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Antibacterial Activity of Adansonia digitata Leaf Extract against Gastrointestinal Bacterial Isolates

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Abstract

Adansonia digitata (A. digitata), also known as baobab, is a traditional medicinal plant that has been shown to possess antibacterial properties. This study was carried out to determine the antibacterial activity of aqueous and ethanolic extracts of A. digitata leaves against Escherichia coli and Staphylococcus aureus isolated from the human gastrointestinal tract (GIT). The leaf extract was screened for its phytochemical constituents to evaluate the availability of active compounds. The leaves extract was subjected to antibacterial analysis by agar well diffusion method using different concentrations. The phytochemical screening revealed the presence of alkaloids, saponins, phenol, tannins and steroids. Ethanolic leaf extracts exhibited inhibitory effects against S. aureus (19±1.78 to 9.6±2.09mm) and E. coli (18.4±1.19 to 11.4±1.07mm) across concentrations of 100 to 12.5mg/ml. Aqueous extracts also showed activity with zones ranging from 13.5±2.00 to 6.3±0.3mm for S. aureus and 15.1±1.60 to 7.00±1.04mm for E. coli. The ethanolic leaf extract inhibited the growth of E. coli and S. aureus at a concentration of 12.5-50mg/ml with a minimum bactericidal concentration (MBC) at 25-50mg/ml. The aqueous leaves extract inhibited the growth of S. aureus and E. coli at a concentration of 25-100mg/ml with an MBC of 50-100mg/ml. The results indicate that Adansonia digitata ethanolic leaf extract has a higher level of bioactive components contributing to its strong antibacterial effect against the pathogenic bacteria. The antibacterial activity of Adansonia digitata leaves extract against E. coli and S. aureus. These findings support the need for standardised methods of extraction and processing to maintain consistency. Further research, including clinical studies and mechanistic evaluation, is warranted.

Keywords: Adansonia digitata, Phytochemical constituents, S. aureus and E. coli, Plant extracts antibacterial activity.

INTRODUCTION

Adansonia digitata (*A. digitata*), also known as baobab, originates from the *Malvaceae* family and is a splendid tree revered for its nutritional and medicinal values (Barakat, 2021). Globally, the tree is known for its high-value multipurpose (Musyoki *et al.*, 2022). The baobab tree is native to Africa and grows in the dry, hot grasslands of sub-Saharan Africa. The baobab tree, also known as kuka in the Hausa language of Nigeria, is used to make kuka soup. *A. digitata* tree indicates a very important profile of biochemical compounds that are beneficial to human health. In Africa, the different parts of the *A. digitata* tree, such as the roots, trunk, stem bark, leaves, pulp, and seeds, are used as traditional medicine in most parts of Africa for treating certain disease conditions. It has been introduced to many countries and is often used as an ornamental plant. The leaves are usually air-dried and stored for future use; other methods include grinding and sieving to fine powdered particles, which is the most common form found sold in various markets (Akwu *et al.*, 2019). *A. digitata* trees are usually very big, up to 25m in height, deciduous in nature, and can survive for many years and serve medicinal purposes to heal diseases, including many infectious conditions with great potential for treatment (Natheer *et al.*, 2012; Dzoyem *et al.*, 2017; Akwu *et al.*, 2019). Baobab leaves serve as a good source of proteins, and their infusions are utilised in the treatment of various diseases, such as diarrhoea, fever, inflammation, kidney disease, and asthma (Yusha'u *et al.*, 2010).

