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Research Article

Phytochemical Screening and Comparative Study of the Antimicrobial Activity of n-Butanol and Ethyl Acetate Fractions of *Isoberlinia tomentosa* Stem Bark Extract

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Abstract

Isoberlinia tomentosa, a medicinal plant commonly found in the southern part of Borno State, Nigeria, has been traditionally used to treat various ailments, including diarrhea, malaria, rheumatic fever, strep throat, urinary tract infections, vaginal yeast infections, and dysentery. This research aimed to assess the in vitro antimicrobial activity and phytochemical composition of the ethyl acetate and n-butanol portions of *Isoberlinia tomentosa* stem bark extracts. The plant-based chemical analysis showed that the n-butanol portion contained flavonoids, cardiac glycosides, terpenoids, tannins, saponins, and carbohydrates. In contrast, the ethyl acetate portion contained tannins, carbohydrates, terpenoids, flavonoids, cardenolides, and cardiac glycosides, but no saponins were detected. Notably, anthraquinone glycosides and alkaloids were also not detected. The antimicrobial screening demonstrated that *Isoberlinia tomentosa* exhibited significant inhibitory activity against certain test organisms. Specifically, the ethyl acetate portion (500 mg/mL) showed pronounced inhibition against Streptococcus pyogenes, Salmonella typhi. and Staphylococcus aureus, Furthermore, the n-butanol portion (500 mg/mL) exhibited broad-spectrum inhibition against all tested bacteria and fungi, including Salmonella typhi Staphylococcus aureus, Bacillus subtilis Streptococcus pyogenes, Escherichia coli,, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Candida albicans. These results imply that the stem bark extract of *Isoberlinia tomentosa* has antibacterial and antifungal properties, affirming its historical application in treating various illnesses.

Keywords

Isoberlinia tomentosa, Phytochemical Screening, Antimicrobial, *in vitro*, Microorganisms

1. Introduction

Due to the growing use of herbal preparations in human healthcare systems, interest in the use of medicinal plants to treat illnesses has recently increase [2].

The use of medicinal plants is becoming more and more popular. Because they deliver vital services that sustain life, plants are important to ecosystems. The significance of plants

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cannot be overstated, as humans and other living organisms rely on them for survival. Medicinal herbs, in particular, serve as indicators of ecosystem health. Utilizing medicinal plants has been practiced since ancient times, with evidence of their utilization found in various cultures, including China, India, Egypt, and Greece. Within traditional medicine, plants were employed for their therapeutic properties, and their use has been well-documented throughout history. The reliance on plants for healthcare is rooted in the human experience, with plants being the primary source of treatment for various diseases. This historical context underscores the importance of therapeutic plants in human medicine.

Plant extracts are the primary source of traditionally used crude drugs, yielding a wealth of information on the therapeutic potential of plant species. This knowledge base renders plants a crucial starting point for drug discovery initiatives. Notably, the diverse anatomical parts of plants, including roots, leaves, and flowers, often produce unique metabolite profiles. Therefore, botanical expertise is indispensable for the precise taxonomical identification of bioactive plants [12].

In Asia, Africa, and Latin America, traditional medicine is widely used to address basic healthcare needs. In developed countries, where it is commonly referred to as complementary or alternative medicine, its popularity is rapidly growing. The term complementary and alternative medicine (CAM) describes medical systems, procedures, and goods that are not included in conventional medicine, according to the National Institutes of Health (NIH). Oriental medicine, which generally refers to Chinese, Japanese, and Korean medicines, is currently practiced in the majority of countries.

Medicinal plants represent the most frequently used therapy in conventional medical systems [1]. The World Health Organization (WHO) reports that more than 80% of people worldwide use traditional medicine, mainly plant-based, for their essential medical requirements [15]. Despite the prevalence of synthetic medication, medicinal plants are increasingly recognized for their importance, and public confidence in their use is growing [15]. Many conventional drugs, such as aspirin, digoxin, and quinine, have been developed from plant-based traditional medicines [16]. With an estimated Half of the medications on the market are made from medicinal plants, these natural remedies hold promise for future medical discoveries [16]. Although the use of medicinal plants has been around for a while, using whole plants or raw supplies can be problematic due to variations in compound composition, synergistic effects, and potential adverse reactions. Isolating bioactive compounds and using pure substances can offer several benefits, including standardized quality control and more accurate assessments of therapeutic effects [1].

