Phytochemical Composition, Antioxidant and Antimicrobial Potentials of some Indigenous Plants in Umudike, Abia State, Nigeria

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ABSTRACT: Twenty four ethanol leaf and stem bark extracts of 17 indigenous plants were examined for their phytochemical composition, antimicrobial and antioxidant properties. Phytochemical compositions were analysed with GC-MS while antimicrobial activities on Staphylococcus aureus and Pseudomonas aeruginosa were investigated by the agar well diffusion method. The antioxidant activities were determined with Ferric reducing antioxidant power (FRAP), total phenolic content (TPC) and 2, 2-dihenyl-1-picrylhydrazyl (DPPH) radical scavenging assays. The antibacterial activity was more towards the gram positive S. aureus than the gram negative P. aeruginosa for all the plant extracts. A wide range of phenolic concentrations among the aqueous plant extracts which varied from 28.04 to 500.26mg GAE per gram were observed. Inhibition percentages of DPPH ranged from 19.13 to 95.77% showing effectiveness in radical scavenging. GC-MS characterization of the plant extracts showed a total of 18 components including alkaloids, flavonoids, phenols, saponins, terpenoids, steroids and glycosides. Irvingia gabonensis leaf (IGL) extract and Tamarind stem bark (TSB) exhibited excellent ferric reducing abilities of 2.11 and 1.56 respectively while Vouacanga Africana leaf (VCA) extract indicated the lowest ferric reducing power of 0.50. Extracts of IGL and TSB exhibited the highest phenolic content. Twenty four ethanol leaf and stem bark extracts of 17 indigenous plants were examined for their phytochemical composition, antimicrobial and antioxidant properties. Phytochemical compositions were analysed with GC-MS while antimicrobial activities on Staphylococcus aureus and Pseudomonas aeruginosa were investigated by the agar well diffusion method. The antioxidant activities were determined with Ferric reducing antioxidant power (FRAP), total phenolic content (TPC) and 2, 2-dihenyl-1-picrylhydrazyl (DPPH) radical scavenging assays. The antibacterial activity was more towards the gram positive S. aureus than the gram negative P. aeruginosa for all the plant extracts. A wide range of phenolic concentrations among the aqueous plant extracts which varied from 28.04 to 500.26mg GAE per gram were observed. Inhibition percentages of DPPH ranged from 19.13 to 95.77% showing effectiveness in radical scavenging. GC-MS characterization of the plant extracts showed a total of 18 components including alkaloids, flavonoids, phenols, saponins, terpenoids, steroids and glycosides. Irvingia gabonensis leaf (IGL) extract and Tamarind stem bark (TSB) exhibited excellent ferric reducing abilities of 2.11 and 1.56 respectively while Vouacanga Africana leaf (VCA) extract indicated the lowest ferric reducing power of 0.50. Extracts of IGL and TSB exhibited the highest antioxidant capacities and therefore could be the main sources of natural antioxidant. An important relationship between total phenolic content was observed showing that the major contributor to the antioxidant properties were phenolic compounds.

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Antioxidants are secondary metabolities that fight against oxidative damage caused by free radicals (Shen et al., 2012; Subhasree et al., 2009). Free radicals are known to display essential activity in the development of tissue damage in many human diseases such as neurodegenerative disorders, cancer, cardiovascular diseases and pathological events in living organism. They rapidly inactivate enzymes, destroy membranes, and damage cell organelles by inducing degradation of nucleic acids and proteins lipids (Giweli et al., 2013; Tuo et al., 2015; Khalaf et al., 2008). Free radicals include reactive nitrogen species (RNS), reactive oxygen species (ROS), and reactive chlorine species (RCS). The human anatomy possesses innate defence mechanisms, such as uric acid, glutathione peroxides, superoxide dismutase, glutathione, cathalase, and ubiquinone which counteract free radicals in the form of endogenous antioxidants (Spiegel et al., 2020; Fernandes et al., 2015; Udem et al., 2018). However, the quantities of these body generated defenders seem to be inadequate, most likely under oxidative stress conditions or