Phytochemicals, also known as plant (phyto) chemicals, cover a wide variety of compounds that are naturally occurring in plants (Huang *et al.*, 2016). The presence of phytochemicals in the African baobab fruit enhances its characteristic colour, aroma, and flavour, and

prevents the invasion of predators (Kumar, 2019). Most of these phytochemicals serve as antioxidants capable of protecting the cells of the body from external oxidative damage from water, food, and air (Bellary *et al.*, 2021). The antibacterial efficacy of *A. digitata* could be attributed to the availability of different constituents of phytochemicals like alkaloids, flavonoids, saponins, tannins, terpenoids, reducing sugar and steroid (Yusha'u *et al.*, 2010). Several studies have been conducted, revealing the presence of useful bioactive constituents. The *A. digitata* tree is considered emblematic and essential in traditional medicine in Africa and India (Bellary *et al.*, 2021).

E. coli is a Gram-negative bacterium that usually resides in the gastrointestinal tract of humans and animals. A versatile microorganism that exhibits various characteristics and plays a vital role in the ecosystem. While the majority of *E. coli* strains remain harmless and sometimes beneficial, certain pathogenic strains can lead to significant illnesses (Ramos *et al.*, 2020). Certain strains of *E. coli* have gained notoriety for their pathogenic nature and association with various clinical manifestations. These pathogenic strains of *E. coli* possess specific virulence factors that enhance their ability to cause infections and diseases in humans. Several virulent strains of *E. coli* can cause diarrhoea, stomach, gastroenteritis, urinary tract infections, and neonatal meningitis, while in some cases, virulent strains are also responsible for haemolytic-uremic syndrome (HUS), peritonitis, mastitis and septicemia (Seth, 2011). The commonest human site affected by *E. coli* infection is the gastrointestinal tract (GIT), where pathogens ingested with food and drink reside. The incidence of GIT infections depends on a variety of factors, including personal hygiene, food hygiene and environmental temperature. *E. coli* strains that lead to diarrheal illness are grouped into specific classes based on virulence factors, mechanism of pathogenicity and clinical syndrome. There are five classes or varieties of *E. coli*, which are usually recognised as causative agents of these diarrheal diseases, including enterotoxigenic *E. coli* (ETEC), enteroinvasive *E. coli* (EIEC), enteropathogenic *E. coli* (EPEC), enteroaggregative *E. coli* (EAggEC) and enterohemorrhagic *E. coli* (EHEC) (Doughari *et al.*, 2011)

Staphylococcus belongs to the genus of Gram-positive bacteria that is frequently present on the skin surfaces and mucosal membranes of humans and animals. *Staphylococcus* bacteria are characterised by their ability to form clusters resembling grapes when observed under a microscope. Among the *Staphylococcus* species, *Staphylococcus aureus* is the most clinically significant and well-known (Nocera *et al.*, 2021). *S. aureus* is a versatile bacterium which colonises various body sites, such as the skin, nose, throat, and gastrointestinal tract. It is a commensal bacterium in many individuals, meaning it can coexist harmlessly without causing any symptoms or diseases. However, under certain circumstances, *S. aureus* can become pathogenic and cause a range of infections (González-García *et al.*, 2021). *S. aureus* is a versatile pathogen that causes a wide range of infections of the skin and soft tissue infections, such as boils, abscesses, and cellulitis. Additionally, it can cause more severe infections, including pneumonia, bloodstream infections, and wound infections. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain that is resistant to many commonly used antibiotics, making it more challenging to treat (Brandt *et al.*, 2018).

Antibiotic resistance is widely considered a serious global public health problem (Nawaz *et al.*, 2020). When bacteria no longer respond to antibiotics, treatment will become more costly, spread will be faster, and panic will be created all around the world (Abbasi *et al.*, 2015). The issues of antibiotic resistance are growing fast due to the ability of the organisms to evolve, transmit and acquire plasmids or other genetic material that encodes for antibiotic resistance from other bacteria (Nazneen *et al.*, 2014). Both environmental and clinical antibiotic-resistant organisms, such as *Salmonella* Typhi, *Pseudomonas aeruginosa*, *E. coli*, *S. aureus* and *Enterobacter aerogenes* have been discovered due to the excessive misuse of antibiotics (Shoba *et al.*, 2012). The organisms have been known to be opportunistic pathogens and have been implicated in so many infections that include pneumonia, urinary tract infections, septicemia and other infections of the soft tissues in hospitalised and immunosuppressed patients (Moriel *et al.*, 2010). Therefore, the main aim of this research is to determine the antibacterial activity of *A. digitata* against *Staphylococcus aureus*, *Esherichia coli*, *Bacillus subtilis*. The extract can also be used in traditional medicine for its various health benefits, e.g., to treat fever caused by malaria (Kaboré *et al.*, 2011).