The development of herbal medicines has been closely tied to advances in chemistry, enabling the seclusion, purification, and plant characterization compounds. Historically, discovering bioactive substances derived from plant sources and determining their frameworks was a difficult and time-consuming procedure. But recent breakthroughs in precision instruments, such as nuclear magnetic resonance (NMR) spectroscopy and high-performance liquid chromatography-mass spectrometry (HPLC/MS), have significantly accelerated the rate of bioassay-guided fractionation [17]. Despite progress in medicinal plant research, upcoming initiatives face numerous difficulties ensuring the standard of herbal products is crucial, and standardizing one major concern for the plant industry is raw materials. [18]. Herbal drugs are susceptible to pollutant and contaminated, particularly involving heavy metals. Therefore, improving the quantity and quality of bioactive substances in herbal drugs while discovering new ones is essential [1]. Given the growing utilization of natural substances worldwide, comprehensive studies on the safety and quality of medications made from plants are necessary to provide reliable information for healthcare applications [14]. The hunt for novel medications has intensified because the rise of infectious illnesses and antimicrobial resistance. Plants have served as a significant source of inspiration for therapeutic compounds, owing to their diverse bioactive attributes. These substances, which include saponins, tannins, and flavonoids, alkaloids, glycosides, and phenolics, can be applied to prevent and cure a variety of illnesses and infections [13].

Isoberlinia tomentosa is a hardwood tree species native to the tropical savannas and dry forests of Africa. Previously underappreciated, this tree is now recognized for its potential medicinal properties, particularly its antidiarrheal activity, which has been validated by scientific studies and traditional healers in the Amuda community. The purpose of this study was to investigate the antimicrobial attributes of *Isoberlinia tomentosa* stem bark extract. The *Isoberlinia* genus, belonging to the Leguminosae family, comprises African tree species that thrive in woodlands and tree-savannas. In Benin, two species of *Isoberlinia* have been identified: *Isoberlinia doka*, which grows on clay and well-drained soils, and *Isoberlinia tomentosa*, which grows on stony and sloping soils. To ensure the sustainability of *Isoberlinia* stands, effective management strategies are necessary, particularly in protected areas like the Amuda Forest Reserve.

2. Materials and Procedures

2.1. Gathering and Identifying Samples

The fresh stem bark of *Isoberlinia tomentosa* was gathered from Amuda, Gwoza Local Government, Borno State, Nigeria, and verified by a plant taxonomist. The sample was allowed to dry in the shade manually cleaned to remove foreign materials, and pulverized using a wooden pestle and mortar.

Plant Extraction

In a round-bottom flask, 1000 grams (1000 g) of the dried

stem bark of *Isoberlinia tomentosa* was ground up and macerated in absolute methanol for 72 hours at 25 ℃ with periodic shaking. After removing any vegetative debris from the soaked sample using a muslin cloth, the extract was filtered through Whatman No. 1 filter paper. After being dried out at 25 ℃, the crude extract was weighed, labeled, and examined further. Using the dry technique, 60 grams (60 g) of the crude extract were separated into ethyl acetate and n-butanol according to their polarities.

2.2. Phytochemical Screening of Ethyle Acetate and n- Butanol Portion of *Isoberlinia tomentosa* Stem Bark Extract

Preliminary phytochemical screening of the ethyle acetate and n-Butanol portion of the *Isoberlinia tomentosa* stem bark were conducted to ascertain whether carbohydrates, tannins, terpenes, flavonoids and steroids and resins using standard procedures as reported by Evans (2009).

