ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

Rapid Assessment of Therapeutic Potential and Antimicrobial Properties of Mimosa pudica on *Pseudomonas aeruginosa* from Clinical Samples Obtained at Alex Ekwueme Federal University Ndufu Alike Ikwo Clinic, Ebonyi State Nigeria

Owolabi, O. J.[1]; Amechi-Nnaji, V. O.[1]; Kelechi- Mathew, O. O.[1]; Akindele, K. I.[1]; Adeshina, A. A.[1]; Oyewunmi, A. A.[1]

[1]Alex-Ekweme Federal University, Ndufu-Alike, Ikwo, Ebonyi State, Nigeria.

Publication Date: 2026/06/04

Abstract: Nature has long served as a source of medicine, with plants providing bioactive compounds effective against various diseases. Multiple antibiotics resistance has been reported in several bacteria especially *Pseudomonas aeruginosa*. This study assessed the therapeutic potential and antimicrobial properties of *Mimosa pudica* against *Pseudomonas aeruginosa* isolated from clinical samples obtained at Alex Ekwueme Federal University clinic. A total of 30 urine and 19 stool samples were collected from male and female patients across different age groups. Among urine samples, the highest collection was from 21-year-olds (7 samples), four (4) tested positive (20%). Similarly, for stool samples, age 20 showed the highest positivity rate, with 3 positives out of 4 (30%), while other age groups (24, 25, 27, 28) recorded no positives. Thirty bacterial isolates were identified, with *Pseudomonas* species being the predominant organism. Antibiotic susceptibility testing revealed 100% resistance to Co-trimoxazole and Ampicillin, Conversely, all isolates were 100% susceptible to Gentamicin and Ciprofloxacin, while Ceftriaxone showed 80% susceptibility. Antimicrobial susceptibility testing of *Mimosa pudica* extracts demonstrated notable inhibitory activity against the isolates. Both ethanolic and aqueous extracts, prepared at concentrations of 100, 50, and 25 mg/ml, showed concentration-dependent inhibition zones. The ethanolic extract produced inhibition zones between 9 –13 mm, while aqueous extracts ranged between 10 –13 mm at 100 mg/ml. Although Gentamicin (positive control) showed higher inhibition (15 –26 mm), the results confirm that *M. pudica* had inhibitory effects on *Pseudomonas* species tested. The results affirmed that *Mimosa pudica* possesses therapeutic properties and proved to be a promising source of natural antimicrobial agents, especially against multidrug-resistant pathogens like *Pseudomonas aeruginosa*. This supports its potential use in developing alternative therapies to combat antibiotic resistance.

Keywords: *Mimosa pudica, Pseudomonas aeruginosa, Antimicrobial Susceptibility, Inhibitory Effects.*

How to Cite: Owolabi, O. J.; Amechi-Nnaji, V. O.; Kelechi- Mathew, O. O.; Akindele, K. I.; Adeshina, A. A.; Oyewunmi, A. A. (2026) Rapid Assessment of Therapeutic Potential and Antimicrobial Properties of Mimosa pudica on *Pseudomonas aeruginosa* from Clinical Samples Obtained at Alex Ekwueme Federal University Ndufu Alike Ikwo Clinic, Ebonyi State Nigeria. *International Journal of Innovative Science and Research Technology*, 11(5), 3046-3056. https://doi.org/10.38124/ijisrt/26may1550

I. INTRODUCTION

Nature has been a source of medicine for thousands of years. The phytochemical constituents and the potency of plants against several diseases attracted scientists to explore natural resources for discovering novel drugs. WHO has reported that 80% of the world population still relies on traditional medicine for primary health care (Giannenas *et al*, 2020). Scientists have recognized the necessity to screen plants to find innovative drugs with therapeutic efficacy in the current context of multiple medication resistance.

Mimosa pudica (Family: *Fabaceae*), a neglected weed, has been studied for its numerous ethnobotanical uses. It is a perennial or annual creeping herb and has been identified as Lajjalu in Ayurveda. It is one of the sought-after plants for its pharmacological properties, which include anti-diabetic, antitoxin, antihepatotoxin, antioxidant, and wound-healing properties (Majeed *et al*, 2021).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

Fig 1 *Mimosa pudica* Plant (Mandal *et al*., 2022).

The plant has been widely mentioned in Ayurveda and the Unani medicine system. In the past, and still in several parts of the world, the different parts of Mimosa are used to relieve several illnesses and health discomfort. The root decoction of this plant is used to relieve toothache. *Mimosa pudica* is reported to stop the bleeding and speed up the healing of the wound. It is mostly utilised in herbal remedies for gynecological conditions (Mandal *et al*, 2022).

Mimosa pudica is a famous ornamental plant commonly known as sleeping grass, sensitive plant, humble plant, shy plant and touch-me not, among other names (Chima *et al*, 2022). Its ornamental use can be attributed to its thigmonastic and semimonastic movements in which closure of leaves and hanging down of petioles takes place in response to certain stimuli like light, vibration, wounds, wind, touch, heat, and cold (Mandal *et al*, 2022). The mechanism behind antibacterial activity of the *Mimosa pudica* plant extracts includes the disruption of bacterial membrane and leakage of the cellular contents (Sutti & Viyoch 2021).

Antibiotics known to be effective on some bacteria species in the past now have little or no effects on these organisms making it difficult to treat infections arising from these organisms (Mancuso *et al*, 2021). In developing countries, the recent emergence of strains with reduced susceptibility to antibiotics demand search for new therapeutic agents (Terreni *et al*, 2021). Historically, plant has been a source of medicinal agents used to treat chronic as well as acute infectious diseases based on the premises that they contain natural substances (Izah *et al*, 2024). The antimicrobial of some plants have proven to be effective against some infectious diseases (Eigenschink *et al*, 2020). There is growing need to develop alternative antimicrobial drugs to treat infectious diseases using medicinal plants because they have been shown to have enormous therapeutic potential even in the face of increasing prevalence of multi-drug-resistant strains of bacteria (Vaou *et al*, 2021).