MATERIALS AND METHODS

Plant sample collection and preparation

Fresh leaves of *Adansonia digitata* were collected from Kaduna South Local Government Area of Kaduna State during early morning hours. The plant sample was subsequently taken to the Botany section, Department of Biological Sciences, Kaduna State University, for proper identification and authentication. A voucher specimen was deposited, and the plant was assigned voucher number (KASU/BSH/988).

Extraction of the *A. digitata* leaves.

The extraction of *A. digitata* leaf material was carried out following the procedure described by Tiwari *et al.* (2011). For ethanol extract, 100g of powdered leaves were suspended in 500ml of 70% ethanol in a sterile conical flask. For aqueous extract, the same quantity of powdered leaves was soaked in 1500ml of distilled water. Both mixtures were stirred thoroughly and allowed to stand for three days with intermittent shaking to enhance the solubilization of phytochemicals. After maceration, the ethanol mixture was filtered using Whatman No.1 filter paper, while the aqueous mixture was filtered using muslin cloth. Each filtrate was concentrated by evaporating the solvent in a water bath at 40℃. The dried extracts were stored in airtight containers until further use.

Phytochemical Screening of *A. digitata* Leaf Extracts

Phytochemical screening was conducted to determine the active compounds in *A.digitata* leaf extracts, following the procedure outlined by Ogbeba *et al.* (2017). The screening covered several important metabolites. To test for alkaloids, a small portion of the extract was heated in dilute hydrochloric acid and treated with Mayer's reagent, resulting in a turbid precipitate that confirmed their presence. For flavonoids, the extract was dissolved in a sodium hydroxide solution; the yellow colour that turned colourless after acid addition indicated flavonoid content. The presence of saponins was evident from a stable foam that formed when the extract was vigorously shaken in water. Steroids were confirmed through a visible colour change from violet to green or blue upon adding concentrated sulfuric acid, in testing for glycosides, a green-black precipitate formed after ferric chloride was added to an aqueous solution of the extract. Lastly, the presence of tannins was verified by adding ferric chloride, which produced a blue hue for gallic tannins and a greenish-black tone for tannins.

Collection and reconfirmation of clinical isolates

The test organisms of *E. coli* and *S. aureus* isolated from Gastrointestinal tract infection patients were obtained from the Department of Microbiology Laboratory in Kaduna State University. The media were prepared according to the manufacturer's instructions. Mannitol salt Agar (MSA) was used to inoculate colonies of *S. aureus,* Eosine Methylene Blue Agar (EMB) was used to inoculate colonies for *E. coli, and* Muller Hinton Agar was used to inoculate colonies for antibiotic susceptibility testing, MBC and MIC determinations. The resulting colonies were Gram-stained and further reconfirmed using biochemical tests such as catalase, coagulase, oxidase, citrate utilisation, indole and Voges-Proskauer (Cheesbrough, 2009).

Preparation of 0.5 McFarland Standard and standardisation of inoculum

One per cent (1%) of Sulphuric acid was mixed by adding 1ml of concentrated H2SO4 into 99ml of water. Barium chloride ($BaCl_2$) of 1%was also prepared by dissolving 0.5g of dehydrated barium chloride in 50ml distilled water. 0.5ml barium chloride solution was added to 9.5ml of sulphuric acid solution to yield 10% barium sulphate suspension. The turbid solution formed was transferred into a test tube as the standard for comparison (Cheesbrough, 2018). Oyeleke and Manga's (2008) method was adopted to standardise the organisms. The isolates being tested were streaked on Mueller-Hinton Agar (MHA). Colonies from the overnight grown culture on the MHA were inoculated into a test tube containing Mueller Hilton broth until the turbidity was equivalent to the density of 0.5 McFarland standard (1.5×10^8 CFU/ml).