2.2.1. Check for Carbohydrates

Each extract that had been dissolved in distilled water received a few drops of Molisch's reagent. One milliliter of concentrated tetraoxosulphate (VI) acid (H_2SO_4) was then added to the test tube's side, causing a layer to form underneath the aqueous layer. After letting the mixture stand for two minutes, five milliliters of distilled water were added to dilute it. A positive test is indicated by the development of a red or muted violet color at the interface between the two layers. [3].

(i). Check for (Fehling's Test) Free Reducing Sugar

Distilled water was used to dissolve 0.2g of each extract, which was then filtered. Five milliliters of Fehling's solution A and B in equal volumes were added to the filtrate to heat it. The presence of reducing sugar was indicated by the formation of a red cuprous oxide (Cu_2O) precipitate. [3]

(ii). Check for Combined Reducing Sugars

Five milliliters of diluted hydrochloric acid were used to hydrolyze each 0.2g extract, and the resulting solution was neutralized with sodium hydroxide solution. It was heated on a water bath for two minutes after a few drops of Fehling's solution were added. The presence of combined reducing sugars is indicated by the formation of a reddish-brown cuprous oxide precipitate. [3].

(iii). Standard Check for Ketoses (Salivanoff's Test)

A small amount of each extract was mixed with a few resorcinol crystals and two milliliters of hydrochloric acid, and the mixture was then brought to a boil for five minutes. It was believed that a red coloring indicated the presence of ketones. [7].

(iv). Check for Pentoses

One milliliter of hydrochloric acid and a small amount of phloroglucinol were added to a small amount of the extract each. Pentoses are present when the mixture is heated over a low flame and turns red. [7].

(v). Check for Soluble Starch

One milliliter of 5% potassium hydroxide (KOH) was used to boil a small amount of each extract. It was then cooled and acidified with H_2SO_4. According to [7], the presence of soluble starch was indicated by a yellow coloring.

2.2.2. Check for Tannins

Before being filtered, each extract (0.5g) that was going to be tested was mixed with roughly 10 ml of distilled water. The following tests were conducted using the filtrate:

A few drops of 1% ferric chloride solution were added to 2 milliliters of the filtrate; the presence of tannins is indicated by the formation of a blue-black, green, or blue-green precipitate.

Two milliliters of the filtrate were mixed with equal parts of 10% lead ethanoate. The presence of tannins was indicated by the formation of a white precipitate.

Each extract's filtrate was boiled with three drops of 10% HCl and one drop of methanol; the presence of tannins was indicated by the red precipitate that formed [3].

2.2.3. Check for Phlobatannins

A tiny quantity of extract was boiled with distilled water, filtered, and then boiled with 1% aqueous HCl. Phlobatannins are indicated by the formation of a red precipitate [3].

2.2.4. Check for Glycosides

(i). Check for Free Anthroquinones (Borntrager's Test)

Ten milliliters of benzene were shaken with each 0.5g plant extract that was to be tested, and the mixture was filtered. The filtrate was mixed with five milliliters of the 10% ammonia solution. After shaking the mixture, the presence of free anthraquinones was determined by looking for a pink, red, or violet color in the ammoniacal (lower) phase [3].

(ii). Check for Combined Anthraquinones (Borntrager's Test)

A red coloring in the ammoniacal (lower) phase indicated the presence of combined anthraquinones. Each plant extract (0.5 g) was shaken with 10 ml of aqueous H_2SO_4 and then filtered while hot. The filtrate was shaken with 5 ml of benzene; the benzene layer separated and half its own volume of 10% ammonia solution was added [3].

2.2.5. Cardiac Glycosides

(i). Salkowski's Check

Two milliliters of chloroform were used to dissolve each of the 0.5 g of extracts that were being studied. To create a lower layer, tetraoxosulphate (VI) acid was cautiously added to the test tube's side. The presence of methylated sterols or a steroidal ring (i.e., the aglycone portion of cardiac glycoside) was indicated by the interface appearing reddish-brown or yellow [5].