The phytochemicals of plants are attributed to multiple pharmacological activities, and they can be screened with some in vitro assays believing that they have the same in vivo potency. Free radicals are highly reactive moieties produced by cells during respiration and cell-mediated immunological responses. Free radicals, such as unpaired electrons or re-active oxygen species (ROS), which contain different oxygen species, such as hydrogen peroxide, can cause a variety of damages, eventually leading to the development of multiple human health disorders, including cancer.

Antioxidants, being molecules that impede the oxidation of other molecules by donating electrons that can neutralize radical production can alleviate ROS-induced cell damage. The secondary metabolites such as polyphenol and flavonoids with at least one hydroxyl group exhibit free radical inhibition, peroxide breakdown, metal inactivation, and oxygen scavenging and play a critical role in multiple biological activities (Tumilaar *et al*, 2024).

In biological systems, some phenolic compounds promote the cellular synthesis of endogenous antioxidants (Rahman *et al*, 2021). The presence of different phytochemicals, such as carbohydrates, terpenoids, phenols, aliphatic, and aromatic molecules, peptides, is supposed to be responsible for the antimicrobial activity of medicinal plants (Pengelly, 2020). Antibiotic and multi-drug-resistant bacteria are currently confronting challenges for researchers in drug discovery and health care across the world. Early isolates revealed a significant genetic component responsible for resistance (Saha & Sarkar 2021).

New antimicrobial chemicals are desperately needed. As a result, researchers are increasingly turning to ethnomedicine in quest of novel leads to develop better medications against microbial diseases. The phytochemical exploration of medicinal plants is not only for the identification of bioactive compounds but also for revealing new sources of economic phytocompounds for the synthesis of complex chemical substances, as well as for determining the true relevance of traditional medicines.

Stools and urine samples collected from Alex Ekwueme Federal University clinic, Ebonyi State. Equipment and reagents (such as sampling bottle, microscope, incubator, autoclave, Petri dishes, slides, wire-loops, universal bottles, test tubes, normal saline, ethanol, crystal violet, hydrogen peroxide, Lugol's iodine, Durham tubes, Kovac's reagent, methyl red indicator dyes, Nutrient Agar, Muller Hinton Agar, Ethanol and Aqueous as the solvent for extract preparation).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

➢ *Description of Study Area*

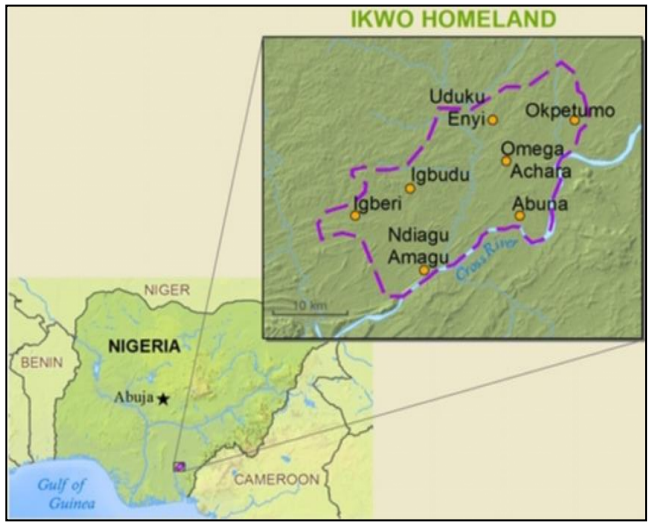

Fig 2 Map of Nigeria Showing the Study Area (AE- FUNAI) (Goggle)

This study was carried out at AE- FUNAI, Ebonyi State. Urine and stools samples was collected from the school clinic among patients that visited. Ikwo measures a Longitude of 6.139499 and latitude; of 8.145989, with majority of the people being farmers of annual crops.

➢ *Sample Collection and Processing*

Thirty samples of Urine and nineteen samples of stools samples were collected from different patients (both male and female) in AE- FUNAI clinic into different sterile sampling bottles. The leaves of *Mimosa pudica* was purchased from international market, Abakaliki, Ebonyi State, Nigeria and then collected in a sterile polythene. It was then transported to Microbiology laboratory, Department of Microbiology, Alex Ekwueme Federal University Ndufu-Alike, Ikwo, for further analysis. All samples were processed in the research laboratory according to the standard microbiological methods under complete aseptic conditions.

➢ *Preparation of Plant Extracts*

Freshly collected leaves of *Mimosa pudica* was washed and dried under the shade at normal room temperature. After drying, the plant material was ground using pestle and mortar into smaller particles and then blended to powder using an electric blender. Twenty-two grams (22g) of the powdered plant was weigh and dissolved in 200ml of ethanol and also aqueous solution after which it was sundry for 24 hours to allow the solvent evaporate.

➢ *Collection of Test Organisms*

The tested microorganisms were obtained from the different stools and urine samples obtained among patients that visited AE- FUNAI clinic, Ebonyi State, Nigeria.

- *Ethical Consideration*

The ethical clearance for this research was given Alex–Ekuweme Federal University ethical committee after all due processes had been followed. Before the collection of the sample, information regarding the study was explained to the subjects. Oral and written consent for participation in the study were also obtained as many of the patient could not read nor write.

➢ *Microbiology Analysis*

- *Preparation of the Stool and Urine Sample*

Nutrient broth was prepared according to manufacturer instruction. 10ml of sterilized nutrient broth was then transferred into 49 sterile swabs respectively. Swab stick was deep into the sampling bottle containing each of the stool and urine sample and was then inoculated into each of the swabs containing already cooled nutrient broth. It was incubated at 37ºC for 24 hours.

