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# Chemical Composition, Antioxidant, and Antimicrobial Activity of *Parinari excelsa* Seed

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**ABSTRACT:** Medicinal plants contain rich phytochemicals, and antioxidant compounds that affect physiological functions, fighting diseases related to inflammation and pains. They also have influence against bacteria, fungi, and parasites that cause several ailments. *Parinari excelsa* is a medicinal plant which belongs to the family of Chrysobalanaceae. In this study, *Parinari excelsa* seed was extracted with n-haxane through Soxhlet extraction method, concentrated with rotary evaporator to obtain the extract. The chemical components was evaluated by phytochemical, and Gas-Chromatography-Mass Spectrometry (GC-MS) methods, after which the antioxidant activity was carried out using 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and hydrogen peroxide ($H_2O_2$). Antimicrobial study was carried out by agar well diffusion method against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Candida albicans*, *Aspergillus niger*, and *Penicillium chrysogenum*, at 25, 50, 75, and 100 mg/mL, From the results, many constiuents of health importance were found in the extract, including a diverse range of phytoconstituents, both saturated and unsaturated, with notable quantities of omega-3 fatty acids (eicosapentadecanoic methyl ester), 1,15-Pentadecanediol, fatty acids amide (palmitic acid amide and Z-9-Octadeceamide), and lauric acid derivative. The plant's seed extract demonstrated a very high antioxidant activity across the various assays, with ABTS showing greater scavenging activity (13.697 µg/mL), followed by $H_2O_2$ (14.999 µg/mL), and DPPH (17.967 µg/mL) being the least; thus, indicating their complementary antioxidant properties. The plant also demonstrated greater effectiveness against the bacteria than the fungi investigated, especially with *B. subtilis* and *E. coli*. The minimum inhibitory concentration, and minimum bactericidal concentration of the sample resonate at 75-100 mg/mL, and at 50-75 mg/mL, respectively. This study justifies the traditional uses of the plant and proposes the use of its seeds to fight infections.

**Keywords:** Medicinal plant, *Parinari excelsa*, Phytochemical, Bioactive compounds, Antioxidant, Antimicrobial.

## Introduction

Medicinal plant extracts are rich in phytochemical, antioxidant and antimicrobial components which influence physiological processes. Phytochemicals and antioxidants compounds such flavonoids, phenolic acids, and carotenoids improve plant survival and resistance by neutralizing free radicals generated under stressful conditions (Edema *et al*., 2009; Ogwuche *et al*., 2020; Garcia and Rodriguez, 2021). In addition to their biological roles, antioxidants prolong the shelf life of foods, cosmetics, and medications by halting the production of free radicals that can result from the reaction of fatty acids with oxygen (Halliwell *et al*., 2015). Knowing how to combine fatty acids with antioxidant activity evaluations provides important information about the health advantages of plant extracts because the content of fatty acids might influence an extract's total antioxidant capacity (Williams and Garcia, 2023).

*Parinari excelsa* Sabine, (common name the Guinea plum) is a large, evergreen tree in the family Chrysobalanaceae. It is wide distributed in tropical Africa and the Americas. Many West African societies eat the plant's fruits for their nutritional value (Doe and White, 2021), despite it's wood long been utilized for toolmaking and construction (Smith and Johnson, 2022). The plant's ethnobotanical significance is highlighted by the fact that parts of it are also important in cultural events and rituals (Jones *et al*., 2023). *Parinari excelsa*,

are also commonly used as spices and local medicine and believed to help in treatment of cold and many other diseases. The plant is used because of its ability to relieve a variety of pain ailments. According to Nwodo *et al*. (2016), it is used to treat conditions linked to inflammation, demonstrating its ability to lessen pain and swelling. Malaria has also been historically treated using *Parinari excelsa* roots and leaves (Ogunleye and Adeyemi, 2021). These traditional and important uses of the plant against these infections and ailments, including microorganisms and parasites, highlights the efficacy of the components in its make up.

The evaluation of chemical components and antioxidant activities in the extracts of *Parinari excelsa* is a promising step to highlighting their applications in medicine and health (Okoro and Adewale, 2022). Therefore, this study is aimed to explore the chemical components, antioxidant, and antimicrobial aspects of the plant's seed.