(ii). Liebermann-Burchard's Test

2 milliliters of acetic anhydride were added to 0.5 grams of each extract, and after it had dissolved, it was thoroughly chilled in ice. Carefully added concentrated tetraoxosulphate (VI) acid, the extract's color changed from violet to blue or bluish-green, indicating the presence of a steroidal ring, or the aglycone portion of cardiac glycoside [5].

2.2.6. Terpenoids

A small amount of the extract was dissolved in ethanol, and then 1 milliliter of acetic anhydride and concentrated H_2SO_4 were added. The presence of terpenoids was indicated by a color shift from pink to violet [5].

2.2.7. Steroidal Nucleus/Cardenolides

Killer Killiani's Check

Each of the test extract (0.5 g) was dissolved with a drop of ferric chloride solution in 2 milliliters of glacial acetic acid. Under layed with one milliliter of concentrated tetraoxosulphate (VI) acid. Appearance of a brown ring at the interphase show the existence of digitoxose sugar, a feature of cardenolide. A ring of violet appears just beneath the brown ring, but in the layer of acetic acid, a greenish ring forms immediately above the brown ring and spreads gradually throughout the layer. [3].

2.2.8. Test for Saponnin

Five millilitres of distilled water were used to boil one gramme (1 g) of each extract. The resulting filtrate was then separated into two parts:

After adding roughly 3 milliliters of distilled water to the first portion, it was shaken for roughly five minutes. Saponins are indicated by frothing that continues to form when heated [6].

Two and a half milliliters of a mixture of Fehling's solutions A and B were added to the second section. Saponin was assumed to be present when a brick-red precipitate appeared [7].

2.2.9. Test for Flavonoids

(i). Shinoda's Test

Ethanol was used to dissolve each extract (0.5 g), which was then heated and filtered. A few drops of concentrated HCl were added to the filtrate along with three pieces of magnesium chips. Flavonoids are indicated by a pink, orange, or red to purple coloring [4].

(ii). Ferric Chloride Test

After being boiled in distilled water, each extract was filtered. A few drops of a 10% ferric chloride solution were added to two milliliters of the filtrate. The presence of a phenolic hydroxyl group is indicated by a green-blue or violet coloring [3].

(iii). Lead Ethanoate Test

Each extract was diluted in a small amount of water and then filtered. Three milliliters of lead ethanoate solution were added to five milliliters of each filtrate. Flavonoids are indicated by the appearance of a buff-colored precipitate [8].

(iv). Sodium Hydroxide Test

After dissolving a small amount of each extract in water and filtering it, two milliliters of 10% aqueous sodium hydroxide were added to create a yellow coloring. When concentrated hydrochloric acid was added, the color changed from yellow to colorless, indicating the presence of flavonoids [3].

2.2.10. Tests for Alkaloids

(i). Preliminary Test for Alkaloids

On a water bath, 5 ml of 1% aqueous HCl was added to each test extract (0.5g), which was then agitated before being filtered. Three milliliters of the filtrate were extracted and separated into equal parts in a test tube. A few drops of Dragendorff's reagent were added to the first section; the presence of an orange-red precipitate was interpreted as a positive result. When Mayer's reagent was added to the second milliliter, a buff-colored precipitate appeared, indicating the presence of alkaloids. When a few drops of Wagner's reagent were added to the final milliliter, a dark-brown precipitate appeared, indicating the presence of alkaloids [8].

(ii). Confirmatory Test for Alkaloids

For the extract that produced a preliminary positive test for alkaloids, a confirmatory test was performed to weed out non-alkaloidal compounds that could cause a "false positive reaction" [3]. Using litmus paper, 1g of each extract was treated with 40% calcium hydroxide until it became noticeably alkaline. The extract was then extracted twice using a 10-ml portion of chloroform. After combining the chloroform extracts, they were concentrated to roughly 5 ml at lowered pressure. Four solvents with varying polarities were used to develop this after it was spotted on TLC plates. Using freshly made Dragendroffs spray reagent, the presence of alkaloids in the developed chromatograms was found. The presence of orange or darker spots on the chromatogram against a

pale-yellow background, which indicates a positive reaction, was interpreted as confirmation that the extract contains alkaloids.

