



# **Phytochemical Evaluation and Antimicrobial Potential Assessment of Some Spices on Selected Pathogenic Microorganisms in Alex Ekwueme Federal Teaching Hospital, Abakaliki, Nigeria**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors DOON and CVU wrote the research concept and designed the study. Authors COO and BU collected materials and data. Authors DOON, CVU and OJO performed data analysis and interpretation. Authors DOON, MMEI and AMCI managed the literature searches and article editing. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The antibacterial activity of *Monodora myristica*, *Xylopi aethiopica*, *Piper guineense*, *Tetrapleura tetraptera* against selected human pathogens like *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Streptococcus mutans* were ascertained using standard microbiological procedures. The herbaceous plants were sun dried and ground into powdery form. Fifty grams (50 g) each of the herbaceous plants were submerged into three (3) different extraction solvents (Ethanol, Methanol and Aqueous) in a conical flask, the flask were shaken intermittently for 24 hours. The herbaceous plants were sieved using whatman number one filter paper. The sieved extracts were allowed to air dry and the dried extracts were stored in a

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sterile sample bottle in the refrigerator until use. Agar well diffusion technique was used to determine the antibacterial activity/efficacy of the herbaceous plants. The antibacterial activity of ethanol, methanol and aqueous extracts of *Azadirachta indica* were determined. The result showed that aqueous extract had antimicrobial activity against all the test bacteria, ethanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Methanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*. Aqueous extract had activity similar to that of ethanol and methanol except that *Streptococcus mutans* which showed resistance to ethanol and methanol extracts was susceptible to aqueous extracts. Phytochemical analysis conducted shows that the herbaceous plant extracts contains substances such as alkaloids, saponin, tannin, flavonoid and phenol. The result obtained from this study revealed that these herbaceous extracts possess bioactive substances which had antibacterial activity on the test bacterial used in the study. Ethanol, methanol and aqueous extracts of *Azadirachta Indica*, *Monodora myristica*, *Xylopi aethiopica*, *piper guineense*, and *Tetrapleura tetraptera* had a remarkable activity against *Staphylococcus aureus*, *E.coli* and *Klebsiella pneumonia* while *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi* were resistant to both ethanol and methanol extracts. However, further in vitro and in vivo studies should be carried out to identify the active constituents responsible for their antibacterial activity.

**Keywords:** Culinary spices; herbaceous plant; ethanol extract; phytochemical constituents.

## 1. INTRODUCTION

Spices which also include plant materials of medicinal importance have been utilized for treating human diseases since the stoneage. Spices are used in cooking as flavorings, in ornamental uses as necklaces, horticulture as flowers around the home [1]. The use of herbsto treat diseasesis almost universal among non-industrialized societies, and is often more affordable than modern pharmaceuticals [2]. Many commercially proven drugs currently in medical use were initially used crudely in traditional ways to treat diseases. However, herbs are used as herbaceous plants for flavoring food, medicine or perfume. Culinary use typically distinguishes herbs as referring to the leafy green parts of a plant (either fresh or dried), from a "spice", a product from another part of the plant (usually dried), including seeds, berries, bark, roots and fruits. In American botanical English the term "herb" is also used as an abbreviation of herbaceous plant [3]. Spice and herbs are often interchangeably used but there actually are subtle differences that distinguish one from the other. Herbs are obtained from the leaves of plants that do not have woody stems. They tend to thrive in more temperate climate and can be used fresh or dry. Spices on the other hand can be obtained from woody or non woody plants and are always dried before use. Except for the leaves, all other parts of the plants are spices, including the seeds, fruits, flowers and bark. Spices are usually native to hot and tropical climatic regions. Additionally, while herbs

sometimes seem to have more medicinal properties than spices do, most herbs and spices have both flavoring and healing properties. By these definitions, it means that the same plant can, in fact be an herb and a spice. Example of such plant is "Cilantro" a Spanish word for Coriander leaves, used in cooking making it legitimate to refer to Coriander as either an herb or a spice depending on what part of the plant you are using. Spices are believed to have antimicrobial properties. The aim of the study is to determine the phytochemical constituents of the spices and the evaluation of the antimicrobial properties against selected pathogenic microorganisms.

## 2. MATERIALS AND METHODS

### 2.1 Spice (Plant) Materials Used

The plant materials used in the present study were [*Azadirachta indica* (Neem), *Monodora myristica* (Ehuru or African calabash) *Xylopi aethiopica* (Uda or Grain of selim), *Piper guineense* (Uziza or Ashanti pepper) and *Tetrapleura tetraptera* (Osirisa or Aidan fruits)].