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inflammation during which the quantity of free radicals produced is increased (Ahn and Je, 2011; Gutteridge, 1994). Antioxidants play important roles in preventing most of these diseases induced by free radicals by preventing or inhibiting the oxidation of oxidizable materials, decreasing oxidative stress and scavenging free radicals (Lim et al., 2009). Plants contain large numbers of biologically active compounds that can act as antioxidants. Under high environmental stress, plants contain non-enzymatic and enzymatic antioxidants. The enzymatic antioxidants are peroxidase (POX), superoxide dismutase (SOD), ascorbate peroxidase (APX) and catalase (CAT) while non-enzymatic antioxidants include α-tocopherol, anthocyanins, polyphenolic, ascorbic acid, catechins, lignans, β-carotene, coumarins, and flavonoid compounds. Furthermore, the most synthetic antioxidants commonly used in cosmetic and food industries are propyl gallate (PG) butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and butylated hydroquinone (BHQ) (Duracková, 2010). However, these synthetic antioxidants are known to be promoters of carcinogenesis. This necessitates the search for natural antioxidants that have little or no side effects for use in the cosmetic and food industries and also as a material in medicine to displace the synthetic antioxidants. Plants that have curative uses are the main sources of antioxidants like phenolic compounds such as flavonoids, tannins, lignin, phenolic acids and stilbenes. They are also rich sources of vitamins such as E, C and A (Karuppanapandian et al., 2011; Erdemoglu et al., 2006). They also exhibit antibacterial, anticancer, immune stimulating, antiviral and anti-inflammatory activities (Reuter et al., 2010). Many studies have shown that plants exhibit important health benefits such as antimicrobial and antioxidants properties and this has led to the development of products for scavenging of free radicals (Kaur et al., 2009). However, a large number of plants are still unexplored as potential sources of antioxidants for use in food, cosmetic and drug industries. This study was designed to investigate the phytochemicals composition, antimicrobial and antioxidant activities of 24 leaf and stem bark extracts from 17 plants namely, Sterchytarpetha indica, Axonopus compressus, Mangifera indica, Irvingia gabonensis, Dacryodes edulis, Anacardium occidentale, Azadirachta indica, Dalium guinenses, Voucanga Africana, Funntumia africana, Tetrapleura tetraptera, Detarium senegalense, Newbouldia laevis, Khayaiv oreins, Nauclea latitolia, Abutilone mahtirianum and Artocarpus altilis

MATERIALS AND METHODS

Collection and identification of leaf and stem bark samples: The leaf and stem bark samples were collected within and around Michael Okpara University of Agriculture, Umudike. They were tightly packed into plastic bags and transferred to the laboratory.

| Scientific Name | Common/local (Igbo) Name | Part of Plant | Sample ID |
|----------------|--------------------------|---------------|-----------|
| 1 | Stachytarpetha indica | Snakeweed/Ogwuiba | L | SNPT |
| 2 | Axonopus compressus | Carpet grass | L | CPG |
| 3 | Mangifera indica | Mango/Mangoro | L | MGL |
| 4 | Mangifera indica | Mango/Mangoro | SB | MG SB |
| 5 | Irvingia gabonensis | Bush Mango/Ogbono | L | IGL |
| 6 | Dacryodes edulis | African Pear/Ube | L | DEDL |
| 7 | Dacryodes edulis | African Pear/Ube | SB | DESB |
| 8 | Anacardium occidentale | Cashew/Kasu | SB | CSB |
| 9 | Azadirachta indica | Neem/Dogonyaro | L | NML |
| 10 | Azadirachta indica | Neem/Dogonyaro | SB | NMSB |
| 11 | Dalium guinenses | Tamarind/Iicheku | L | TML |
| 12 | Dalium guinenses | Tamarind/Iicheku | SB | TSB |
| 13 | Voucanga Africana | Milk bush/Pete pete | L | VCA |
| 14 | Funtumia africana | Silk Rubber/Mba-miri | L | FTAL |
| 15 | Tetrapleura tetraptera | Aiden fruit or Gum Tree/Okirika or Oshosh | L | TTL |
| 16 | Tetrapleura tetraptera | Aiden fruit or Gum Tree/Okirika or Oshosh | SB | TTSB |
| 17 | Detarium senegalense | Detar Tree/Ofo | L | DSGL |
| 18 | Neuboundia laevis | Boundary tree/Ogirisi | L | NBL |
| 19 | Neuboundia laevis | Boundary tree/Ogirisi | SB | NSB |
| 20 | Khayaiv oreins | African mahogany/Utu-eyi or Ono | L | KYIV |
| 21 | Nauclea latifolia | African peach/Ubuhunu | L | NCLF |
| 22 | Abatilone mahtirianum | Bush or Country mallow | L | AMT |
| 23 | Artocarpus altilis | Bread Fruit | L | SCL |
| 24 | Artocarpus altilis | Bread Fruit | SB | SCSB |

L = leaf; SB = stem bark
They were identified by Mr. Sylvester Ibe of the Forestry Department of the University while voucher specimens were deposited in the herbarium of the Plant Science and Biotechnology (PBS) Department of the same University. Details of the plants collected are shown in Table 1

Pre-treatment of Samples: The samples were washed thoroughly thrice with double distilled water and were shade dried for 14 days.