## Materials and methods

*Materials:* Chemical reagents (analytical grade) used are n-Hexane, DPPH, ABTS, hydrogen peroxide, etc., and apparatuses used in the study include Analytical balance (Mettler Toledo ME204E, Switzerland), Soxhlet Extractor, Rotary Evaporator (Büchi Rotavapor® R-300, Switzerland), UV-Visible Spectrophotometer (Shimadzu UV-1800, Japan), Gas Chromatograph–Mass Spectrometer (GC-MS, Agilent Technologies 7890A GC with 5975C mass selective detector, coupled with the NIST Library for compound identification), Water Bath (Grant SUB Aqua Pro, UK), Oven (Memmert UN30 Universal Oven, Germany), Centrifuge (Hettich EBA 200, Germany). Plant material used: *Parinari excelsa*. Microrganisms employed in the study are *E. coli*, *S. aureus*, *P. aeruginosa*, *B. subtilis*, *C. albicans*, *A. niger*, and *P. chrysogenum*

*Collection, preparation and extraction of the sample*: The fresh seeds of *Parinari excelsa* were collected from herbal market (Igbudu) in Warri, Delta State, Nigeria and authenticated by a taxonomist in the Department of Botany, Delta State University, Abraka, Delta State, Nigeria, and herbarium number (DELSU-378) allocated. After then, washed, dehusked, and ground using an electric blender and stored in airtight containers under dry conditions prior to Soxhlet extraction with n-Hexane for 8 hours to obtain the extract.

*Phytochemical screening*: The procedure for phytochemical screening followed the method of Adewoyin *et al*. (2017), and Onunkwo (2021), to screen for tannins, alkaloids, terpenoids, steroids, flavonoids, glycosides, saponin, and volatile oils.

*Gas chromatography-mass spectrometry (GC-MS)analysis for fatty acids profile:* The n-hexane extract was be mixed with methanolic sulfuric acid (2% sulfuric acid in methanol) to catalyze the esterification process before the mixture was heated to 60°C for 2 hours. After esterification has been achieved, distilled water was added, and Fatty Acid Methyl Esters (FAMEs) were extracted with n-hexane. The FAMEs separated were then used for GC analysis/characterization. The FAMEs form of the extract was inserted the GC-MS Column (HP-5MS (30 m × 0.25 mm × 0.25 µm)) at an Oven temperature: 50°C (2 min hold), ramped at 10°C/min to 300°C, and injection temp. of 250°C, with Helium carrier gas (at 1 mL/min). The resultant frequency results was analysed in the mass detector section operating at mass range of 50–600 m/z for identification of compounds and their masses by comparing retention indices and mass spectra with the NIST (National Institute of Standards and Technology) database.

*ABTS radical scavenging activity:* ABTS 7 mM and 2.45 mM potassium persulphate were mixed and dissolved in double distilled water. The solution was then diluted with distilled water in a 1:9 v/v ratio. A 190 µl volume of reagent was pipetted into a microtiter well with succeeding addition of 10 µl of sample/standard (gallic acid, ascorbic acid). Absorbance was measured at λ=735 nm. A reagent blank reading was taken (A0) and after addition of sample, the absorbance (A6) reading was taken after 6 min after initial mixing. For calculating the antioxidant activity, values before the start of decrease of the absorbance (A0–A6) and the last measurement value was used (Re *et al*., 1999; Khatua *et al*., 2017).

Values were calculated accordance to formula: % ABTS Scavenging = (A0 –A6)/A0) 100

*DPPH assay radical scavenging activity*: The DPPH reagent was DPPH (8 mg) dissolved in MeOH (100 mL) for a solution concentration of 80 µL/mL. To determine the scavenging activity, 100 µL DPPH reagent was mixed with 100 µL of sample in a 96-well microplate and was incubated at room temperature for 30 min. After incubation, the absorbance was measured 514 nm using a microplate reader, and 100 % methanol was used as a control (Reische *et al*., 2002; Khatua *et al*., 2017). The DPPH scavenging effect was measured using the following formula:

$$\% \text{ DPPH Scavenging} = (A0 - A10)/A0) \ 100$$

*Hydrogen peroxide scavenging activity aAssay*: The method described by Khatua *et al*. (2017) was adopted. A solution of hydrogen peroxide (20 mM) was prepared in sodium phosphate buffer (pH 7.4). Various

concentrations of 1 mL of extract or ascorbic acid (reference antioxidant) in methanol were added to 2 mL (20 mM) of the hydrogen peroxide. The absorbance was measured at 230 nm after 10 min against a blank solution that contained extracts in sodium phosphate buffer without hydrogen peroxide.