#### 2.1.1 Test organisms

Six (6) bacterial organisms used are *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. *Escherichia coli*, *Streptococcus mutans* and *Salmonella typhi*. These test organisms were collected from Microbiology Laboratory unit of Alex Ekwueme Federal Teaching Hospital Abakaliki.

### 2.1.2 Study area

The study area was the Alex Ekwueme Federal University Teaching Hospital, Abakaliki which is located at the center of Abakaliki town behind Nigerian Prisons and the annex located along Abakaliki – Enugu expressway formally known as Ebonyi State University Teaching Hospital. It is the major Hospital in Abakaliki metropolis.

### 2.1.3 Collection of plant materials

The herbaceous plants were bought /collected from Abakpa main market in Abakaliki metropolis of Ebonyi State. Authentication of these Herbaceous plants was done by Dr. Nnamani of Applied Biology Department, Ebonyi State University, Abakaliki.

### 2.1.4 Preparation of herbaceous plants extracts

Three different solvents namely, aqueous, methanol and ethanol were used, fifty grams (50 g) of each ground food spice materials [*Azadirachta indica* (Neem), *Monodora myristica* (Ehuru) *Xylopia aethiopica* (Uda), *Piper guineense* (Uziza) and *Tetrapleura tetraptra* (Osirisa)] were soaked in 250 ml of water aqueous, ethanol and methanol in a conical flask and allowed to stand on a shaker for 24hr and was filtered with Whatman number 1 filter paper. The extract were also tested for purity by plating them on nutrient agar and incubated for 24hrs at 37°C [4].

## 2.2 Phytochemical Analysis of the Herbaceous Plants

### 2.2.1 Test for tannins

Five grams (5 g) of the food spice was stirred into 10 ml of distilled water and filtered. A few drops of Ferric chloride reagents were then added to the filtrate. Presence of Tannins is indicated by a blue – black, green or blue – green precipitate [5].

### 2.2.2 Test for saponins

One gram (1g) of the extracts was mixed with 5 ml of distilled water. A few drops of Fehling's solution were added to the extracts. Presence of green colour indicate presence of Saponins [5].

### 2.2.3 Test for flavonoid

About 0.25 g of the extracts was dissolved in 5 ml of ethanol, 0.6g of potassium Hydroxide (KOH) was added to 20 ml of ethanol in a beaker, about 0.5 N of ethanol – potassium hydroxide was added to 1 ml of the filtrate. Presence of yellow colour indicate the presence of Flavonoids [5].

### 2.2.4 Test for alkaloids

About 0.5g of the extracts was stirred into 5 ml of 1one percent (1%) aqueous Hydrochloric acid on a steam bath (Water bath), 1 ml of the filtrate was treated with a few drops of Mayer's reagents, production of turbidity of precipitation was taking as preliminary evidence for the presence of Alkaloids [5].

### 2.2.5 Purification and identification of bacterial isolates

All the bacterial isolates (*E. coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus mutans* *Salmonella typhi* and *Pseudomonas aeruginosa*) were purified on nutrient agar, Mannitol Salt agar, Salmonella/Shigella Agar, Eosin Methylene Blue agar and MacConkey's agar plates. Gram staining and conventional biochemical test such as Indole test, Oxidase test, Coagulase test, Catalase test, Voges Proskauer (VP) test and sugar fermentation test. Identified and purified test organisms were stored in the refrigerator in a nutrient agar slants [6].

## 2.3 Preparation of 0.5 Mcfarland Turbidity Standard

Turbidity standard equivalent of 0.5 McFarland Standard was prepared by adding 1 ml of concentrated H<sub>2</sub>SO<sub>4</sub> to 99 ml of distilled water and dissolving 0.5 g of dehydrated barium chloride (BaCl<sub>2</sub>.2H<sub>2</sub>O) in 50 ml of distilled water in separate reaction flasks respectively. Barium chloride solution (0.6 ml) was added to 99.4 ml of the H<sub>2</sub>SO<sub>4</sub> solution in a separate test tube and was mixed well to obtain 0.5 McFarland turbidity standard. Small portion of the turbid solution was transferred to a capped test tube stored at room temperature (28°C). This was used to adjust and to compare the turbidity of the test bacteria in order to get a confluent growth on a growth or culture plate [6] when performing antimicrobial susceptibility testing (AST).