Extraction: This was achieved based on the procedure reported by Azwanida (2015) with little modification. The dry samples were mechanically pulverized into powder with wooden mortar and pestle. The plant powder (40 g) was soaked in 200 mL of absolute ethanol for 20 h followed by filtration under applied vacuum through Whatman no 1 filter paper spread on a fitting Buchner funnel. The filtrate (extract) was then concentrated using a rotary evaporator to 2 ml. The extracts for DPPH, total phenolic and FRAP assays were left overnight for complete evaporation of the ethanol and the resulting solid residue was used for these analyses. The extract for GC-MS analysis was transferred into a labelled Teflon screw-cap vial and was cleaned up with 3 g of anhydrous sodium sulphate in a well packed column before analysis.

2, 2-Diphenyl-1-Picrylhydrazyl (DPPH) photometric assay: The free radical scavenging activity of the extract was investigated by the DPPH assay according to the method described by Mensor et al. (2001) using a Bio-base double beam scanning UV–VIS spectrophotometer (model BK-D 590). The crude extract at concentrations (25, 50, 100, 200 and 400) μg/mL each was mixed with 1 mL of 0.5 mM DPPH (in methanol) in a cuvette. The absorbance at 517 nm was taken after 30 min of incubation in the dark at room temperature. The experiment was done in triplicate. The percentage antioxidant activities were calculated as follows.

\[
\% AA = 100 - \left( \frac{\text{ABS sample} - \text{ABS blank}}{\text{ABS control}} \times 100 \right)
\]

Where AA = antioxidant activity

Methanol (1 mL) plus 2.0 mL of the test extract was used as the blank while 1.0 mL of the 0.5 mM DPPH solution plus 2.0 mL of methanol was used as the negative control. Ascorbic acid (vitamin C) was used as the reference standard (Iwalowa et al., 2008; Nurhaslina et al., 2019). The half maximal inhibitory concentrations (IC₅₀) of the plant extracts were calculated from the plot of mean percentage DPPH inhibitory activity versus the equivalents of the tested samples concentrations in linear regression.

Total Phenolic Content Assay: Total phenol content (TPC) of each extract was determined using the Folin–Ciocalteau (FC) method described by Do et al. (2014) with minor modifications. The dried extract was dissolved in distilled water to a concentration of 50μg/mL. The calibration curve was established using gallic acid (0–60 μg/mL). The diluted extract or gallic acid (1.6 μL) was added to 0.2 mL FC reagent (5-fold diluted with distilled water) and mixed thoroughly for 3 min. Sodium carbonate (0.2 mL, 10% w/v) was added to the mixture and the mixture was allowed to stand for 30 min at room temperature. The absorbance of the mixture was measured at 760 nm using a Bio-base double beam scanning UV–VIS spectrophotometer (model BK-D 590). TPC was expressed as milligram gallic acid equivalent per gram of extract (mg GAE/g extract).

Ferric Reducing Antioxidant Potential Assay: The ferric reducing antioxidant potential assay is a procedure for determining the reducing power of substances that are electron donors. This was determined according to the method described by Duh et al. (1999). Different concentrations (15–240 μg/mL) of the solvent fractions and the standard (gallic acid) were mixed with 2.5 mL of phosphate buffer (0.2 mol/L, pH 6.6) and 2.5 mL of 1% w/v potassium ferricyanide. The mixture was incubated for 20 min at 50°C. 2.5 mL of 10% trichloroacetic acid was added to acidify the mixture. Thereafter, 1 mL of the acidified mixture was mixed with 1 mL of distilled water and 0.5 mL of 0.1% FeCl₃. The absorbance of the resulting solution was measured at 700 nm. The antioxidant power of the plant fractions was expressed as:

\[
\text{FRAP %} = \frac{\text{Absorbance of sample} \times 100}{\text{Absorbance of gallic acid}}
\]