- *Culturing of the Stool and Urine Sample*

Muller Hinton Agar was prepared according to manufacturer instruction and after which it was allowed to get cooled to a temperature of 45 º C. It was then poured into sterile petri dishes. A loopful of each of the sample was streaked on already gelled Muller Hinton Agar medium. It was then incubated at 37ºC for 24 hours. Colonies that appeared greenish- blue were recorded as positive.

- *Sub-Culturing of the Bacterial Isolates*

Nutrient broth was prepared according to manufacturer instruction, sterilized at 121ºC for 15 minutes and allowed to get cooled to a temperature of 40 º C. Ten milliliters(10ml) of the nutrient broth was measured into 30 sterile test tubes and then incubated as the pure culture for further analysis.

➢ *Characterization and Identification of Bacteria Isolate Associated with the Stool and Urine Samples Gotten from AE-FUNAI Clinic*

- *Gram Staining*

Gram staining was carried out as described by Udoh *et al*, (2022). Pure colonies of each bacterial were observed for morphological features using Bergey's Manual of Determinative Bacteriology as a standard for comparison. Cell shape was determined under X100 objective of the light microscope after Gram staining procedure. Bacterial smear was prepared on the slide using an inoculation loop. This was done by introducing a drop of distilled water on grease free labeled slide followed by the sample and then smeared, air dried and heat fixed. The slide was flood with crystal violet staining reagent for about 60 seconds, then washed using a gentle indirect stream of tap water for about two seconds. The slide was then flooded with a mordant (Lugol's iodine) for 15-30 seconds. The slide was decolorized using 70% ethanol for 10 seconds and washed off. Lastly, the slide was flooded with 0.5% counter stain (safranin) for 30 seconds, and then washed using indirect stream of tap water and air dried. A drop of immersion oil was dropped on the stained sample and observed under the microscope.

Characterization and identification were done on the basis of cultural appearance of micro-organism, colony morphology, differential and selective media and also by biochemical test (Ufuoma *et al*, 2023).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

- *Biochemical Tests*

Biochemical tests were done according to the method previously describe by (Udensi *et al*, 2024). The test includes; citrate utilization, catalase, indole, oxidase test. Bacteria isolates were identified based on Berge's Manual of Determinative Bacteriology.

- *Catalase Test*

A sterile wire loop was used to pick the test organism mixed with water inside clean test tube before addition of three drops of hydrogen peroxide. A drop of 3% v/v hydrogen peroxide solution. Formation of bubbles indicated positive reaction.

- *Citrate Utilization Test*

Simmon citrate agar slopes were inoculated with the test organism at 37°C for 48 hours. The citrate was greenish in colour, when it turned blue, it indicated positive result. The test is based on the ability of an organism to use citrate as its sole carbon source.

- *Oxidase Test*

The reagent was prepared using 0.1g of the organism dissolved into 10ml of distilled water. A Filter paper was soaked with 1% oxidase reagent (diamine hydro chlorine) and a sterile stick was used to pick the test organisms unto the filter paper, and was observed for deep blue coloration formation within 10 seconds which indicated a positive reaction.

- *Indole Test*

Five milliliter (5 ml) of peptone water broth was pipetted into test tubes, corked properly and sterilized by autoclaving at 121^0C for 15 minutes at 15 psi. It was allowed to cool to 40^0C before it was inoculated with the test organism and incubated for 72 hours. 3 drops of Kovak's reagent was then added to the culture and left to stand for 30 minutes. Formation of red at the surface layer indicated a positive reaction.

- *Sugar Fermentation Test*

Different broth (Hi-Media- India) containing lactose Glucose Sucrose as the only source of carbohydrates were prepared and sterilized with the addition of 5 drops of phenol red indicator and Durham's tube, and autoclaved at 121°C and 15psi of pressure for 20 minutes. The lactose broth was inoculated with the test organism after cooling to around 45°C and was incubated at 37^0C for 24 hours. Negative control was maintained without culture. Observations were made for gas production and colour changes. A yellow ring indicated positive result while a red ring indicated negative result.

- *Coagulase Test*

The smear of the organisms was made on grease free-glass slides. One millilitre 1.ml of human plasma was added to it to observe the presence of agglutination which indicated a positive reaction.

➢ *Antimicrobial Sensitivity Testing Using the Antibiotics Disc*

The turbidity of the bacteria isolates suspensions was compared with 0.5 Macfarland's standard. Mueller Hinton Agar was prepared according to manufacturer instruction. It was allowed to cool to 45° C before it was dispensed aseptically in 20 ml volume Petri dishes.

Isolated bacteria were subjected to antibiotic sensitivity tests on Mueller Hinton Agar (MHA) medium using the disc diffusion method (Kebbeh, 2021). From the stock culture of each isolate, subcultures were made in peptone water and incubated at 37°C for 24 h. A suspension of each broth culture was gently streaked over the entire surface of the MHA plate with a sterile swab stick. The inoculated plates were allowed to stand for 3–4 minutes to remove any excess fluid and then incubated for 3hrs at 37°C. Thereafter, selected antibiotics were placed on the MHA plates using a disc dispenser. The antibiotics used were; Ampicillin (AM) (20/10ug), Co-Trimaxazole (TM) (5ug), Ciprofloxacin (CIP) (5ug), Ceftriaxone (CRO) (30ug), and Gentamicin (CN) (120ug). Using a disc dispenser, the multi-discs were aseptically placed at the center of the MHA culture plate so that the discs were equidistant from the perimeter of the plates. The plates were incubated for 24hrs at 37°C. After incubation, the diameter of the zone of inhibition were measured and compared with zone diameter of interpretative chart (CLSI 2013) according to Aggarwal *et al*, 2024 to determine the sensitivity of the isolates to antibiotics.

➢ *Antibiotics Used for the Study*

Table 1. Fifteen antibiotics used for the study, their potency and disc code Ampicillin (AM) (20/10ug), Co-Trimaxazole (TM) (5ug), Ciprofloxacin (CIP) (5ug), Ceftriaxone (CRO) (30ug), and Gentamicin (CN) (120ug).