*Antimicrobial assay:* The antimicrobial activity of the extract was evaluated using the agar well diffusion method. All the microbes used were subjected to 0.1 McFarland standard solution is 1% of $H_2SO_4$ plus 1 mL of $BaCl_2$. All the Nutrient agar plates were prepared and labelled accordingly. From the extract concentrations of 25, 50, 75, and 100 mg/mL, a sterile pipette was used to transfer 1 mL or 100 µL to the corresponding hole bore on the agar plate. This continues until the last concentration, followed by, inoculation with bacterial and fungi strains (*E. coli*, *S. aureus*, *P. aeruginosa*, *B. subtilis*, *C. albicans*, *A. niger*, and *P. chrysogenum*), then incubation at a temperature of 37 °C for 24-48 hours for bacteria plates, whereas fungi plates were incubated at room temperature 28 °C for 3-5 days. After which, zone of inhibition was measured, and Minimum Inhibitory Concentration (MIC) were determined in millimeters. The samples were further inoculation using the MIC plates in the agar media at the various concentrations to observe for turbidity test (Minimum Bactericidal Concentration (MBC)/Minimum Fungicidal Concentration (MFC)).

*Antibiotics susceptibility test*: A 3.7 g of Muller Hinton agar was weighed, sterilized using an autoclave at a temperature of 121 °C for 15 min. The agar was later poured on the sterile petri dishes at a cooling temperature of 40-45 °C. All the test isolates were inoculated on the agar with the exceptions of fungi isolates. Also, potato dextrose agar was used for fungi isolates. A sterile force was used to place gram disc and gram disc on already solidify and inoculated agar plates. All the plates were incubated at a temperature of 37 °C for whereas fungi plates were incubated at room temperature 28 °C for 3-5 days. After incubation, individual antibiotic discs and their zone of inhibitions were measured using a graduated measuring ruler and recorded in mm.

*Data analysis:* All experiments were carried out in triplicate. Results were expressed in statistical analysis as mean ± standard deviation using Microsoft Excel software 2016 package.

## Results and Discussion

*Phytochemical screening result*: The results of the phytochemical screening of the extracts are shown in Table 1.

**Table 1:** Results of phytochemical screening of *Parinari excelsa*

| **Phytochemicals** | ***Parinari excelsa*** |
|---|---|
| Tannins | - |
| Flavonoids | + |
| Terpenoids | ++ |
| Alkaloids | ++ |
| Saponin | ++ |
| Volatile oil | + |
| Cardiac glycosides | ++ |
| Steroids | ++ |

Key: ++ = Abundantly present; + = Moderately present; - = Absent

From Table 1, alkaloids, terpenoids, saponin, steroids, and cardiac glycoside were found to be abundantly present in *Parinari excelsa*, and flavonoids and volatile oils were also present but in moderate amount. However, tannin was absent in plant. These phytochemicals found the plants have a lot of pharmacological importance, and also show why they are used for traditional purposes to treat infections. For example, Plant steroids are used in the cosmetic, soap and pharmaceutical industries to produces creams, soaps and ointments; also alkaloids also have antibacterial and anti-inflammatory properties (Oduje *et al*., 2015; Masesh *et al*., 2011). This explains while they are used traditionally to treat colds and various other ailments (Ogunleye and Adeyemi, 2021; Olawale and Nnamdi, 2023; Okafor and Adeyemi, 2023; Singh and Shukla, 2024).

*GC-MS chromatogram of Parinari excelsa extract*: The GC-MS chromatogram of *Parinari excelsa* extract result is shown Figure 1.