Where FRAP = ferric reducing antioxidant power

GC/MS Analysis: An agilent 6890N gas chromatography equipped with an auto sampler connected to an Agilent Mass Spectrophotometric Detector was used. 1 μL of sample (extract) was injected in the pulsed splitless mode onto a 30 m x 0.25 mm ID DB 5MS coated fused silica column with a film thickness of 0.15 μL. Helium gas was used as a carrier gas and the column head pressure was maintained at 20 psi to give a constant of 1 ml/min. Other operating conditions were preset. The column temperature was initially held at 55 °C for 0.4 min, increased to 200 °C at a rate of 25 °C/min, then to 280 °C at a rate of 8
°C/min and to a final temperature of 300 °C at a rate of 25 °C/min, held for 2 min. The identification was based on retention time. Components with lower retention times eluted first before the ones of higher retention times.

The relative percentage amount of each component was calculated by comparing the average peak area to the total areas. The software adapted to handle mass spectra and chromatograms was chemstation. Interpretation of the mass spectrum of GCMS was conducted using the database of National Instrument of Standard and Technology (NIST) having more than 63,000 patterns. Unknown components were compared to the known ones using the NIST library. Molecular weights and structures of the components of the test materials were ascertained. The spectrum profile of GC-MS confirms the presence of the main components with their retention times. The height of the peak aligned with the concentration of the components in the extracts.

Antimicrobial assay: The antimicrobial screening tests were carried out using the agar well cup-plate diffusion method described by Oforkansi et al. (2013), Irawan et al. (2014) and Ike et al. (2021) with slight modification. One species each of the gram positive S. aureus and the gram negative P. aeruginosa were used as the test organisms. Sterile Mueller agar plates were seeded with 0.1 of standardized broth culture of the microorganism. A 6 mm diameter well in the solid agar was made by the use of sterile cork borer for each of the microbial isolate. Solutions of ciprofloxacin were added into separate agar well as positive control and DMSO or methanol as negative control. The remaining wells were filled with the respective test agents. For proper diffusion all the plates were left for 1 h at room temperature. Thereafter, they were incubated at 37 °C for 24 h. Inhibition Zones around the wells were measured in millimeter. The investigation was carried out in triplicate and the average values calculated for antimicrobial assay.

RESULTS AND DISCUSSION

Antioxidant activity (DPPH): The antioxidant activities of various indigenous plant extracts were evaluated by DPPH radical scavenging mechanism which has been widely used to examine the free radical scavenging abilities of numerous plant extracts Durga et al., 2020). The results are shown in Table 2 and are expressed as the relative activities against standard ascorbic acid.

All the plant extracts showed dose-dependent antioxidant assay, that is, increase in the concentration of the crude extract increases the percentage of the antioxidant activity. A Similar result was reported by Donga et al. (2020) and Jimoh et al. (2019). Nevertheless, inhibition percentages of DPPH range from 19.13 to 95.77%. In comparison to the various plant extracts, NML indicated the least inhibition percentage with 19.13% showing less effectiveness in radical scavenging, followed by NSB with 30.96%, NCLF, 33.18%, VCA, 47.03%, NBL, 55.56% and CPG, 57.59%. TSB, FTAL and MGL possess the highest DPPH activity among the studied plants with 95.77%, 95.14% and 95.03% respectively. Therefore, the percentage of radical scavenging activity inhibition can be arranged in the following order; TSB > FTAL > MGL > AMT > DESB > NMSB > TML, TTL > KYIV > CSB > SNPT > MGSB etc. IC₅₀ values give an indication of the concentrations of the samples at which 50% of DPPH free radicals that have been scavenged Vijendren et al. (2015). The lower the IC₅₀ the stronger the antioxidant activity. IGL has the lowest IC₅₀ value and hence the strongest antioxidant activity.

