. digitata*. In another study carried out by Magashi and Abdulmalik (2018), a number of phytochemicals were found in the stem bark of *A. digitata*. The difference in the phytochemical components found in other studies could be linked to factors such as geographic location, growth stage of the plant, extraction solvent and method among others. The antibacterial findings revealed that all the extracts inhibited MRSA but differed in their degrees of activity depending on the solvent used, the plant parts, and the concentration. With increasing concentration of the extracts, there was a proportionate increase in the antibacterial activity, implying a concentration-dependent reaction. There were more inhibition zones created by the ethanolic extract of the leaves (23.0 mm at 400 mg/mL), followed by methanolic leaf extracts (20.0 mm at the same concentration).

The ethanolic and methanolic stem bark extracts had inhibition zones of 17.0 mm and 15.0 mm, respectively. There was minimum activity of the aqueous extracts, with inhibition zones of 15.0 mm for the leaf and 11.0 mm for the stem bark. The increased activity in leaf extracts than stem bark extracts might be linked to the presence of a diverse group of phytochemicals in leaves such as tannins and terpenoids. The increased activity of ethanol than methanol and water can be linked to the increased effectiveness of ethanol in the extraction of antibacterial components from A. digitata in the current research. These results are relatively similar to the research work by Datsugwai and Yusuf (2018) on the antimicrobial activity of methanolic and ethanolic extracts of *A. digitata* against various bacterial pathogens like S. aureus.

Magashiand Abdulmalik (2018) similarly found out that ethanolic stem bark extracts showed antibacterial activity against S. aureus among other bacteria. But the inhibition zones obtained were not similar in all cases as the values in this current study.This is because there can be many factors responsible for the variation in the inhibition zone size. Antibacterial activity was further confirmed by the results of the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Ethanolic leaf extract had the least MIC at 25 mg/mL and MBC at 50 mg/mL, hence more potent than other extracts tested. Ethanolic extract of stem bark had MIC and MBC at 50 and 100 mg/mL, respectively. Methanolic extracts of leaf and stem bark had MIC at 50 and 100 mg/mL and MBC at 100 and 200 mg/mL, respectively. Aqueous leaf and stem bark extracts had the least activity; they had MIC at 100 and 200 mg/mL and MBC at 200 and 400 mg/mL, respectively. These results imply that ethanolic leaf extract was the most potent preparation against MRSA.

In the brine shrimp lethality test, there were variations among the extracts with regard to preliminary toxicity. Ethanolic leaf extract was found to have the highest percentage mortality rate at 68% and LC_{50} at 580 µg/mL, while aqueous stem bark extract had the lowest percentage mortality rate at 35% and LC_{50} at 1450 µg/mL. LC_{50} for all the extracts was greater than 500 µg/mL, indicating lower toxicity in the preliminary test. The higher biological activity of ethanolic leaf extract might therefore be linked to its high antibacterial activity. However, the results of the brine shrimp test only provide preliminary data on the toxicity of the extracts. In GC–MS study on the most potent ethanolic leaf extract, eight main components were found. Among them, hexadecanoic acid methyl ester was found to be the highest with peak area of 14.62%, followed by phytol (12.48%) and 9,12-octadecadienoic acid methyl ester (11.37%). Some of other components included in the ethanolic leaf extract were oleic acid methyl ester, squalene, vitamin E, β-sitosterol, and stigmasterol. With the help of these components, a potential chemical basis of the antibacterial activity may be provided.

Conclusion

The results show that *Adansonia digitata*, especially the ethanolic extract from its leaves, can be a good source of antibacterial components that act against MRSA. However, since the experiments have been performed under in vitro conditions, and since the toxicity was only estimated preliminarily, the extract cannot be taken as an alternative to clinically tested antibiotics. It would be advisable to conduct further research to find and analyze the active components, study their mechanism of action, and perform thorough toxicological and pharmacological studies.

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