### 2.3.1 Standardization of test bacteria

All test bacteria were standardized individually before use by inoculating a 5 ml normal saline in sterile test tubes with loopful of a 24 hr young culture of the test organism from a nutrient agar slant. Afterwards, dilutions using loopful of the test bacterium and sterile water were carried out in order to get microbial population of  $10^5$  colony forming unit per milliliter (CFU/ml) by comparing it with 0.5 McFarland turbidity standards [7].

### 2.3.2 Screening for antimicrobial activity of aqueous, ethanol and methanol extracts using agar well diffusion method

Twenty milliliter (20 ml) each of sterilized molten Muller Hinton agar was poured aseptically into sterile Petri dishes of equal sizes (20 ml) and then allowed to solidify (gel). The surface of the Mueller Hinton agar plates were then streaked with standardized inoculums of the test bacteria that was adjusted to 0.5 McFarland turbidity standards. Thereafter, a sterilized 6 mm cork borer was used to bore 5 holes on the Mueller Hinton agar plate(s), and 4 of the holes were filled with equal volumes of the respective plant extracts that was diluted with 75 % DMSO [7]. Sterilized distilled water was used as the negative control. The plates were allowed for about 30mins for pre-diffusion of the plant extracts, and these were incubated at 37°C for 24 hrs. After incubation, the inhibition zone diameters were measured in millimeter using a meter rule. The inhibition zone diameter (IZD) of each plant extracts were evaluated by subtracting the size of the cork borer from the IZD measured [8,7].

### 2.3.3 Determination of Minimum Inhibitory Concentrations (MIC) of the plant extracts against test organisms using agar well diffusion method

Varying concentration of each extract (100 mg/ml, 50 mg/ml, 25 mg/ml, 12.5 mg/ml), were prepared via serial dilution. 0.1 ml of each concentration was added to each 5 ml of nutrient broth containing 0.5ml of standardized test organism of bacterial cells. The tubes were incubated aerobically at 37°C for 24 hr. A tube containing no antibiotics and no extract was used as a positive control. The tube with least concentration of extracts without growth after incubation was taken as the MIC [4].

## 3. RESULTS

Table 1 shows Biochemical and Morphological Characterization of the test Bacteria Isolates.

Table 3 shows Antibacterial Activity of Ethanol, Methanol and Aqueous extracts of *Azadirachta indica* (Leaf) against selected clinical bacterial pathogens. The result shows that aqueous extract had activity against the test bacteria, ethanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Methanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*. Aqueous extract had activity similar to that of ethanol and methanol except that *Streptococcus mutans* which showed resistant to ethanol and methanol extracts was susceptible to aqueous extracts.

Table 4 Shows Antibacterial Activity of Ethanol, Methanol and Aqueous extracts of *Monodora myristica* (Seed) against selected clinical bacterial pathogens. The result shows that ethanol extracts had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Methanol had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Aqueous extracts had no activity against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*.

Table 5 shows Antibacterial Activity of Ethanol, Methanol and Aqueous extracts of *Piper guineense* (seed) against selected clinical bacterial pathogens. Aqueous extracts had no activity against the test bacteria. Ethanol extracts had activity against three of the six test bacterial. Also methanol extracts had activity similar to that of ethanol extract. Methanol showed highest activity more than ethanol and aqueous extracts.

Table 6 shows Antibacterial Activity of Ethanol, Methanol and Aqueous Extracts of *Tetrapleura tetraptera* (seed) against selected clinical bacterial pathogens. *Klebsiella pneumoniae* was resistant to methanol, ethanol and aqueous extracts. Methanol extract showed significant more than aqueous and ethanol extracts.

*Tetrapleura tetraptera* showed significant activity against the test bacteria. Aqueous and ethanol extracts also showed activity against the test bacterial, but *Pseudomonas aeruginosa* was resistant to ethanol extract.

Table 7 shows Antibacterial Activity of Ethanol, Methanol and Aqueous extracts of *Xylopia aethiopica* (seed) against selected clinical bacterial pathogens. The test bacterial show

significant susceptibility to the herbaceous plants. Ethanol had activity against *Klebsiella pneumoniae*, *Streptococcus mutans* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa* and *Salmonella typhi*. Methanol had activity against *Staphylococcus aureus*, *Streptococcus mutans*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa* and *Salmonella typhi*.