### Table 2. DPPH Radical Scavenging Activity of the extracts

| Plant Extract | DPPH (mean) | SD     | IC₅₀     |
|---------------|------------|--------|----------|
| MGSB          | 85.52      | 0.067209 | 429.339  |
| MGL           | 95.03      | 0.067209 | 118.304  |
| NSB           | 30.96      | 0.308001 | 699.84   |
| NBL           | 55.56      | 0.641159 | 345.86   |
| TTGB          | 91.54      | 0.242336 | 262.72   |
| TTL           | 94.68      | 0.067209 | 84.3558  |
| KYIV          | 93.79      | 0.292969 | 534.56   |
| IGSB          | 87.50      | 0.067215 | 32.65    |
| SNPT          | 88.44      | 2.311741 | 346.88   |
| DESB          | 94.80      | 0.155198 | 18.9131  |
| FTAL          | 95.14      | 0.067215 | 29.01    |
| NCLF          | 33.18      | 0.292969 | 17.942381.04 |
| SCSB          | 78.19      | 0.559588 | 46.98    |
| DSGL          | 90.03      | 0.155203 | 19.607   |
| CSB           | 90.68      | 0.116415 | 54.862   |
| VCA           | 47.03      | 0.067215 | 86.2338  |
| AMT           | 94.96      | 0.067209 | 44.891   |
| TML           | 94.72      | 0.134424 | 54.54    |
| IGL           | 93.99      | 0.682127 | 4.826    |
| NML           | 19.13      | 0.597391 | 41.2192  |
| SCL           | 85.25      | 0.308001 | 25.55    |
| CPG           | 57.59      | 0.134419 | 647.08302 |
| NMSB          | 94.76      | 0.335719 | 19.968   |
| TSB           | 95.77      | 0.136022 | 151.45   |
| Ascorbic Acid | 97.33      | 0.085140 | 6.1      |

Total Phenolic Content (TPC): Tables 3 shows that the values of the total phenolic content of the 24 indigenous plant extracts varied from 28.04 to 500.26 mg GAE/g of sample calculated by the Folin-Ciocalteu method (Lu et al., 2011; Abdel-Hameed, 2009). This indicated a wide range of phenolic concentration among the various aqueous plant extracts. Three extracts showed very high phenolic contents (greater than 300 mg GAE/g) namely, TSB, NNAJI, J. C; AMAKU, J. F; NGWU, C. M; CHUKWUEMEKA-OKORIE, H. O; AKPOMIE, K. G; UGWU, B. I; SIYAKA, M. Z; ODOEMELAM, S. A.
DEDL and CSB with values of 500.26, 411.66 and 370.54 respectively. Seven other plant extracts such as DESB, NMSB, MGL, TML, TTSB, IGSB and KYIV also exhibited high phenolic contents of 285.12, 281.47, 277, 239.41, 232.93 227.03 and 216.2 mg GAE/g respectively. Among the considered plant extracts, NML exhibited a very low phenolic content of 28.04 mg GAE/g.

Table 3. Total phenolic content (TPC) of the ethanolic extracts of the Plants

| Samples  | Average mg g⁻¹ Gallic Acid Equivalents | SD   |
|----------|--------------------------------------|------|
| DSGL     | 169.54                               | 3.8123 |
| AMT      | 194.87                               | 3.5405 |
| TML      | 259.41                               | 11.623 |
| TSB      | 500.26                               | 65.641 |
| TTSB     | 232.93                               | 3.4087 |
| TTL      | 217.48                               | 12.57 |
| VCA      | 46.42                                | 2.4826 |
| NCLF     | 47.01                                | 4.5126 |
| IGL      | 121.47                               | 1.2413 |
| NMSB     | 281.47                               | 1.7791 |
| CSB      | 370.34                               | 7.4673 |
| NBL      | 46.54                                | 7.212 |
| KYIV     | 216.2                                | 4.9019 |
| NSSB     | 55.38                                | 4.0967 |
| NML      | 28.04                                | 2.6529 |
| DESB     | 235.12                               | 2.9432 |
| SCL      | 87.31                                | 6.6031 |
| FTAL     | 135.17                               | 3.724 |
| SCSB     | 35.14                                | 1.779 |
| MGL      | 27.47                                | 5.681 |
| DEDL     | 411.66                               | 4.9018 |
| SNPT     | 129.25                               | 7.0189 |
| MGSB     | 110.63                               | 1.7673 |
| CPG      | 43.48                                | 2.8055 |

**Ferric Reducing Antioxidant Power (FRAP):** The result obtained for the ferric reducing power is shown in Table 4. The abilities of the various extracts to reduce Fe³⁺ to Fe²⁺ ranges from 0.50 to 2.11. IGL and TSB extracts showed excellent ferric reducing ability compared to other extracts, with 2.11 and 1.56 respectively. VCA extract indicated the lowest ferric reducing power with 0.50 followed by CPG and NML extracts with 0.54 and 0.56 respectively. The total antioxidant capacities from both FRAP and DPPH assays varied significantly and could be attributed to the different structure of phenolic compounds Kumaran and Karunakaran (2007).