Table 1 Antibiotics Screened for the Study

Antibiotic Code	Potency (µg)	Disc code
Ampicillin	20/10	AM
Co- Trimaxazole	5	TM
Ciprofloxacin	5	CIP
Ceftriaxone	30	CRO
Gentamicin	120	CN

➢ *Antibiotic Susceptibility Test Using the Plant Extract*

The test organisms were cultured in peptone water for 18-24 hours. Mueller-Hinton Agar plates were prepared and inoculated with 0.5 ml of the peptone water cultures, which were evenly spread using a sterile swap stick on the surface of the agar. A hole was created in the Muller Hilton Agar and a pipette was carefully used to dip a drop of *Mimosa pudica* extracts in different concentration of 100mg/ml, 50mg/ml and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

25mg/ml respectively into the hole with Gentamycin (10mcg) as the control. The plates were incubated at 37°C for 24 hours.

Zones of inhibition around the antibiotic discs were measured in millimeters after the incubation period. These measurements were interpreted according to the Clinical Laboratory Standards Institute (CLSI) guidelines of 2015, classifying the isolates as susceptible, intermediate, or resistant based on the size of the inhibition zones.

➢ *Phytochemical Analysis of Plant Extracts*

The extracts were subjected to phytochemical tests for plant secondary metabolites; tannins, saponins, steroid, alkaloids and glycosides were determined in accordance with the methods of Agidew *et al*, 2022.

II. RESULTS

➢ *Percentage of Urine Samples Positive to Pseudomonas aeruginosa*

Table 2 showed the distribution of urine sample positivity rates across ages 17–28, with a total of 30 samples tested. The highest number of samples were collected from 21-year-olds (7 samples), where 4 tested positive, giving a 20.0% positivity rate. Age 21 and 22 had the most positive samples in absolute terms (4 positives out of 7 and 4 positives out of 5 respectively), corresponding to the highest individual percentage positive (20.0%). Age 19 recorded zero positive samples, while age 27 had no samples collected at all.

Table 2 Percentage of Urine Samples Positive to *Pseudomonas aeruginosa*

Age group	No. of samples	No. of positive sample	Percentage positive (%)
17	1	1	5.00
18	3	3	15.0
19	3	0	0.00
20	5	3	15.0
21	7	4	20.0
22	5	4	20.0
23	1	1	5.00
24	2	2	10.0
25	1	1	5.00
26	1	0	0.00
27	0	0	0.00
28	1	1	5.00
Total	30	20	100

➢ *Percentage of Stool Samples Positive to Pseudomonas aeruginosa*

Table 3 revealed the distribution of stool sample positivity rates across ages 17–28, with total of 19 samples tested. The highest number of samples was collected from 21-year-olds (5 samples), where two (2) tested positive, giving a 20.0% positivity rate. Age 20 had the most positive samples in absolute terms (3 positives out of 4), corresponding to the highest individual percentage positive (20.0%). Age 22, 23, 24, and 25 recorded zero positive samples, while age 24,25, 27 and 28 had no samples collected at all.

Table 3 Percentage of Stool Samples Positive for *Pseudomomas aeruginosa*

Age group	No. of samples	No. of positive sample	Percentage positive (%)
17	1	1	10.0
18	1	1	10.0
19	4	2	20.0
20	4	3	30.0
21	5	2	20.0
22	2	0	0.00
23	1	0	0.00
24	0	0	0.00
25	0	0	0.00
26	1	1	10.0
27	0	0	0.00
28	0	0	0.00
Total	19	10	100

➢ *Cultural Characterization of the Bacteria Isolates*

The cultural characterization of bacterial isolates associated with the swabs from stool and urine samples from AE- FUANI Clinic, Ebonyi State showing their morphology on Muller Hinton Agar (Table 4). Notable isolates include: *Pseudomonas aeruginosa (*Greenish colonies on Muller Hinton Agar*)*.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

Table 4 Cultural Characterization of the Bacteria Isolates

ISOLATE CODE	COLONY MORPHOLOGY ON DIFFERENT SELECTIVE MEDIA	PROBABLE BACTERIA
US1	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US2	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US3	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US4	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US5	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US6	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US7	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US8	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US9	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US10	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US11	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US12	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US13	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US14	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US15	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US16	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US17	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US18	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US19	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
US20	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS21	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS2	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS3	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS4	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS5	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS6	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS7	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS8	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS9	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*
SS10	Greenish colonies on Muller Hinton Agar	*Pseudomonas aeruginosa*

LEGEND: US- Urine Sample, SS- Stool Sample

➢ *Morphological and Biochemical Characteristics of Bacterial Isolates from the Swabs*

A total of thirty (30) bacteria species from the stool and urine samples from different patient at AE-FUNAI were identified by morphological characteristics, pigmentation on media, microscopy and biochemical test and the result are presented in table 5 below. The major bacteria isolates belong the genus, *Pseudomonas aeruginosa.*

Table 5 Biochemical Characterization and Identification of the Isolates

Isolates code	Catalase	Oxidase	Indole	Citrate Test	Methyl red	VP Test	Suspected Organisms
US1	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US2	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US3	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US4	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US5	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US6	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US7	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US8	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US9	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US10	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US11	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US12	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US13	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US14	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US15	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US16	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US17	+	+	-	+	-	+	*Pseudomonas aeruginosa*

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

US18	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US19	+	+	-	+	-	+	*Pseudomonas aeruginosa*
US20	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS1	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS2	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS3	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS4	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS5	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS6	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS7	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS8	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS9	+	+	-	+	-	+	*Pseudomonas aeruginosa*
SS10	+	+	-	+	-	+	*Pseudomonas aeruginosa*

LEGEND: US- Urine Sample, SS- Stool Sample, +: Positive, -: Negative.