2.3. Evaluation of Antimicrobial Activity of n-Butanol and Ethyl Acetate Partition Portion

The n-Butanol and ethyl acetate partition portion of the plant's antimicrobial activity was assessed.

(i). Different Concentrations and Dilutions of Ethyle Acetate and n-Butanol Partition Portion of *Isoberlinia tomentosa* Stem Bark Extract

The stock solution of the ethyle acetate and n-butanol partition portion of *Isoberlinia tomentosa* was made by mixing 10 g with 10 ml of distilled water, and the concentration was 1000 mg/ml. This was diluted to 800 mg/ml, 600 mg/ml, 400 mg/ml, and 200 mg/ml, in that order.

(ii). Getting the Test Organisms Ready

One milliliter each of the pure broth culture of all the bacteria, including *Streptococcus pyogenes, Staphylococcus aureus,, Bacillus subtilis Salmonella typhi, Escherichia coli, Klebsiella neumoniae Pseudomonos aeruginosa* and *Candida albicans* was obtained from the University of Maiduguri's Veterinary Microbiology Laboratory, was added to 9 milliliters of sterile sodium chloride (NaCl) solution (made by dissolving 4.25 grams of analar-grade NaCl, BDH Lab. Poole, England) in 500 milliliters of distilled water, and sterilized in a portable autoclave for 15 minutes at 121 degrees Celsius. To create a final dilution of C x 103 organisms, one milliliter of this was added to nine milliliters of NaCl solution, and from this, another milliliter of the suspension was added to nine milliliters of NaCl solution. This was utilized for the antibacterial and *Candida albicans* activities (i.e., serial dilution was performed to create a tenfold suspension). [9].

(iii). Discs with Concentrations of the Ethyle Acetate and n-Butanol Portion of *Isoberlinia tomentosa* Stem Bark Extract, and the Tetracycline Discs.

Using an office punch, Whatman filter paper No. 1 was punched into circular discs that were each 6 mm in diameter. After that, the discs were placed in a glass petri dish and sterilized for 30 minutes at 60 oC in a hot air oven. Sixteen (16) sterile discs were soaked in the prepared extract using a pair of sterile forceps after one milliliter of each of the various extract concentrations was put in a sterile glass plate. They were left to dry. To make sure the discs didn't adhere to one another, they were examined [10]. The discs containing *Isoberlinia tomentosa* ethyle acetate and n-Butanol partition portion of the stem bark for the antibacterial tests, extract was utilized. In a sterile, glass petri dish, one capsule of 250 mg powdered tetracycline was dissolved in one milliliter of distilled water to yield 250 mg/ml. Inside, seventeen sterile discs were placed to soak in tetracycline before being allowed to dry. This resulted in 250 mg/ml of tetracycline discs, which is equal to 2.5 ×105µg/ml.

(iv). Getting Culture Media Ready

For the bacteria in this study, nutrient agar (Biotec Medical Market, UK) was the culture medium. Following the manufacturer's instructions, 18.5 g of powder was dissolved in 500 ml of distilled water to create the nutrient agar, which was then sterilized for 15 minutes at 121 ℃. After autoclaving, the pH fell between 7.1 and 7.5. This was poured to a depth of 4 mm (roughly 25 ml per plate) into sterile, disposable plastic petri dishes with a 90 mm diameter. To ensure a consistent depth of the medium, care was taken to pour the plates on a level surface.