Table 4: Ferric Reducing Potentials

| Plant Extract | FRAP (mean values) | SD   |
|---------------|---------------------|------|
| MGSB          | 1.9315              | 0.00495 |
| MGL           | 1.56                | 0.005657 |
| NSB           | 2.12                | 0.005657 |
| NML           | 0.88                | 0.001414 |
| TML           | 0.001414            | 0.005657 |
| IGL           | 0.001213            | 0.005657 |
| NMSB          | 0.001213            | 0.005657 |
| TSB           | 0.001213            | 0.005657 |
| CPG           | 0.001213            | 0.005657 |
| Ascorbic Acid mg/mL | 2.124 | 1.9315 |

**Phytochemical Composition:** The GC-MS of the plant extracts showed a total of 18 components including alkaloids, flavonoids, phenols, saponins, terpenoids, steroids and glycosides. These results are itemized in Table 5.

Table 5. Phytochemical Compositions of the Plant Extracts

| Sample ID | Scientific Name | Major Bioactive Compounds |
|-----------|-----------------|---------------------------|
| PS1       | *Stachytarpheta indica* L. | Mimosamine; dl-Allo-cystathionine; piperidine-1-thiocarboxamide; phosphorothioic acid-ester; d-arabino-Hexose; 2-deoxy-, cyclic 1,2-ethanediyl mercaptal, tetracetate; S-[2-aminoethyl]-[dl-cysteine |
| PS 2      | *Axonopus compressus* L. | 2-thio-o-imidazolidin-4-one-5-ethanoic acid; pentaborane(9); S-carboxymethyl-L-cysteine; 5-hydroxy pentanamide; Piperazine, 2-methyl-; 2-methyl-, 3-Piperindol, 1,6-dimethyl-reserpine |
| PS 3      | *Mangifera indica* L. | 1,4-oxathian-2-one, 6-methyl-, 3,3,3-trifuoro-N-[2-(phenylcarbamoyl)phenyl]-2-(trifluoromethyl)propionamide; ethanol, 2,2’-(nitrosoimino)bis-; cycloheptanone, oxime; Imidazole, 2-amino-5-{[(2-carboxy)vinyl]- |
| PS 4      | *Mangifera indica* \v/
| SB        | | Cycloheptanol, 2-chloro-, trans-; 1,2-cyclopentanediol, trans-; pentanoic acid, 2- (aminoxy)-; acetic acid, (2,4,5-trichlorophenoxy)-, 2-butoxypropyl ester; sparsomycin; gentamicin a |
| PS 5      | *Irvingia gabonensis* L. | 5-Hexen-3-yn-2-ol; methyl-1-trimethylsilyl-2-methyl-cyclopentene-3-carboxylate; pentadecafluorooctanoic acid ester;1-phenyl-3,5,6-trimethyl-7-oxo-6,7(8H)-dihydropyrazolo(3,4-b)1,4 diazepine; 4H-1-benzopyran-4-one; N-methyl-2-(triphenylphosphoranylidene) amino-benzamide; |