One gram (1g) of the extract was weighed and dissolved in 10ml of 10% Dimethyl Sulfoxide (DMSO) in a test tube to have 100mg/mL as the stock concentration. 5ml was dispensed from the stock solution into a tube containing 5mL of 10% DMSO, resulting in a concentration of 50mg/ml. 5ml was dispensed from the second test tube into the third tube containing 5ml of 10% DMSO to give a concentration of 25mg/ml. From the third test tube, 5ml was dispensed to the fourth tube to get a concentration of 2.5mg/mL. Ciprofloxacin was used as a positive control (Cheesbrough, 2018).

Determination of antibacterial activity using agar well diffusion assay

The agar well diffusion technique, as described by Ajijolakewu and Awarun (2015), was adopted with slight modification to determine the antibacterial activities of the extracts. 0.1ml of the respective standardised inoculum was spread on a sterile Mueller Hinton agar plate, using a sterile swab stick. A sterile 4mm diameter cork-borer was used to bore 5 wells at different concentrations, in addition to an extra one which served as a positive control. 0.1 ml of each extract concentration (100, 50, 25, and 12.5mg/ml) was introduced into the wells. The plate was allowed to stand on the laboratory bench for 1 hour for proper diffusion of the extract into the medium. The plate was incubated at 37℃ for 24hours. Ciprofloxacin was used as the positive control. Using a ruler, the zones of inhibition were observed and measured at the end of the incubation period around the agar well.

Determination of Minimum Inhibitory Concentration (MIC)

The method of Ali *et al*. (2017) was used to determine the MIC of the extract using the broth dilution technique. Two-fold serial dilution of the extracts was prepared by adding 5mL of 100mg/mL of the extract into a test tube containing 5mL of Mueller-Hinton broth and mixing vigorously to produce a solution of 100mg/mL of the extract. The process was repeated serially up to the fourth test tube, and then the last 5ml was discarded, leaving equal volume in the tubes, producing the concentration of 100, 50, 25, and 12.5mg/mL. The fifth test tube does not contain extracts, which serve as the negative control. 0.5ml of 0.5MacFarland standards of the test organisms was introduced into the test tubes and incubated at 37℃ for 24 hours. The test tubes were observed for turbidity. The least concentration with no turbidity was taken as the MIC.

Determination of Minimum Bactericidal Concentration (MBC)

According to Ali *et al*. (2017), the MBC of the extract was performed to determine if the test isolates in the test tubes without turbidity were inhibited or killed. Aseptically,0.1ml was transferred from tubes with different concentrations that showed no turbidity onto the solidified Mueller-Hinton agar medium. Then the test tubes were incubated at 37℃ for 24 hours. The MBC was recorded as the lowest concentration of the extract that resulted in less than 99% growth on the agar plates.

RESULTS

Physical characteristics of ethanol and aqueous leaf extract of *A.digitata*.

A hundred (100g) each of coarse leaf extract was used for the extraction using ethanol and aqueous. The ethanol extract of the leaf showed characteristics of green with a gummy texture, and that of the aqueous extract was brown with a loose texture (Table 1). For ethanol, the weight of extract recovered was 20.8 g, while aqueous was 38.7g

Phytochemical Constituents of the Leaf Extract of *A. digitata*

The phytochemical constituent of *A. digitata* leaf extracts indicates positive (detected) or negative (not detected) of each compound, as shown in Table 2. These include: tannins, saponins, alkaloids, phenols, steroids, phyto-steroids and quinones.

Microscopy and Biochemical Identification of the Isolates.