(v). Antimicrobial Activities of Ethyle Acetate and n-Butanol Partition Portion of *Isoberlinia tomentosa* Stem Bark Extract

To prevent water from condensing back into the agar, the plates were dried upside down in an incubator set to 37 ℃ with their lids open and inverted. [9]

(vi). Tests for Disc Diffusion Antifungal and Disc Diffusion Antibacterial Selectivity

The C x 103 test organisms (Gram positive and Gram negative bacteria) were pipetted into the solidified nutrient agar plates in amounts of one milliliter each. The excess was then allowed to circulate around the medium's surface. Using sterile forceps, the tetracycline antibiotic discs (2.5 x 105 µg/disc) were placed on the plate that had been evenly inoculated with the test organism. The blotting paper discs that were previously impregnated with varying concentrations of the ethyle acetate and n-Butanol partition portion of *Isoberlinia tomentosa* stem bark extract were positioned on every plate. In order to determine whether the growth of the test organism would be inhibited at a distance from the disc that is related to the organism's sensitivity, the plates were incubated for 24 hours at 37 ℃ for bacteria and checked for antimicrobial diffusion from the discs into the medium [11].

The antibiotic discs: ciprofloxacin (5µg/disc) Tetracycline On top of the previously made sabouraud-2% dextrose agar with graded concentrations of the ethyle acetate and n-Butanol partition portion of *Isoberlinia tomentosa* stem bark extract (8 in all) and the control (1 plate).

3. Phytochemical Screening of n-Butanol and Ethyl Acetate, Portion of *Isoberlinia tomentosa* Stem Bark Extract

Table 1. *Phytochemical screening of n-Butanol and Ethyl Acetate.*

S/N	Active Component Test	Ethyl acetate	n-Butanol
1	Carbohydrates		
i	Molishs test	+	+
ii	Fehling test	+	+
iii	Reducing sugar Combing	+	+
iv	Pentoses	_	_
v	Ketoses	_	+
2	Soluble Starch Test	_	_
3	Tannins Test		
i	Ferric Chloride Test	+	+
ii	Lead acetate Test	_	+
4	Flavonoids Test		
i	Shinodas	+	+
ii	Ferric Chloride Test	_	+
Iii	Lead acetate Test	_	+
iv	Sodium hydroxide Test	_	_
5	Glycosides Anthraquinones		
i	Test Free anthraquinone-	_	_
ii	Anthraquinone Combined	_	_
6	Terpenoids Test	+	+
7	Cardenolides Test		
i	Killer Killianis	+	+
8	Saponins Test	_	+
9	Phlobatanins	_	_
10	Test for Cardiac Glycoside		
i	Salkowski	+	+
ii	ii. Lieberman Burchard	+	+
11	Test Alkaloids		
i	Dragengroff reagent	_	_
ii	Mayer reagent	_	_
iii	Wagner reagent	_	_

3.1. Phytochemical Constituents of n-Butanol and Ethyl Acetate Partitioned Portion of *Isoberlinia tomentosa*

The phytochemical study demonstrate that the n-Butanol partition portion contains flavonoids, cardiac glycosides, tannins, saponins, terpenoids, and cardenolides. Even though some of the chromogenic tests produced negative results, as indicated in Table 1, carbohydrates, tannins, terpenoids, cardiac glycosides, cardenolides, and flavonoids were all present in ethyl acetate. Anthroquinone glycosides and alkaloids were noticeably absent.

Table 2. *Antimicrobial Activity of Ethyl acetate partition portion of Isoberlinia tomentosa Stem bark Extract.*

Plant extract and standard medication concentration in milliliter.

S/N	Organism	500	400	300	200	100	CIP	TE
1	S. aureus	10.00±0.58	7.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	18.00±0.00	ND
2	S Pyogens	10.00±0.58	7.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	30.00±0.00	ND
3	B subtilis	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	20.00±0.00	ND
4	E. coli	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	23.00±0.00	19
5	S typhi	15.00±0.58	12.00±0.00	9.00±0.00	7.00±0.00	0.00±0.00	21.00±0.00	0.00
6	K. neumoniae	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	20.00±0.00	ND
7	P. aeruginosa	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	19.00±0.00	ND
8	C albicans	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	21.00±0.00	ND

Mean±SEM (n=3) there is significant different P<0.005
ND= Not detected, CIP= Ciprofloxacin, TE= Tetracycline, 0.00=Resistant