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PS 6 Dacryodes edulis L
Ethanone; 1,1'-biphenyl, 2,3,4,4'-tetramethoxy-5-methyl-6'-; 1,1'-Biphenyl, 2,3,4,4'-tetramethoxy-5-methyl-6'-diethylyaminomethyl; pregann-20-one;gambubotalin; chloropropylate; ellagic acid; benzofuran-2-carboxylic acid; levodopa;
resveratrol;carbazochrome; benzoic acid, 4-hydroxy-
PS 7 Dacryodes edulis SB
1-(2-Nitroanilino)-1-deoxy-.alpha.-d-ribofuranose; guanosine;mannosamine;1,2,3-
triazole-4-carboxydrizide; N2-(4-hydroxybenzylidene)-5-chloro-; pyrimidine-2,4-
dione;cytine; 1-(2-chlorophenylsulfonyl)-2-(3-hydroxypropyl)urea
PS 8 Anacardium occidentale L
α-d-Lyxo-hexopyranoside; hexyl 6-(acetylamo)4,6-dideoxy-1-thio-furan-2-
one;imidazol; 2-amino-5-[(2-carboxyvinyl)-1-[β-d-Ribofuranosyl]-4-
difluoromethyl-5-bromouracil; pterin-6-carboxylic acid; sparsomycin; 1,4-
hydroxyslyse; Pyrazole[4,5-b]imidazole; 1-formyl-3-ethyl-6-[d-ribofuranosyl]
cytine; pterin-6-carboxylic acid; α-N-normethadol; levodopa;mannosamine,
dexosyergalin, alanine, 3-(3,4-dihydroxyphenyl)-, methyl ester,L-,
physan-3,14-diol, 4,5-epoxy-, (5α)-
PS 9 Azadirachta indica L
3-Quinolinol; trans-8-Hydroxy-bicyclo(3,3,0)non-3-ene; propenoic acid, 3-(4-
hydroxy-3-methoxypheny)-ellagic acid;benzoic acid, 3,4-dihydroxy-, methyl
ester; aurin; alanine, 3-(3,4-dihydroxyphenyl)-, methyl ester, L-
PS 10 Azadirachta indica SB
3-Quinolinol; trans-8-Hydroxy-bicyclo(3,3,0)non-3-ene; propenoic acid, 3-(4-
hydroxy-3-methoxypheny)-ellagic acid;benzoic acid, 3,4-dihydroxy-, methyl
ester; aurin; alanine, 3-(3,4-dihydroxyphenyl)-, methyl ester, L-
PS 11 Dalium guineens L
N-methyl-N-[4-[4-fluoro-1-hexahydropryridyl]-2-butynyl]-desulphosinigrin,dl-
allo-cystathionine, 2,4-hexadien-1-ol; methanone (2,4-dihydroxyphenyl)phenyl
PS 12 Dalium guineensSB
12,15-ocadecadiynoic acid, methyl ester; 4-hydroxyhistamine; 2H-Benzoxathiol-1-
one, 5-hydroxy-6-nitro-1,2-propanedioi, 3-(butylthio)-cyclopropanepropionic
acid; R-limonene; dl-cystathionine; D-sterapine;dl-Citrufile; α-D-
Galactopyranose; 1,2-benzenedioi, 2,6,4,8-tetraazabicyclo[3.3.0]octan-3-one; 9-
oxacyclic[3,3,1]nonane-2,6-diol
PS 13 Vouanga Africana L
2-hydroxy-3-nitropyridine;methimirlon; 1-(4-Hydroxy-3-methoxyphenyl)-1-
ethoxyacetic acid ethyl ester, O-trimethylsilyl; acetic acid, butyl
ester;benzenethanol;2[3,3]-14α-Trihydroxy-27-nor-5a-cholest-7-en-6-one; 3-O-
acetyl-exo-1,2-O-ethylidene-α-d-erythrorufanos; 3-(2-furyl)-3-methyl-1,2-
diphenylcyclopene; 2-(1-Hydroxyethyl)-2-methyl-1,3-oxathiolane
PS 14 Fun tumia Africana L
Phenol, 1,6-di-t-butyl-4-[2-[N,N-dimethylamino]ethyl]-Benzonic acid, 2-methyl-
(2-methylphényl)methyl ester; quercetatin; resveratrol; ellagic acid;levodopa; 2-
propenoic acid, 3-(4-hydroxy-3-methoxyphenyl)-; benzofuran-2-carboxylic acid;
Acetic acid, phenyl ester;
PS 15 Tetrpleura tetraptera L
D-sterapine;dammar-22-en-3-ol, 20,24-epoxy-24-methyl-, 2,8-bornanedioi, 2,6-
diazipo(4,4)nonane-3,7-dione; formic acid;oxybenzene, 3-hexyn-1-ol;
Imidazole, 2-amino-5-[2-(carboxyvinyl)];-dinoso acetate
PS 16 Tetrpleura tetraptera SB
Mannosamine; dl-allo-cystathionine;thiokarbamate, S-methyl-,N-(2-methyl-3-
oxoybutyl)-butanoic acid, 2-amino-4-(methylsulfanyl); gala-lido-ido-ctose; 5-
 nitromidazole-4-propionic acid
PS 17 Detarium senegalense L
2,7-Bis-pyrryl[2-(2-hydroxy-ethoxy)-ethoxy]-ethyoxymorpho-fluoren-9-
one;isopropcetic acid, N-(3-methylbenzoyl) pentadecyle; benzoic acid ester; beta-caroten; succinic acid, phenethyl 2-chloroethyl ester
PS 18 Newbouldia laevis L
12-Hydroxysearic acid, phenacel ester; d-a-friedoolecan-1-one, 3,24-dihydroxy-
glutaric acid, heptylthethylhydrofurufyel ester;2-[N-methylacetamido]-4-phenyl-6-
methyl-8-benzylidene-5,6,7,8(4H)-tetrahydropyridine(4,3-
d)-1,3-thiazine;tetra bromo-O-sulfobenzoic anhydride
PS 19 Newbouldia laevis SB
S-[2-(2-Hydroxy-3-isopropoxypropylamino)ethyl][thiophosphate; D-fructose,
diethyl mercapta; pentaceteate; L-glucose; 9-oxacyclo[6,1,0]nonan-4-ol; D-
sterapine, 5-thio-D-glucose
PS 20 Khaya ivorensis L
Pregann-20-one, 2-hydroxy-5,6-epoxy-15-methyl-; morphinan-3,14-diol, 4,5-epoxy-
; R-limonene,aAndrostan-3-one, cyclic 1,2-ethanediy mercaptole, (5α)-furan-2-
one, 3,4-dihydroxy-5-[1-hydroxy-2-fluoroethoxy]-pyrazole[4,5-b]imidazole, 1-
formyl-3-ethyl-6-[d-ribofuranosyl]-; D-sterapine; Phosphorothioic acid, S-ester
with trimethylatednimino propanethiol (2:1)
PS 21 Nuclea latitolia L
Cystine; D-sterapine; pyrrolizin-1,7-dione-6-carboxylic acid, methyl (ester);
mannosamine, 6H-1,2,5-Octadiazole[3,4-E]indole-6,8-a-diol, 4,5,5a,7,8a-
 hexahyro-, 3-oxide; Pyrazole[4,5-b]imidazole, 1-formyl-3-ethyl-6-[d-
ribofuranosyl]-; d-Glycero-dido-heptose
PS 22 Abutilon mauritianum L
dl-allo-cystathionine; 6H-1,2,5-octadiazole[3,4-E]indole-6,8-a-diol, 4,5,5a,7,8a-
 hexahydro-, 3-oxide; 1-gala-lido-cto; 4,4-ethylgenoxygen-pentanenitrile; 2-
aminoquinoline-4-carboxylic acid;furan-2-one, 3,4-dihydroxy-5-[1-hydroxy-2-
fluoroethoxy]-chlororotocine; 4-cyclopropylcarbonyloxytridecane; 1-(3-
hydroxypropyl)-2-piperidione,
PS 23 Arctocarpus altillis L
D-arabino-hexose, 2-deoxy-, cyclic 1,2-ethenediy mercapta, tetraacetate; pentanol,
5-amino-, imidazole-4-carboxylic acid, 2-fluoro-1-methoxyethyl-, ethyl ester,
valine, 3-[sulfotio]
PS 24 Arctocarpus altillis SB
Gentamicin a; Pyridine-3-carboxamide, 1,2-dihydro-4,6-dimethyl-2-thioxo-
;sparsomycin, l-gala-lido-ido-cto;pentanoic acid, 3,3-dimethyl-4-semicarbazono-
L = leaf; SB = stem bark