- *Percentage Sensitivity and Resistant Patterns of all Bacteria Isolates from the Urine and Stool Samples to Five Antibiotics using Antibiotics Breakpoint Method.*

The table (5) below presents the susceptibility and resistance profiles of the antibiotics screened in this study. The isolates displayed 100% resistance to Co-Trimaxazole,and Ampicillin indicating these antibiotics may be less effective. In contrast, all the bacteria isolates display 100% susceptible to Gentamicin and Ciprofloxacin and Ceftriaxone recorded 80%. The isolates showed varying susceptibility to the different antibiotics as illustrated in Table 6 below.

Table 6 Sensitivity and Resistant Patterns of all Bacteria Isolates from the Skin Swab Samples to Five Different Antibiotics.

Isolate code	**CN (120ug)**	**CRO (30ug)**	**CIP(5ug)**	**TM (5ug)**	**AM(20/10ug)**
US1	S	S	S	R	R
US2	S	S	S	R	R
US3	S	S	S	R	R
US4	S	S	S	R	R
US5	S	S	S	R	R
US6	S	S	S	R	R
US7	S	S	S	R	R
US8	S	S	S	R	R
US9	S	S	S	R	R
US10	S	S	S	R	R
US11	S	S	S	R	R
US12	S	S	S	R	R
US13	S	S	S	R	R
US14	S	S	S	R	R
US15	S	S	S	R	R
US16	S	S	S	R	R
US17	S	S	S	R	R
US18	S	S	S	R	R
US19	S	S	S	R	R
US20	S	S	S	R	R
SS1	S	S	S	R	R
SS2	S	S	S	R	R
SS3	S	S	S	R	R
SS4	S	S	S	R	R
SS5	S	S	S	R	R
SS6	S	S	S	R	R
SS7	S	S	S	R	R
SS8	S	S	S	R	R
SS9	S	S	S	R	R
SS10	S	S	S	R	R

LEGEND: Ampicillin (AM) (20/10ug), Co- Trimaxazole (TM) (5ug), Ciprofloxacin (CIP) (5ug), Ceftriaxone (CRO) (30ug), Gentamicin (CN) (120ug), S- Susceptible and R- Resistance.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

➢ *Antimicrobial Susceptibility Testing*

Antimicrobial Susceptibility Test was carried out using the plant extract (*Mimosa pudica*). The extract was prepared at different concentration of 100mg/ml, 50mg/ml and 25mg/ml for both the ethanol and aqueous as the solvent. Table 7 and 8 shows the different result of the zone of inhibition measure in millimeter (mm) based on the capacity of the extract on different concentration.

Table 7 Antimicrobial Activity of Ethanolic Extract of *Mimosa pudica*

Isolates Code	**Zone of inhibition in diameter (mm)**			
	100*µ*g/ml	**50*µ*g/ml**	**25*µ*g/ml**	**Positive Control (CN 10mcg)**
US1	13	12	10	17
US2	11	10	0	15
US3	12	11	10	15
SS1	10	9	0	20
SS2	12	10	10	15

LEGEND: US- Urine Sample, SS- Stool Sample, CN- Gentamicin

Table 8 Antimicrobial Activity of Aqueous Extract of *Mimosa pudica*

Isolates Code	**Zone of inhibition in diameter (mm)**			
	100*µ*g/ml	**50*µ*g/ml**	**25*µ*g/ml**	**Positive Control (CN 10mcg)**
US1	12	10	0	26
US2	11	0	0	20
US3	13	12	10	26
SS1	12	13	0	22
SS2	12	11	10	19

LEGEND: US- Urine Sample, SS- Stool Sample, CN- Gentamicin

➢ *Phytochemical Screening of Mimosa pudica Plant Extracts*

The phytochemical screening result showed the presence of medically active compounds in the aqueous and ethanolic extract of dry leaves powder of *Mimosa pudica.* Terpenoids, saponins, phenols, flavonoids, and alkaloids were present in all extracts of studied medicinal plants. Cardiac glycosides are present in aqueous extract but absent in ethanolic extract, while tannins are absent in both ethanolic and aqueous extract as shown in Table 9.

Table 9 Phytochemical Screening of *Mimosa pudica* Plant Extracts

Secondary metabolites	***Mimosa pudica***	
	Aqueous extract	**Ethanol extract**
Terpenoids	+++	+++
Saponins	++	++
Phenols	++	++
Flavonoids	+++	+++
Alkaloids	++	++
Cardiac glycosides	+	-
Tannins	-	-

(+) = indicates low concentration (++) = shows moderate concentration (+++) = shows high concentration (-) = indicates absence

III. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

➢ *Discussion*

The analysis of urine sample positivity across the age range of 17–28 years revealed that out of 30 samples, 20 (66.7%) were positive for bacterial growth. The highest number of positive cases was recorded among individuals aged 21 and 22 years, both contributing 20% positivity. This suggests that young adults within this age bracket are more prone to urinary tract infections (UTIs), possibly due to lifestyle factors, sexual activity, or hygiene practices. Conversely, no positive cases were detected at age 19 and 26, while age 27 had no samples, indicating variation in infection rates across age groups. These findings are in agreement with previous studies. According to Yang *et al,* (2021) reported a higher prevalence of UTIs among young adults, particularly between 20–29 years, attributing the trend to increased exposure to risk factors during early adulthood. Similarly, Inwang *et al,* (2021) found that the age group 21–30 years accounted for the majority of UTI cases in southeastern Nigeria. The predominance of positive cases among young adults in the present study therefore aligns with existing evidence that UTIs are more frequent in sexually active and socially mobile age groups.