3.2. Antimicrobial Susceptibility Effect of Ethyl Acetate Partition Portion of *Isoberlinia tomentosa* Stem Bark Extract

Table 2 shows that the partition portion of ethyle acetate Stem bark extract at the concentration of (500 mg/ml) showed higher *Staphylococcus aureus* inhibition (10.00±0.58 mg/ml). *Pyogenes Streptococcus* (10.00±0.58 mg/ml) Typhi salmonella (15.00±0.58 mg/ml) at 400 mg/ml *Streptococcus pyogenes* (7.00±0.00 mg/ml) and Staphylococcus aureus (7.00±0.00 mg/ml) At 300 mg/ml, *Salmonella typhi* (12.00±0.00 mg/ml) Typhi salmonella (9.00±0.00 mg/ml) at 200 mg/ml *Bacillius subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Candida albican* and *Pseudomonas aeruginosa* were resistant to *Salmonella typhi* (7.00±0.00 mg/ml).

Table 3. *Antimicrobial Activity of Isoberlinia tomentosa Stem Bark Extract's n-Butanol Partition.*

Concentration of Plant extract and standard drugs mg/ml

S/N	Organism	500	400	300	200	100	CIP	TE
1	S. aureus	17.00±0.00	13.00±0.00	9.00±0.58	7.00±0.00	0.00±0.00	18.00±0.00	ND
2	S Pyogens	22.00±0.58	18.00±0.00	14.00±0.00	10.67.±0.33	7.00±0.00	30.00±0.00	ND
3	B subtilis	16.00±0.33	11.00±0.00	7.00±0.00	0.00±0.00	0.00±0.00	20.00±0.00	ND
4	E. coli	17.00±0.00	13.00±0.58	8.33±0. 67	4.67±2.33	0.00±0.00	23.00±0.00	19
5	S typhi	18.00±0.58	14.00±0.00	10.67±0.00	7.33±0.33	0.00±0.00	21.00±0.00	0.00
6	K. neumoniae	13.00±0.00	10.00±0.00	7.00±0.58	0.00±0.00	0.00±0.00	20.00±0.00	ND
7	P. aeruginosa	18.00±0.00	14.33±0.33	11.00±0.00	7.00±0.00	0.00±0.00	19.00±0.00	ND

S/N	Organism	500	400	300	200	100	CIP	TE
8	C albicans	20.00 ±0.00	17.00 ±0.58	14.00 ±0.00	11.00 ±0.00	8.00 ±0.00	21.00 ±0.00	ND

Mean ±SEM (n=3) there is significant different P<0.005
ND= Not detected, CIP= Ciprofloxacin, TE= Tetracycline, 0.00=Resistant

3.3. Susceptibility to Antimicrobials Impact of *Isoberlinia tomentosa* Stem Bark Extract's n-Butanol Partition

Table 3 demonstrates that *Streptococcus pyogenes* was more inhibited by the partition portion of n-Butanol Stem bark extract at a concentration of 500 mg/ml (22.00 ±0.58 mg/ml). *Salmonella typhi* (18.00 ±0.58 mg/ml), *Pseudomonas aeruginosa* (18.00 ±0.00 mg/ml), *Staphylococcus aureus* (17.00 ±0.00 mg/ml), and *Candida albican* (20.00 ±0.00 mg/ml) 400 mg/ml of *Escherichia coli* (17.00 ±0.00 mg/ml), *Bacillus subtilis* (16.00 ±0.33 mg/ml), and *Klebsiella pneumoniae* (16.00 ±0.33 mg/ml) *Pyogenes Streptococcus* (18.00 ±0.00 mg/ml) *Salmonella typhi* (14.00 ±0.00 mg/ml), *Pseudomonas aeruginosa* (14.33 ±0.33 mg/ml), *Staphylococcus aureus* (13.00 ±0.00 mg/ml), and *Candida albican* (17.00 ±0.58 mg/ml) *Klebsiella pneumoniae* (10.00 ±0.00 mg/ml), *Bacillus subtilis* (11.00 ±0.00 mg/ml), and *Escherichia coli* (13.00 ±0.58 mg/ml) at 300 mg/ml *Salmonella typhi* (10.69 ±0.00 mg/ml), *Pseudomonas aeruginosa* (11.00 ±0.00 mg/ml), *Streptococcus pyogenes* (14.00 ±0.00 mg/ml), *Candida albican* (14.00 ±0.00 mg/ml), and *Staphylococcus aureus* (9.00 ±0.58 mg/ml) *Escherichia. coli* (8.33.00 ±0.67 mg/ml), *Klebsiella pneumoniae* (7.00 ±0.58 mg/ml) and *Bacillus subtilis* (7.00 ±0.00 mg/ml) at 200 mg/ml *Pyogenes Streptococcus* (10.67 ±0.33 mg/ml) *Salmonella typhi* (18.00 ±0.58 mg/ml), *Pseudomonas aeruginosa* (18.00 ±0.00 mg/ml), *Staphylococcus aureus* (7.00 ±0.00 mg/ml), and *Candida albican* (11.00 ±0.00 mg/ml) At 100 mg/ml, *Escherichia coli* (4.67 ±2.33 mg/ml) The n-Butanol component demonstrated broad-spectrum inhibition against all tested bacteria, including *Streptococcus pyogenes* (7.00 ±0.00 mg/ml) and *Candida albican* (8.00 ±0.00 mg/ml).