NNAJI, J. C; AMAKU, J. F; NGWU, C. M; CHUKWUEMEKA-OKORIE, H. O; AKPOMIE, K. G; UGWU, B. I; SIYAKA, M. Z; ODOEMELAM, S. A
Antimicrobial Activity: The result of the antimicrobial screening of the plant extracts are shown in Figures 1 – 3. It can be observed that the extracts showed degrees of inhibition on the microorganism investigated. All the plant extracts exhibited higher inhibition zone towards the gram positive *S. aureus* than the gram negative *P. aeruginosa*. The microorganisms were sensitive to MGL, SNPT, NCLF and TTSB which can be attributed to the presence of secondary metabolites including steroids, flavonoid, alkaloids, terpenoids, glycosides (Cai et al. (2004). Metabolites like flavonoids can complex with microbial cells and soluble proteins. Alkaloids have biological activities such as anti-plasmodic, analgesic and the ability to intercalate between DNA strands Ofokansi et al. (2013).
Conclusion: The FRAP and DPPH assays show Irvingia gabonensis leaf (IGL) and Tamarind stem bark (TSB) extracts had the highest contents of phenolic compounds and the highest antioxidant activities compared to other plant extracts. Therefore, the extracts could be considered as natural sources of antioxidants for treatment of diseases caused by free radicals. The finding also suggest that these plant extracts could be effective and efficient materials for the treatment of bacteria caused by Staphylococcus aureus.

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