However, unlike some earlier studies where higher prevalence was observed among females due to anatomical predisposition (Inwang *et al,* 2021), the present study shows that positivity was more evenly distributed across sexes, with males contributing a significant proportion of cases. This divergence may reflect differences in sample size, health-seeking behavior, or environmental factors specific to the study population.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

Out of the 19 urine samples analyzed, 10 (52.6%) were positive for bacterial growth, indicating a moderate prevalence of urinary tract infections (UTIs) among the studied population. The highest positivity rate was observed in the age group 20 years, where 3 out of 4 samples tested positive (30.0%). This suggests that individuals in this age group may be more predisposed to UTIs, possibly due to increased physiological and lifestyle factors such as sexual activity and stress-related immune suppression. Other notable findings include the 19- and 21-year-old groups, each recording a 20.0% positivity rate, with 2 positive cases each. This further reinforces the trend that early adulthood (19–21 years) carries a relatively higher risk of UTIs. In contrast, certain age groups (22, 23, 24, and 25 years) showed no positive samples, while ages 24, 25, 27, and 28 had no samples collected at all, which limits comparative interpretation in those age brackets. Interestingly, age 26 recorded a positivity rate of 10.0% despite having only one sample, while ages 17 and 18 also showed positivity (10.0% each). These findings suggest that although UTIs can occur across different ages within the studied range, the burden tends to peak around the early twenties.

The biochemical characterization of stool and urine samples from patients at AE-FUNAI revealed that all thirty (30) isolates belonged to *Pseudomonas aeruginosa*. This finding indicates a high prevalence of *Pseudomonas aeruginosa* in the clinical samples studied, suggesting its role as a dominant pathogen in the sampled population. The consistent positive reactions for catalase, oxidase, and citrate tests, combined with negative results for indole and methyl red, strongly support this identification.

This result aligns with previous studies reporting *Pseudomonas aeruginosa* as a frequent cause of both urinary tract infections (UTIs) and gastrointestinal infections due to its opportunistic nature and ability to thrive in diverse environments. Jibril *et al.,* (2025) reported that *P. aeruginosa* accounted for a significant proportion of UTI pathogens in Nigerian clinical settings.

However, unlike some previous studies where multiple bacterial genera such as *Escherichia coli*, *Klebsiella spp.*, and *Staphylococcus spp.* were co-isolated with *Pseudomonas* (Viksne *et al,* 2023), the present study exclusively identified *P. aeruginosa.* This unusual dominance may be attributed to sample size, environmental factors, or hospital-specific microbial ecology at AE-FUNAI Clinic.

The antimicrobial susceptibility testing of bacterial isolates from urine and stool samples revealed a distinct resistance pattern. All isolates demonstrated complete resistance (100%) to Co-trimoxazole and Ampicillin, suggesting that these antibiotics may no longer be effective in managing infections caused by the isolates in the study area. In contrast, isolates showed complete susceptibility (100%) to Gentamicin and Ciprofloxacin, while Ceftriaxone exhibited high efficacy with 80% susceptibility. These findings are consistent with earlier studies across Nigeria and other parts of Africa, which have reported high resistance rates to commonly used and affordable antibiotics such as Ampicillin and Co-trimoxazole. For instance, Kebbeh, (2021) reported widespread resistance of *Pseudomonas aeruginosa* and other enteric bacteria to Ampicillin and Co-trimoxazole, attributing this to the indiscriminate use of these antibiotics in clinical practice and self-medication. Similarly, Adeyemo *et al,* (2025) highlighted the declining efficacy of first-line antibiotics in treating urinary and gastrointestinal infections in south west of Nigeria. The high susceptibility of the isolates to Gentamicin and Ciprofloxacin observed in this study corroborates findings by Muteeb, (2023), who noted that aminoglycosides and fluoroquinolones remain among the most effective classes of antibiotics against multi-drug-resistant Gram-negative bacteria. The relatively strong performance of Ceftriaxone (80% susceptibility) also aligns with previous reports (Olowe *et al,* 2013), though slightly lower efficacy compared to Gentamicin and Ciprofloxacin may reflect emerging resistance trends.

The antimicrobial susceptibility testing of *Mimosa pudica* extracts against bacterial isolates from urine and stool samples demonstrated varying degrees of inhibitory activity. Both ethanolic and aqueous extracts showed measurable antimicrobial effects, with higher inhibition zones observed at increased extract concentrations (100 mg/ml) compared to lower concentrations (25 mg/ml). The ethanolic extract produced inhibition zones ranging from 9–13 mm, while the aqueous extract ranged from 10–13 mm at 100 mg/ml. Although the positive control (Gentamicin) produced larger inhibition zones (15–26 mm), the results indicate that *M. pudica* possesses bioactive compounds with notable antibacterial properties.

These findings are consistent with earlier studies that highlighted the antimicrobial potential of *Mimosa pudica*. Dalimunte *et al,* (2023) reported significant antibacterial activity of ethanolic extracts of *Mimosa pudica* against *Escherichia coli* and *Staphylococcus aureus*, attributing the activity to phytochemicals such as alkaloids, tannins, and flavonoids. Similarly, *Idris & Mohd,* (2021) observed higher antimicrobial activity in ethanolic extracts compared to aqueous extracts, a trend also observed in the present study, suggesting that ethanol is a more effective solvent in extracting bioactive constituents.

In contrast, some studies have reported slightly stronger antibacterial effects for aqueous extracts. For instance, Kumar, (2024) demonstrated that aqueous extracts of *Mimosa pudica* inhibited multi-drug-resistant *Klebsiella* and *Salmonella* strains with inhibition zones up to 15 mm, comparable to standard antibiotics. This slight variation from our findings may be due to differences in extraction techniques, bacterial strains tested, and phytochemical content of *Mimosa pudica* influenced by geographical location and environmental conditions. The observed concentration-dependent effect in this study aligns with the work of Horablaga *et al,* (2023), who noted that higher extract concentrations correlate with increased antimicrobial activity due to the availability of higher quantities of active phytochemicals. Furthermore, the fact that some isolates (e.g., US2 and SS1) showed no inhibition at lower concentrations (25 mg/ml) emphasizes the need for optimal

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

dosing when considering plant-based antimicrobial applications.