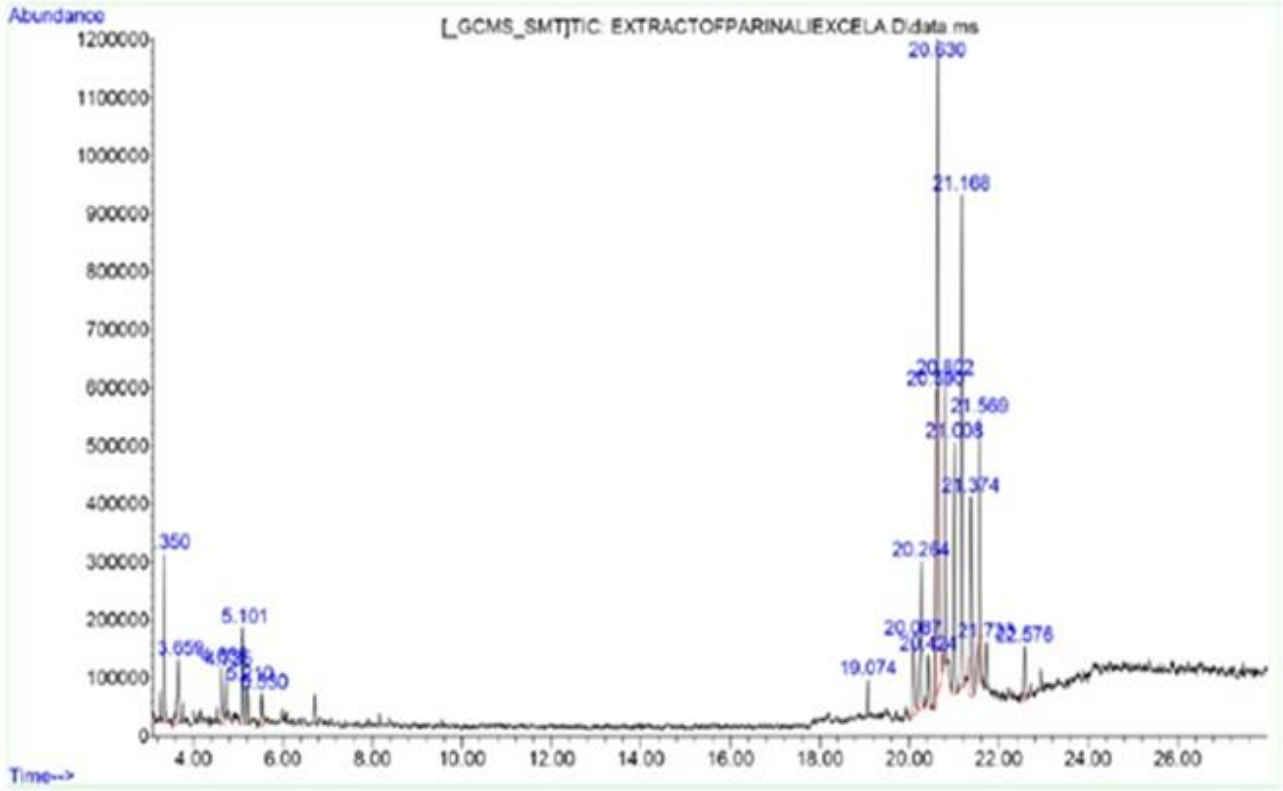


**Figure 1:** GC-MS Chromatogram of *Parinari excelsa*.

The chromatogram (Figure 1) illustrates the abundance of ionized fragments on the y-axis plotted against retention time on the x-axis. The GC-MS analysis of *Parinari excelsa* extract identified approximately 20 compounds, including aromatic hydrocarbons, essential fatty acids, and esters, within a retention time ranged of 3 to 24 minutes. At 3 and 7 minutes, the presence of volatile low-molecular-weight compounds were observed; less volatile compounds were found within the retention times of 19 to 22 minutes; and most prominent peak appeared at 20.530 minutes. These sharp, high-abundance peaks represent high molecular weight compounds, likely consisting of essential hydrocarbons such as o-Xylene (106.078 amu, 3.35 RT); Mesitylene (120.094 amu, 5.095 RT); Hexadecanamide (225.256 amu, 19.074 RT); fatty acids such as 12-Hydroxydodecanoic acid (216.173 amu, 20.087 RT); Beta-pinene (136.125 amu, 20.264); (Z)-9-Octadecenamide (281.272 amu, 20.630 RT); (Z)-5,8,11,14,17-Eicosapentaenoic acid (EPA), methyl ester (316.24 amu, 20.168 RT): 4,7,10,13,16,19-Docosahexaenoic acid (DHA), methyl ester (342.256 amu, 21.38 RT); Bicyclo[2.2.1]heptane, 7,7-dimethyl-2-methylene- (136.125 amu, 21.569 RT); Cyclooctaneacetic acid, 2-oxo- (184.11; 21.723 RT); and Urea, N-phenyl-N'-1H-purin-6-yl- (254.092 amu, 22.576 RT) (Table 2).