**Table 1. Morphological and Biochemical identification of the isolates**

Morphology of The organisms	Indole test	Coagulase test	Catalase	Citrate	Voges-proskauer test(VP)	Mortality test	Gram staining test	Oxidase	Lactose test	Fructose test	Organism confirmation
Cocci in cluster	-	+	+	-	-	-	+	-	-	-	<i>Staph. aureus</i>
Cocci	+	-	+	-	+	+	-	+	+	-	<i>E. coli</i>
Cocci in chains	-	-	-	-	-	-	+	-	-	-	<i>Strep</i>
Coccobacilli	+	-	-	-	+	-	-	+	-	-	<i>Kleb</i>
Coccobacilli	-	-	-	-	-	+	-	+	-	-	<i>Pseudo</i>
Rod	-	-	+	-	-	+	-	-	-	-	<i>Salmonella typhi</i>

Key: + = positive, - = negative, Pseudo = *Pseudomonas*, strep = *Streptococcus mutans*, E.coli = *Escherichia coli*, Kleb = *Klebsiella pneumoniae*, Staph aureus = *Staphylococcus aureus*

**Table 2. Phytochemical constituents of *Azadirachta indica*, *Monodora myristica*, *Xylopia aethiopica*, *Piper guineense* and *Tetrapleura tetraptera***

Herbaceous plants	Bio Constituents	Aqueous	Ethanol	Methanol
<i>Azadirachta indica</i>	Alkaloid	-	-	-
	Saponin	-	-	-
	Flavonoid	-	-	-
	Tannins	+	+	+
	Phenol	-	-	-
<i>Xylopia aethiopic</i>	Alkaloid	+	+	+
	Saponin	+	+	+
	Flavonoid	+	+	+
	Tannins	+	+	+
<i>Monodora myristica</i>	Alkaloid	+	+	+
	Saponin	+	+	+
	Flavonoid	+	+	+
	Tannins	+	+	+
<i>Piper guineense</i>	Alkaloid	-	-	-
	Saponin	+	+	+
	Flavonoid	+	+	+
	Tannins	+	+	+
<i>Tetrapleura tetraptera</i>	Alkaloid	-	-	-
	Saponin	+	+	+
	Flavonoid	+	+	+
	Tannins	+	+	+

Key: + = Present, - = Absent

**Table 3. Antibacterial activity of ethanol, methanol and aqueous extracts of *Azadirachta indica* (Leaf) against selected clinical bacterial pathogens**

F1	Staph	Kleb	<i>E. coli</i>	Strep	Pseudo	Sal
1	16.67 ± 0.58	13.67 ± 0.58	13.67 ± 0.58	14.67 ± 0.58	0.00 ± 0.00	13.67 ± 0.58
2	12.00 ± 0.00	13.33 ± 0.58	15.33 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3	13.00 ± 0.00	12.33 ± 0.58	13.33 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Key: F2 = Extraction Solvent, 1 = Aqueous = 2 = Ethanol, 3 = Methanol, Kleb = *klebsiella pneumoniae*, Pseudo = *Pseudomonas aeruginosa*, Staph = *Staphylococcus aureus*, Strep = *Streptococcus mutans*, Sal = *Salmonella typhi*, Values expressed as mean (±) standard deviation of triplicate analysis

**Table 4. Antibacterial activity of ethanol, methanol and aqueous extracts of *Monodora myristica* (Seed) against selected clinical bacterial pathogens**

F1	Staph	Kleb	<i>E. coli</i>	Strep	Pseudo	Sal
1	0.00 ± 0.00	20.33 ± 0.58	20.33 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
2	17.67 ± 0.58	14.33 ± 0.58	16.67 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3	13.67 ± 0.58	15.67 ± 0.58	15.67 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	9.00 ± 0.00

Key: F2 = Extraction Solvent, 1 = Aqueous = 2 = Ethanol, 3 = Methanol, Kleb = *klebsiella pneumoniae*, Pseudo = *Pseudomonas aeruginosa*, Staph = *Staphylococcus aureus*, Strep = *Streptococcus mutans*, Sal = *Salmonella typhi*. values expressed as mean (±) standard deviation of triplicate analysis

**Table 5. Antibacterial activity of ethanol, methanol and aqueous extracts of *Piper guineense* (Seed) against selected clinical bacterial pathogens**