The phytochemical screening of *Mimosa pudica* leaves revealed the presence of several bio-active secondary metabolites, including terpenoids, saponins, phenols, flavonoids, and alkaloids in both aqueous and ethanolic extracts. The aqueous extract showed higher concentrations of most metabolites compared to the ethanolic extract, with particularly high levels of saponins, alkaloids, and terpenoids. Cardiac glycosides were detected only in the aqueous extract, while tannins were absent in both solvent extracts.

These findings are consistent with earlier reports that identified diverse phytoconstituents in *Mimosa pudica*. Rizwan *et al*, (2022) also documented the presence of alkaloids, flavonoids, terpenoids, and saponins in aqueous and ethanolic extracts, supporting the therapeutic potential of this plant (*Mimosa pudica*). Similarly, Ngoc *et al*, (2024) observed that aqueous extracts of *M. pudica* yielded higher amounts of alkaloids and saponins compared to ethanolic extracts, which aligns with the current study.

➢ *Conclusion*

The study demonstrated that *Mimosa pudica* possesses significant therapeutic potential against *Pseudomonas aeruginosa*. Phytochemical screening revealed the presence of key bio-active compounds such as alkaloids, flavonoids, saponins, phenols, and terpenoids, which are known to confer antimicrobial and medicinal properties. The antimicrobial susceptibility testing further showed that both aqueous and ethanolic extracts of *Mimosa pudica* exhibited inhibitory effects on *Pseudomonas aeruginosa*, with higher concentrations producing larger zones of inhibition, comparable in some cases to standard antibiotics. The aqueous extract demonstrated slightly superior activity, likely due to its higher yield of polar phytochemicals such as saponins and cardiac glycosides. *M. pudica* as a promising source of natural antimicrobial agents, particularly against multidrug-resistant pathogens like *Pseudomonas aeruginosa*.

➢ *Recommendation*

- Future studies should focus on isolating, purifying, and characterizing the active phytochemicals in *Mimosa pudica* responsible for the observed antimicrobial activity, in order to develop standardized natural drug formulations.
- Comprehensive in-vivo experiments and toxicity profiling should be carried out to confirm the safety, dosage range, and therapeutic efficacy of *Mimosa pudica* extracts against *Pseudomonas aeruginosa* and other pathogens.
- Considering the increasing resistance of *Pseudomonas aeruginosa* to conventional antibiotics, *Mimosa pudica* extracts should be explored as complementary or alternative agents in antimicrobial drug development, particularly in areas with high prevalence of multi-drug-resistant infections.

REFERENCES

[1]. Adeyemo, A., Ojewuyi, A., Odeyemi, A., Adeyemo, A., Olumakinde, T., Akokhia, A., ... & Hassan, A. (2025). Patterns of Antibiotic Resistance in Children Hospitalized with Urinary Tract Infection in a Teaching Hospital in South-West Nigeria. *Sierra Leone Journal of Medicine*, *2*(1), 7-15.

[2]. Agidew, M. G. (2022). Phytochemical analysis of some selected traditional medicinal plants in Ethiopia. *Bulletin of the National Research Centre*, *46*(1), 87.

[3]. Chima, N., Amadi, L. O., & Ugboma, C. J. (2022). Antimicrobial Sensitivity Profile of Mimosa pudica Leaf Extract and its Combination Treatment with Potassium Aluminum Sulphate on Some Bacteria. *South Asian J Res Microbiol*, *14*(1), 36-45.

[4]. Dalimunte, K., Arianto, A., & Salim, E. (2023). Phytochemical Screening And Antibacterial Activity Of The Ethanol Extract Of Putri Malu (Mimosa Pudica Linn.) Leaves Combined With Klanceng Honey Against Staphylococcus Aureus Bacteria. *International Journal of Science, Technology & Management*, *4*(6), 1619-1625.

[5]. Eigenschink, M., Dearing, L., Dablander, T. E., Maier, J., & Sitte, H. H. (2020). A critical examination of the main premises of Traditional Chinese Medicine. *Wiener Klinische Wochenschrift*, *132*, 260-273.

[6]. Giannenas, I., Sidiropoulou, E., Bonos, E., Christaki, E., & Florou-Paneri, P. (2020). The history of herbs, medicinal and aromatic plants, and their extracts: Past, current situation and future perspectives. In *Feed additives* (pp. 1-18). Academic Press.

[7]. Horablaga, N. M., Cozma, A., Alexa, E., Obistioiu, D., Cocan, I., Poiana, M. A., ... & Buzna, C. (2023). Influence of sample preparation/extraction method on the phytochemical profile and antimicrobial activities of 12 commonly consumed medicinal plants in Romania. *Applied Sciences*, *13*(4), 2530.

[8]. Idris, F. N., & Mohd Nadzir, M. (2021). Comparative studies on different extraction methods of Centella asiatica and extracts bioactive compounds effects on antimicrobial activities. *Antibiotics*, *10*(4), 457.

[9]. Inwang, I. O., Umoh, A. V., Abasiattai, A. M., & Onwuezobe, I. A. (2021). Asymptomatic bacteriuria in a university teaching hospital in Southern Nigeria: Prevalence, uropathogens, and antibiotic susceptibility. *Nigerian Journal of Medicine*, *34*(4), 383-389.

[10]. Izah, S. C., Ogidi, O. I., Ogwu, M. C., Salimon, S. S., Yusuf, Z. M., Akram, M., ... & Iyingiala, A. A. (2024). Historical perspectives and overview of the value of herbal medicine. In *Herbal medicine phytochemistry: Applications and trends* (pp. 3-35). Cham: Springer International Publishing.

[11]. Jibril, A. H., Bawa, H., Mohammed, K., Nuhu, A., & Uhuami, A. O. (2025). High risk of Pseudomonas aeruginosa infection in patients attending public hospitals in Sokoto, Nigeria. *The Microbe*, *6*, 100271.

[12]. Kebbeh, A. (2021). *Antibiotics Susceptibility Patterns of Uropathogenic Bacteria Isolated From Patients with Community-Acquired Urinary Tract Infections*,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26may1550

Kanifing General Hospital, the Gambia, 2021 (Doctoral dissertation, University of Ghana).