**Table 2:** Results of Fatty acid profile of *Parinari excelsa*

| **Major Constituents of *Parinari excelsa* extract** | **Mass (amu), and Retention time (RT)** | **Function (from NIST and NIH databases)** |
|---|---|---|
| Hexadecanamide | 225.256 amu, 19.074 RT | Palmitic acid amide (anti-inflammatory, antioxidant, and neuroprotective agent) |
| (Z)-9-Octadecenamide | 281.272; 20.630 | fatty acids amide (cardio protector) |
| o-Xylene | 106.078; 3.35 | Potential use as germicide |
| Mesitylene | 120.094; 5.095 | anti-inflammatory & analgesic |
| (Z)-Eicosapentaenoic acid, methyl ester | 316.24 amu, 20.168 RT | Omega-3 fatty acid used as additive in pharma. & nutraceuticals |
| 4,7,10,13,16,19-Docosahexaenoic ester | 342.256 amu, 21.38 RT | Potential cardio protector |
| Beta-pinene | 136.125 amu, 20.264 | Antimicrobial, and anti-inflammatory |
| 12-Hydroxydodecanoic acid | 216.173 amu, 20.087 RT | Lauric acid (antibacterial & antifungal) |

This chromatographic pattern suggests that *Parinari excelsa* is primarily composed of dominant phytochemicals in high concentration, likely contributing to its observed pharmacological properties, including strong

antioxidant and moderate antimicrobial activities. (Dokubo *et al*., 2013; Dokubo *et al*., 2021; Adedapo and Oladejo, 2021). The presence of high-impact bioactive compounds in *Parinari excelsa* reinforces its therapeutic relevance.

*ABTS radical scavenging activity*: The result of the scavenging activities of ABTS in relationship to ascorbic acid standard is shown in Table 3. The plotting to calculate the scavenging values is shown in Figure 2. From the results, the calculated IC50 value of the *Parinari excelsa* was 13.697µg/mL, and that of the standard ascorbic acid was -1.377µg/mL. The *Parinari excelsa* seed extract showed antioxidant activity with ABTS, though lower than that observed using standard ascorbic acid. The strong antioxidant activity obtained in *Parinari excelsa* seed extract is as a result of rich phytochemicals present in the plant; as the greater the presence of these bioactive compounds in an extract, the more the antioxidant activity (Omenna, 2015; Sunitha, 2016; Devipriya *et al*., 2021; Okafor and Adeyemi, 2023).

**Table 3:** ABTS Antioxidant Activity of *Parinari excelsa*

| Concentration (µg/ml) | Scavenging Effect | % Scavenging Effect | % Ascorbic Acid |
|---|---|---|---|
| 10 | 1.0853 | 5.266±0.035 | 65.028±0.010 |
| 20 | 1.0357 | 9.601±0.024 | 77.859±0.032 |
| 50 | 0.9623 | 16.002±0.001 | 89.177±0.059 |
| 100 | 0.9483 | 17.224±0.000 | 95.025±0.014 |
| 150 | 0.9327 | 18.592±0.003 | 95.985±0.003 |