F1	Staph	Kleb	<i>E. coli</i>	Strep	Pseudo	Sal
1	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
2	14.67 ± 0.58	9.00 ± 0.00	13.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3	15.67 ± 0.58	10.67 ± 0.58	12.67 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Key: F2 = Extraction Solvent, 1 = Aqueous = 2 = Ethanol, 3 = Methanol, Kleb = *klebsiella pneumoniae*, Pseudo = *Pseudomonas aeruginosa*, Staph = *Staphylococcus aureus*, Strep = *Streptococcus mutans*, Sal = *Salmonella typhi*. Values expressed as mean (±) standard deviation of triplicate analysis

**Table 6. Antibacterial activity of ethanol, methanol and aqueous extracts of *Tetrapleura tetraptera* (Seed) against selected clinical bacterial pathogens**

F1	Staph	Kleb	<i>E. coli</i>	Strep	Pseudo	Sal
1	13.00 ± 0.00	0.00 ± 0.00	13.67 ± 0.58	0.00 ± 0.00	21.33 ± 0.58	13.33 ± 0.58
2	12.00 ± 0.00	0.00 ± 0.00	13.00 ± 0.00	15.00 ± 0.00	0.00 ± 0.00	15.33 ± 0.58
3	13.67 ± 0.58	0.00 ± 0.00	12.67 ± 0.58	14.00 ± 0.00	13.33 ± 0.58	12.33 ± 0.58

Key: F2 = Extraction Solvent, 1 = Aqueous = 2 = Ethanol, 3 = Methanol, Kleb = *klebsiella pneumoniae*, Pseudo = *Pseudomonas aeruginosa*, Staph = *Staphylococcus aureus*, Strep = *Streptococcus mutans*, Sal = *Salmonella typhi*. Values expressed as mean (±) standard deviation of triplicate analysis

**Table 7. Antibacterial activity of ethanol, methanol and aqueous extracts of *Xylopiya aethiopic* against selected clinical bacterial pathogens**

F1	Staph	Kleb	<i>E. coli</i>	Strep	Pseudo	Sal
1	17.00 ± 0.00	17.67 ± 0.58	20.00 ± 0.00	15.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
2	17.33 ± 1.15	16.00 ± 0.00	19.67 ± 0.58	16.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3	16.67 ± 0.58	17.67 ± 0.58	18.00 ± 0.00	14.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Key: F2 = Extraction Solvent, 1 = Aqueous = 2 = Ethanol, 3 = Methanol, Kleb = *klebsiella pneumoniae*, Pseudo = *Pseudomonas aeruginosa*, Staph = *Staphylococcus aureus*, Strep = *Streptococcus mutans*, Sal = *Salmonella typhi*. Values expressed as mean (±) standard deviation of triplicate analysis

#### 4. DISCUSSION

This study was conducted to evaluate the efficacy of ethanol, methanol and aqueous (water) extracts of *Azadirachta indica* (Neem), *Monodora myristica* (Ehuru) *Xylopiya aethiopic*

(Uda), *Piper guineense* (Uziza) and *Tetrapleura tetraptra* (Osirisa)] against selected human bacteria pathogens namely *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Streptococcus mutans*. Table 3 showed

antibacterial activity of ethanol, methanol and aqueous extracts of *Azadirachta indica* (Leaf). The result shows that aqueous extract had activity against the test bacteria, ethanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Methanol extract had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*. Aqueous extract had activity similar to that of ethanol and methanol except that *Streptococcus mutans* which showed resistant to ethanol and methanol extracts was susceptible to aqueous extracts. In test tubes, Neem has been shown to have significant effects on both Gram-positive and Gram-negative organisms and other bacteria. Previous studies have shown that extracts of *Azadirachta indica* is effective against *E. coli* and *Streptococcus faecalis*. This study is in agreement with a study by Okemo et al., (2001) who also reported that crude extract of neem plant was very effective against *Staphylococcus aureus* and *E. coli* (Saba et al., 2011). These antibiotic principles are actually the defensive mechanism of the plants against different pathogens (Hafiza, 2000). This study is similar to the findings of Gajendrashinh et al., (2012), the preliminary screening of antimicrobial activity of aqueous and ethanol extracts of *A. indica* leaf against bacterial strains showed that the leaf extracts of *A. indica* expressed antibacterial activity on at least one bacterium. *Azadirachta indica* leaf extract at stoke concentration had great inhibitory activity against all the test organisms. *E. coli* was highly susceptible to all the plant extracts. This study is in conformity with the study of Saradha jyothi (Subbarao (2011) which showed that *Azadirachta indica* leaf posse good antibacterial activity, confirming the great potential of bioactive compounds and is useful for rationalizing the use of this plant in primary health care. The extracts of Neem when used as medicinal plant could be useful for inhibiting the growth of carcinogenic bacterium, *S. sobrinus* (Mohashine et al., 1997). The result of antibacterial activity of ethanol, methanol and aqueous extracts of *Monodera myristica* (seed) showed that ethanol extracts had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Methanol had activity against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli*, but showed no activity against

*Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi*. Aqueous extracts had no activity against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Salmonella typhi* (Table 4). Six (6) phytochemical compounds were observed in this herbaceous plant in each of the solvent extracts analysed. They include Alkaloids, Flavonoids, Saponins, Glycosides, Polyphenols and Tannins. This findings agrees with the work earlier done by Ekwenye and Okorie (2010) but in total disagreement with that done by Adeleye et al., (2008) who observed that *Monodora myristica* contains Anthraquinone without any glycosides. Table 5 showed antibacterial activity of ethanol, methanol and aqueous extracts of *Piper guineense* (Seed). Aqueous extracts had no activity against the test bacteria. Ethanol had activity against three of the six test bacterial isolates. Also methanol extract had activity similar to that of ethanol extracts. Methanol showed highest activity more than ethanol and aqueous extracts. *Piper guineense* is believed to stimulate the production of hydrochloric acid in the stomach aids digestion. Aqueous extracts of *Piper guineense* indicated the presence of Flavonoid, Glycosides, Phlobatannins, Saponin. Antibacterial from plants have great potentials because of their lesser side effects which is often the problem with artificial antimicrobials [9]. The inhibition zone of *Piper guineense* was comparable to the control drug which makes it an alternative to the control drug [10]. Resistance is also not there compared with most conventional antibiotics [11]. This work has been reported by Al-Bayati and Sulaiman [12] and Dagne [13]. Table 6 showed the result of antibacterial activity of ethanol, methanol and aqueous extracts of *Tetrapleura tetraptera* (Seed). *Klebsiella pneumoniae* was resistant to methanol, ethanol and aqueous extracts. Methanol extract showed significant activity against the test bacterial isolates more than aqueous and ethanol extracts. *Tetrapleura tetraptera* showed significant activity against the test bacteria but *Pseudomonas aeruginosa* was resistant to ethanol extract. *Tetrapleura tetraptera* as a spice have been used in orthodox medicine to treat a variety of human illnesses [14-19]. The fruit of *Tetrapleura tetraptera* had low value of tannin, sterol, phenol and saponnin, but high values were obtained for hydrogen cyanide, alkaloid and flavonoid, Tannins are useful in treating stomach cramps and intestinal disorders such as diarrhoea (Fahey 2005, Akinpelu and Onakoya, 2006). Table 7 showed antibacterial activity of ethanol, methanol and aqueous extracts of *Xylopi*

*aethiopica*. The test bacterial showed significant susceptibility to the herbaceous plants. *E coli*, but had no activity against *Pseudomonas aeruginosa* and *Salmonella typhi*. Methanol had activity against *Staphylococcus aureus*, *Streptococcus mutans*, *Klebsiella pneumoniae* and *Escherichia coli*, but had no activity against *Pseudomonas aeruginosa* and *Salmonella typhi*. *Xylopia aethiopica* in combination with other plants proves more effective against chronic respiratory tract disease [20,21]. The Phytochemical constituents of the fruits of *Xylopia aethiopica* showed the presence of Cardiac glycosides, Flavonoids, Phlobatannin, Tannins, Phenols, Anthraquinones, Saponins and Sterols [22].

## 5. CONCLUSION

This finding justifies the traditional use of these plants (spices and herbs) for therapeutic purposes. It could be concluded that the demonstration of antimicrobial activity against both Gram-negative and Gram-positive bacteria is an indication that the plants are a potential source for production of drugs with a broad spectrum of activities. The results of the study also support the traditional application of the plants (spices and herbs). Therefore, it is suggestive that these spices and herbs possess compounds with potential antimicrobial properties that can be used to manufacture potent antibacterial agents in novel drugs for the treatment of gastroenteritis, enteric fever, urethritis, wound and skin infections associated with the test bacteria.

## CONSENT

It's not applicable.

## ETHICAL APPROVAL

It's not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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