Biochemical tests and Gram staining of each isolate are depicted in Table 3. The Gram reaction of *S. aureus* isolates was all Gram-positive, clustered Cocci. Isolates of *E. coli* appear to be gram-negative rod-shaped (bacillus). The biochemical test confirmed that *S. aureus* isolates were catalase, coagulase, citrate, VP and MR positive but indole negative. *E. coli* is catalase, indole, MR positive, but coagulase, VP, and citrate negative.

Antibacterial activity of *A. digitata*leavesextract against clinical isolates

The antibacterial activity of *Adansonia digitata* leaf extracts against *Staphylococcus aureus* and *Escherichia coli* at varying concentrations is presented in Table 4. The highest zone of inhibition (19.4±1.78mm) was recorded at 100mg/ml for both ethanol and aqueous extracts, while the lowest activity (6.3±0.3mm) was observed at 12.5mg/ml. In comparison, the standard antibiotic control (Ciprofloxacin) exhibited the strongest antibacterial effect, with inhibition zones ranging from 23±1.9mm to 17.4±4.8mm against all the tested isolates.

Table 1: Physical Characteristics of Ethanol and Aqueous Leaf Extract of *Adansonia digitata*

Solvent	Initial weight of sample (g)	Weight of extract recovered (g)	Extract appearance
Ethanol	100g	20.8g	Green with a gummy texture
Aqueous	100g	38.7g	Brown with loose texture

Table 2: Phytochemical Constituents of ethanol and aqueous extracts of *A. digitata*

Phytochemicals	Ethanol Extract	Aqueous Extract
Tannins	+	+
Flavonoids	+	+
Saponins	+	+
Alkaloids	+	-
Glycoside	-	-
Phenol	+	+
Terpenoids	+	+
Steroids	+	-
Phyto-steroids	+	-
Phlobatannin	-	-
Quinones	-	-

KEY: += detected, - = not detected

Table 3: Microscopy and Biochemical Identification of the Isolates.

Isolates code	Gram reaction	shape	Catalase	Coagulase	Indole	Methyl-red	Voges-proskauer	Citrate
Stp1	+	Cocci	+	+	-	+	+	+
Stp2	+	Cocci	+	+	-	+	+	+
Stp3	+	Cocci	+	+	-	+	+	+
Stp4	+	Cocci	+	+	-	+	+	+
Stp5	+	Cocci	+	+	-	+	+	+
Eco1	-	Rod	+	-	+	+	-	-
Eco2	-	Rod	+	-	+	+	-	-
Eco3	-	Rod	+	-	+	+	-	-
Eco4	-	Rod	+	-	+	+	-	-
Eco5	-	Rod	+	-	+	+	-	-

Keys: Stp= *Staphylococcus aureus*, Eco= *Escherichia coli*,+ =POSITIVE, - =NEGETIVE,

Table 4: Antibacterial activity of *A. digitata* leaf Extract against Clinical isolates

Isolate	ZI concentration (mg/ml)	Ethanol Extract (mm)	Aqueous Extract (mm)
S. aureus	100	19.4±1.78	13.5±2
	50	16.8±1.82	10.6±2.38
	25	13.1±2.04	9.3±2.3
	12.5	9.6±2.09	6.3±0.3
Control(Ciprofloxacin)	100	22.5±2.05	17.4±4.08
E. coli	100	18.4±1.19	15.1±1.6
	50	15.2±1.03	11.4±1.07
	25	12.7±1.60	9.6±2.07
	12.5	11.4±1.07	7.00±1.04
Control(Ciprofloxacin)	100	23±4.06	20.5±1.09

Keys: ±= Standard Deviation, mg/ml= milligram per mile, mm= milimetre.