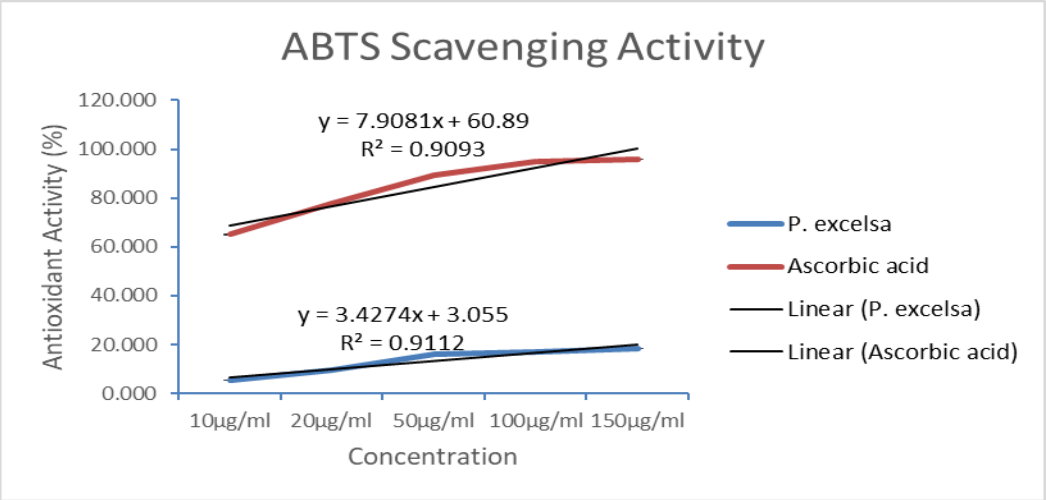


**Figure 2:** ABTS scavenging ability of n-hexane seed extract of *Parinari excelsa*

*DPPH assay radical scavenging activity*: The result of the scavenging activities of DPPH in relationship to ascorbic acid standard is shown in Table 4. The plotting to calculate the scavenging values is shown in Figure 3. From the results, the calculated IC50 value of the *Parinari excelsa* was 17.967µg/mL, and that of the standard ascorbic acid was 10.170µg/mL. The *Parinari excelsa* seed extract showed antioxidant activity with DPPH, though lower than that observed using standard ascorbic acid. The strong antioxidant activity obtained in *Parinari excelsa* seed extract is as a result of rich phytochemicals present in the plant; as the greater the presence of these bioactive compounds in an extract, the more the antioxidant activity (Omenna, 2015; Sunitha, 2016; Devipriya *et al*., 2021; Singh and Shukla, 2024).

**Table 4:** DPPH antioxidant scavenging activity (%) of *Rhaphiostylis beninensis*

| Concentration (µg/ml) | Scavenging Effect | % Scavenging Effect | % Ascorbic Acid |
|---|---|---|---|
| 10 | 0.4537 | -1.795±0.002 | 74.346±0.001 |
| 20 | 0.4387 | 1.571±0.000 | 78.684±0.001 |
| 50 | 0.4143 | 7.031±0.002 | 79.806±0.004 |
| 100 | 0.4087 | 8.302±0.000 | 80.030±0.001 |
| 150 | 0.4017 | 9.873±0.001 | 84.892±0.004 |