3.4. Discussion

The phytochemical analysis showed that the n-butanol portion contained terpenoids, cardenolides, cardiac glycosides, tannins, saponins, and carbohydrates, while the ethyl acetate portion contained terpenoids, cardiac glycosides, cardenolides, and flavonoids, but no saponins. Notably, anthraquinone glycosides and alkaloids were not detected. The antimicrobial screening demonstrated that *Isoberlinia tomentosa* exhibited significant inhibitory activity against certain test organisms. The ethyl acetate portion (500 mg/mL) showed pronounced inhibition against *Salmonella typhi*, *Streptococcus pyogenes*, and *Staphylococcus aureus*. The n-butanol portion (500 mg/mL) exhibited broad-spectrum inhibition against all tested bacteria, including *Salmonella typhi*, *Bacillus subtilis*, *Escherichia coli*, *Streptococcus pyogenes*, *Staphylococcus aureus Klebsiella pneumoniae*, *Candida albicans* and *Pseudomonas aeruginosa.*

4. Conclusion

Based on the results of this investigation, it can be inferred that the ethyl acetate and n-butanol stem bark extracts of *Isoberlinia tomentosa* possess antibacterial and antifungal properties, inhibiting the growth of various pathogens, including: *Staphylococcus aureus*, which causes pneumonia, skin infections, and sepsis) Strep throat is caused by *Streptococcus pyogenes.*, skin infections, and rheumatic fever) *Bacillus subtilis* (causes food poisoning and infections in immune compromised individuals) *Escherichia coli* (causes urinary tract infections, diarrhea, and sepsis) *Salmonella typhi* (causes typhoid fever) *Klebsiella pneumoniae* (causes pneumonia, urinary tract infections, and sepsis) *Pseudomonas aeruginosa* (causes respiratory infections, skin infections, and sepsis) *Candida albicans* (causes candidiasis, which includes systemic infections, vaginal yeast infections, and oral thrush in immune compromised individuals).

These pathogens are implicated in various diseases, including diarrhea, candidiasis, typhoid fever, pneumonia, and sepsis. Therefore, this research provides a foundation for the creation of innovative antimicrobial agents for managing and treating these illnesses.

Abbreviations

S-aureus	Staphylococcus Aureus
S-pyogenes	Streptococcus Pyogenes
B-subtilis	Bacillus Subtilis
E coli	Escherichia Coli
S-typhi	Salmonella Typhi
K-pneumoniae	Klebsiella Pneumonia
P-aeruginosa	Pseudomonas Aeruginosa
C-albican	Candida Albica
CIP	Ciprofloxacin
TE	Tetracycline
ND	Not Detected

Conflicts of Interest

The authors declare no conflicts of interest.

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