MIC and MBC of the leaf extract

The MIC shows that the extracts were able to prevent the growth of the isolates at a concentration range between 12.5mg/ml-50mg/ml, and the Bacterial concentration (MBC) was 50mg/ml to 100 mg/ml (Table 5). The ethanolic leaf extract inhibited the growth of *E. coli* and *S. aureus* at a concentration of 12.5-50mg/ml with a minimum bactericidal concentration (MBC) at 25-50mg/ml. The aqueous leaves extract inhibited the growth

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of *S. aureus* and *E. coli* at a concentration of 25-100mg/ml with an MBC of 50-100mg/ml.

Table 5: Minimum Inhibitory Concentration and Minimum Bactericidal Concentration of the Extract

Isolate code	Solvent	MIC	MBC
Eco1	Ethanol	25	50
	Aqueous	50	50
Eco2	Ethanol	12.5	25
	Aqueous	25	50
Eco3	Ethanol	12.5	25
	Aqueous	50	50
Eco4	Ethanol	25	50
	Aqueous	100	-
Eco5	Ethanol	25	50
	Aqueous	50	100
Stp1	Ethanol	25	50
	Aqueous	100	-
Stp2	Ethanol	25	50
	Aqueous	50	100
Stp3	Ethanol	50	50
	Aqueous	50	-
Stp4	Ethanol	50	50
	Aqueous	50	-
Stp5	Ethanol	50	50
	Aqueous	50	-

Keys: Stp= *Staphylococcus aureus*, Eco= *Escherichia coli*, - = no growth

DISCUSSION

The physical characteristics of ethanol and aqueous leaves extract of *A. digitata* are influenced by the solvent properties, extraction method and phytochemical composition of the plant material. The green colour of ethanol extract is likely due to the presence of chlorophyll, which is a green pigment found in plants. Ethanol tends to retain more chlorophyll than aqueous extract, similar to that obtained by another researcher (Manyarara *et al.*, 2013). The presences of the polar compounds contribute to the gummy texture, such as flavonoids, phenolic. These compounds are more soluble in ethanol than in water, resulting in a viscous and sticky texture. The brown colour of the aqueous extract is likely due to the presence of phenolic compounds, which can undergo oxidation reactions, leading to the formation of brown pigments. The loose texture of the aqueous solution is attributed to the lower solubility of polar compounds in water compared to ethanol, resulting in a less viscous and powdery texture (Mahmud *et al.*, 2023).

The phytochemical analysis result of ethanol and aqueous extract of the leaves of *Adansonia digitata* indicates the presence of secondary metabolites such as flavonoids, alkaloids, tannins, saponins and phenols. The appearance of the flavonoids in this research shows that the naturally occurring phenolic compounds have a beneficial effect in the human diet as antioxidants and neutralising free radicals (Ajiboye *et al.*, 2020). Phenol usually exhibits broad-spectrum activity, including antibacterial, antiviral, and antifungal properties. They can disrupt the bacterial cell membrane, interfere with metabolic processes, and prevent the growth of microorganisms. This metabolite has been reported to possess antibacterial activity of *A.digitata* leaf extract against *E.coli* and *S. aureus* at different concentrations. Agbafor and Nwachukwu (2011) indicated that phytochemicals such as alkaloids, saponins, flavonoids, tannins and terpenoids are mainly bioactive chemical components that could be responsible for various antibacterial activities in the plant, hence they provided the need for the development of drugs by pharmaceutical companies.Terpenoids are usually found to be useful in the preventive and therapeutic processes of several diseases, including cancer. Terpenoids are mainly known to have antibacterial, antifungal, antiparasitic, antiviral, anti-allergenic, antispasmodic, anti-hyperglycemic, anti-inflammatory and immune modulatory properties. The presence of flavonoids in the extract serves as a potent water-soluble antioxidant and free radical scavenger that protects the oxidative cell from damage and also curtails anticancer activity. It provides assistance in managing diabetes induced oxidative stress. In various pharmacies, steroids are important as they contain compounds like sex hormones, which are commonly used for drug production (Ajiboye *et al.*, 2020). Tannin and saponin were detected in the extract. Saponins provide protection against hypercholesterolemia and have antibiotic properties. They also possess antitumor, antioxidant and anti-mutagenic activities that can lower the possible risk of cancers in humans through preventing the growth of cancerous cells (Amin *et al.*, 2013).