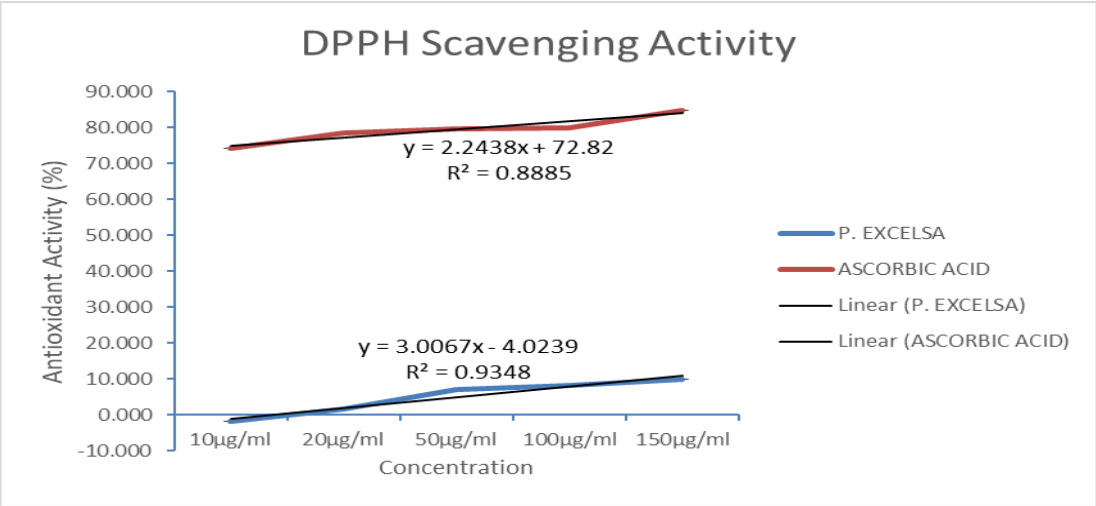


**Figure 3:** DPPH scavenging ability of n-hexane seed extract of *Parinari excelsa*

*Hydrogen peroxide scavenging activity assay*: The result of the scavenging activities of $H_2O_2$ in relationship to ascorbic acid standard is shown in Table 5. The plotting to calculate the scavenging values is shown in Figure 4. From the results, the calculated IC50 value of the *Parinari excelsa* was 14.999µg/mL, and that of the standard ascorbic acid was 5.841µg/mL. The *Parinari excelsa* seed extract showed antioxidant activity with $H_2O_2$, though lower than that observed using standard ascorbic acid. The strong antioxidant activity obtained in *Parinari excelsa* seed extract is as a result of rich phytochemicals present in the plant; as the greater the presence of these bioactive compounds in an extract, the more the antioxidant activity (Omenna, 2015; Sunitha, 2016; Devipriya *et al*., 2021; Singh and Shukla, 2024).

Overall, the plant extract possesses a very high antioxidant property across the assays with ABTS showing greater property (IC50, 13.697µg/mL), followed by $H_2O_2$ ($IC_{50}$, 14.999 µg/mL), and DPPH ($IC_{50}$, 17.967 µg/mL) being the least. This is an indication that when it is consumed, it has the ability to mop up free radicals that causes oxidative stress from the blood stream (Kohen and Nyska, 2002; Olawale and Nnamdi, 2023).

**Table 5:** $H_2O_2$ antioxidant scavenging activity assay of *Parinari excelsa*

| Concentration (µg/ml) | Scavenging Effect | % Scavenging Effect | % Ascorbic Acid |
|---|---|---|---|
| 10 | 0.1527 | 2.553±0.001 | 8.511±0.001 |
| 20 | 0.1473 | 5.958±0.001 | 12.341±0.001 |
| 50 | 0.1413 | 9.787±0.001 | 25.107±0.000 |
| 100 | 0.1370 | 12.553±0.001 | 28.936±0.001 |
| 150 | 0.1313 | 16.170±0.001 | 45.745±0.001 |

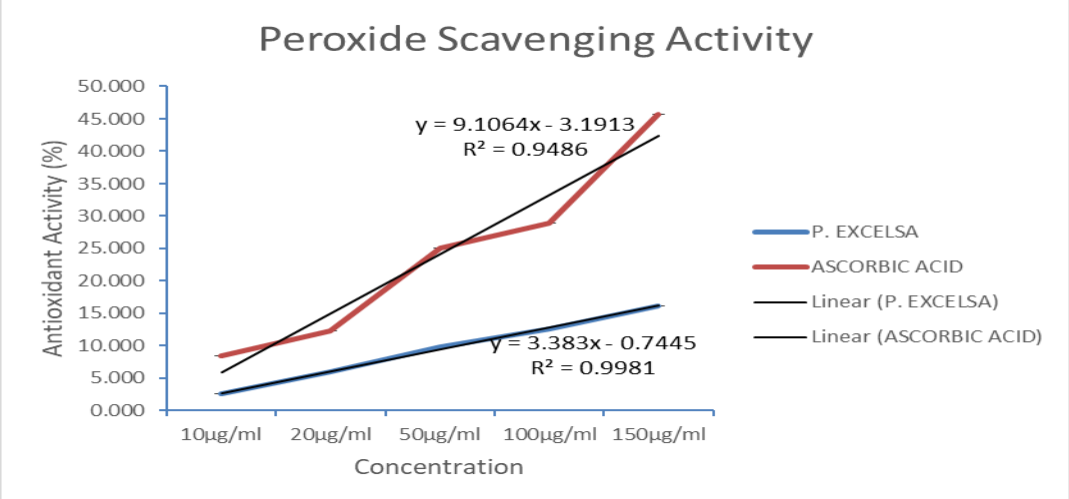


**Figure 4:** $H_2O_2$ scavenging ability of n-hexane seed extract of *Parinari excelsa*

*Antimicrobial Investigation of Parinari* excelsa: The antimicrobial analysis results of extract against *E. coli*, *S. aureus*, *P. aeruginosa*, *B. subtilis*, *C. albicans*, *A. niger*, and *P. chrysogenum* are shown in Tables 6 to 8.