[13]. Kumar, K. (2024). *Evaluation of Antibiotics, Alternative Antimicrobials and their Combination in Controlling Multidrug Resistant Pseudomonas aeruginosa Infection* (Doctoral dissertation, Indian Veterinary Research Institute).

[14]. Majeed, I., Rizwan, K., Ashar, A., Rasheed, T., Amarowicz, R., Kausar, H., ... & Marceanu, L. G. (2021). A comprehensive review of the ethnotraditional uses and biological and pharmacological potential of the genus mimosa. *International Journal of Molecular Sciences*, *22*(14), 7463.

[15]. Mancuso, G., Midiri, A., Gerace, E., & Biondo, C. (2021). Bacterial antibiotic resistance: the most critical pathogens. *Pathogens*, *10*(10), 1310.

[16]. Mandal, A. K., Pandey, A., Sah, R. K., Baral, A., & Sah, P. (2022). In Vitro Antioxidant and Antimicrobial Potency of Mimosa pudica of Nepalese Terai Region: Insight into L-Mimosine as an Antibacterial Agent. *Evidence-Based Complementary and Alternative Medicine*, *2022*(1), 6790314.

[17]. Moradali, M. F., & Rehm, B. H. A. (2022). *Pseudomonas aeruginosa lifestyle: a paradigm for adaptation, survival, and persistence*. *Frontiers in Cellular and Infection Microbiology*, 12, 857977. https://doi.org/10.3389/fcimb.2022.857977

[18]. Moradali, M. F., & Rehm, B. H. A. (2022). *Pseudomonas aeruginosa lifestyle: a paradigm for adaptation, survival, and persistence*. *Frontiers in Cellular and Infection Microbiology*, 12, 857977.

[19]. Muteeb, G. (2023). Network meta-analysis of antibiotic resistance patterns in gram-negative bacterial infections: a comparative study of carbapenems, fluoroquinolones, and aminoglycosides. *Frontiers in microbiology*, *14*, 1304011.

[20]. , L. E., Veeraraghavan, B., & Kolenda, C. (2022). *Multidrug-resistant Pseudomonas* Nabarro *aeruginosa: implications for current and future therapy*. *Expert Review of Anti-infective Therapy*, 20(3), 319–334. https://doi.org/10.1080/14787210.2022.2044991

[21]. Ngoc, Q. N., Van, T. N., Minh, T. N., Cong, H. N., Tri, N. P., Tan, P. D., & Yen, N. T. T. (2024, March). Mimosa pudica (sensitive plant): Phenolic content, flavonoid content, and antioxidant activity. In *AIP Conference Proceedings* (Vol. 3014, No. 1, p. 070005). AIP Publishing LLC.

[22]. Pengelly, A. (2020). *The constituents of medicinal plants: an introduction to the chemistry and therapeutics of herbal medicine*. Routledge.

[23]. Rahman, M. M., Rahaman, M. S., Islam, M. R., Rahman, F., Mithi, F. M., Alqahtani, T., ... & Uddin, M. S. (2021). Role of phenolic compounds in human disease: Current knowledge and future prospects. *Molecules*, *27*(1), 233.

[24]. Rizwan, K., Majeed, I., Bilal, M., Rasheed, T., Shakeel, A., & Iqbal, S. (2022). Phytochemistry and diverse pharmacology of genus mimosa: a review. *Biomolecules*, *12*(1), 83.

[25]. Saha, M., & Sarkar, A. (2021). Review on multiple facets of drug resistance: a rising challenge in the 21st century. *Journal of xenobiotics*, *11*(4), 197-214.

[26]. SUTTI, T., & Viyoch, J. (2021). *Development of anti-acne soap containing Mimosa pudica L. extract* (Doctoral dissertation, Naresuan University).

[27]. Terreni, M., Taccani, M., & Pregnolato, M. (2021). New antibiotics for multidrug-resistant bacterial strains: latest research developments and future perspectives. *Molecules*, *26*(9), 2671.

[28]. Tumilaar, S. G., Hardianto, A., Dohi, H., & Kurnia, D. (2024). A comprehensive review of free radicals, oxidative stress, and antioxidants: Overview, clinical applications, global perspectives, future directions, and mechanisms of antioxidant activity of flavonoid compounds. *Journal of Chemistry*, *2024*(1), 5594386.

[29]. Udensi, G. C., & Onuorah, S. C. (2024). Antibiotics susceptibility patterns of bacteria associated with diabetic wound infections in selected hospitals in Awka, Anambra state, Nigeria. *International Journal of Science and Research Archive*, *13*(1).

[30]. Udoh, S., Adukwu, E., Varadi, A., & Saad, S. (2022). Effectiveness of the Human Oral Microbe Identification Microarray in Identifying Periodontal Pathogens: A Systematic Review. *Applied Microbiology*, *2*(3), 614-625.

[31]. Ufuoma, O. E. O. P. A., & Isioma, S. C. (2023). Microbial Load And Public Health Risks of Contaminated Keypads of Selected Automated Teller Machines of Some Banks in Abraka-Nigeria. *Sokoto Journal of Medical Laboratory Science*, *8*(2).

[32]. Vaou, N., Stavropoulou, E., Voidarou, C., Tsigalou, C., & Bezirtzoglou, E. (2021). Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. *Microorganisms*, *9*(10), 2041.

[33]. Viksne, R., Racenis, K., Broks, R., Balode, A. O., Kise, L., & Kroica, J. (2023). In vitro assessment of biofilm production, antibacterial resistance of staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter spp. obtained from tonsillar crypts of healthy adults. *Microorganisms*, *11*(2), 258.

[34]. Yang, X., Chen, H., Zheng, Y., Qu, S., Wang, H., & Yi, F. (2022). Disease burden and long-term trends of urinary tract infections: A worldwide report. *Frontiers in public health*, *10*, 888205.