The gram staining performed in this research shows that the clinical isolates of *E. coli* were Gram-negative, while those of *S. aureus* were Gram-positive. This differentiation is crucial in understanding the antibacterial activity of *Adansonia digitata* leaf extract, as gram-negative bacteria have an outer membrane containing lipopolysaccharides, which may affect the permeability of the extract's

bioactive compounds (Kohlerschmidt *et al.*, 2021).

The antibacterial activity of *Adansonia digitata* leaf extracts against *S. aureus* and *E. coli* isolates at different concentrations provides important information on the effectiveness of the plant extracts as potential antimicrobial agents. The highest zone of inhibition for both the ethanol and aqueous extracts was observed at a concentration of 100 mg/ml, where the zone of inhibition was 19.4±1.78 mm. This suggests that at higher concentrations, both extracts were highly effective in preventing the growth of *S. aureus* and *E. coli*. This outcome aligns with the general observation that the antibacterial activity of plant extracts typically increases with higher concentrations of the extract (Ajiboye *et al.*, 2020). The least sensitivity was observed at the lowest concentration of 12.5 mg/ml, with inhibition zones for both isolates (*S. aureus* and *E. coli*). This reduction in antibacterial activity at lower concentrations may indicate that the bioactive compounds are present in insufficient quantities to effectively disrupt bacterial growth or cell wall integrity. The antibacterial activity of the extracts was observed to be enhanced by an increased in the corresponding concentration of the extracts. This is in agreement with the work of Abdullah and Mohammed (2019), i.e, the higher the concentration of the plant extract, the greater the zones of inhibition. The ethanolic extract shows more antibacterial activity than the aqueous which could be attributed to the fact that ethanol is an organic solvent that can extract more phyto-constituents than aqueous. However, this finding contradicts the work of Magashi and Abdulmalik (2018), where they revealed that ethanolic extract has higher solubility for more bioactive compounds, thus, having the greatest antibacterial activity, which is due to a high content of potent, synergistically acting phytochemicals, extracted efficiently by the solvent. A broad-spectrum antibiotic, ciprofloxacin, used as a control, showed higher antibacterial activity on the tested isolates than the plant extracts. The antibiotics are mainly well-refined industrial products with a broader-spectrum activity than some of the crude extracts. If the extracts used in the present work are refined, more and better activity could be achieved (Abalaka *et al.*, 2010).

The MICs of the extracts were determined on all the test organisms. The MBC results showed that the leaf extracts were very active even at lower concentrations against the clinical human isolates. This suggests that the plant possesses potent bioactive compounds capable of inhibiting pathogenic bacteria even at low concentrations. The antibacterial activity of the leaf extract may be attributed to the synergistic interaction of multiple phytochemicals present in the crude extract. (Ajiboye *et al.*, 2020).

CONCLUSION

Adansonia digitata leaf extracts contain potent bioactive phytochemicals including alkaloids, saponins, flavonoids, phenol, tannin and terpenoids, which contribute to its significant antibacterial activity. The bacterial isolates of *E. coli* and *S. aureus* were reconfirmed using Gram staining and biochemical tests. Various concentrations (100, 50, 25, 12.5mg/ml) of the leaf extracts were tested against the specified organisms, and the outcome revealed the notable growth inhibition for *E. coli* and *S. aureus* organisms. The MIC activity of the extracts against the test isolates was revealed at the higher concentration of 100mg/mL; the ethanol and aqueous extracts inhibit the growth of the isolates, signifying the antibacterial activity of the plant with therapeutic effect on the treatment associated with the human gastrointestinal tract.

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