**Table: 6:** Antimicrobial activity results of *Parinari excelsa*

| **Isolates** | **25 mg/mL** | **50 mg/mL** | **75 mg/mL** | **100 mg/mL** |
|---|---|---|---|---|
| *E. coli* | 0 mm | 0 mm | 8 mm | 11 mm |
| *S. aureus* | 0 mm | 0 mm | 0 mm | 10 mm |
| *P. aeruginosa* | 0 mm | 0 mm | 0 mm | 8 mm |
| *B. subtilis* | 0 mm | 5 mm | 7 mm | 12 mm |
| *A. niger* | 0 mm | 0 mm | 0 mm | 8 mm |
| *P. chrysogenum* | 0 mm | 0 mm | 0 mm | 5 mm |
| *C. albicans* | 0 mm | 0 mm | 0 mm | 9 mm |

**Table: 7:** Minimum bactericidal concentration (MBC) for *Parinari excelsa*

| **Isolates** | **25 mg/mL** | **50 mg/mL** | **75 mg/mL** | **100 mg/mL** |
|---|---|---|---|---|
| *E. coli* | +ve | +ve | - | - |
| *S. aureus* | +ve | - | - | - |
| *P. aeruginosa* | +ve | - | - | - |
| *B. subtilis* | +ve | +ve | +ve | +ve |
| *A. niger* | +ve | +ve | - | - |
| *P. chrysogenum* | +ve | +ve | +ve | +ve |
| *C. albicans* | +ve | +ve | - | - |

**Table 8:** Antibiotics sensitivity analysis

| **Standard Antibiotics** | **Potency** | ***E. coli*** | ***P. aeruginosa*** |
|---|---|---|---|
| Offloxacin | 10µg | 0 (r) | 15 mm (s) |
| Augmentin | 30µg | 0 (r) | 12 mm (s) |
| Pefloxacin | 10µg | 0 (r) | 10 mm (s) |
| Ceftazidime | 30µg | 0 (r) | 10 mm (s) |
| Gentamycin | 10µg | 0 (r) | 13 mm (s) |
| Cipofloxacin | 10µg | 0 (r) | 16 mm (s) |
| Ceporex | 10µg | 0 (r) | 8 mm (r) |
| Ceftriaxone | 30µg | 18 mm (s) | 12 mm (s) |
| Streptomycin | 30µg | 9 mm (s) | 0 (r) |
| Cefuroxine | 30µg | 0 r | 9 mm (s) |
| **Fungi sensitivity** | | | |
| Antibiotics | potency | *C. albicans* | *A. niger* |
| Fluconazole | 10µg | 8 mm (s) | 5 mm (r) |
| Nystatin | 5µg | 0 (r) | 0 (r) |
| Miconazole | 5µg | 4 mm (r) | 0 (r) |

Key: S=Sensitivity; R=Resistant

From Table 6, the extract exhibited more efficacy against *B. subtilis* (at 5, 7, and 12 mm for 50, 75, and 100 mg/mL concentrations, respectively), followed by *E. Coli* (at 8, and 11 mm for 75, and 100 mg/mL concentrations, respectively). *P. aeruginosa*, *C. albicans*, *A. niger*, and *P. chrysogenum* had resistance from 5 to 10 mm for 100 mg/mL. The MIC of *Parinari excelsa* was obtained at 75 mg/mL for *E. coli* and *B. subtilis* at 8 and 7 mm, and greater inhibitions of 11 and 12 mm at 100 mg/mL were observed against the same bacteria, respectively. For the MBC results (Table 6), *Parinari excelsa*'s bactericidal potency was at lower concentrations (with turbidity at 25 mg/mL for *S. aureus* and *P. aeruginosa*, and no bacterial growth at 50-100 mg/mL for the same organisms). Bacterial growth (shown by turbid tube) was recorded from 25-50 mg/mL for *E. coli*, and 25-75 mg/mL for *B. subtilis*. And for fungi strains, MFC turbidity was observed from 25-50 mg/mL for *A. niger* and *C. albicans*; and that for *P. chrysogenum*, it was across all concentrations tested (Table 6). This showed that the MBC of the extract resonates more at 50-75 mg/mL. Some results were comparable to that obtained in the works of Adewoyin et al. (2017), and Olawale and Nnamdi (2023). In comparison, antibiotics sensitivity analysis showed that *E. coli* was resistant to most standard antibiotics (e.g., Ofloxacin, Augmentin, etc.), except Ceftriaxone (18 mm), highlighting the possible use of the extract as a closer alternative due to its efficacies against the organism, though lower concentrations were used for the antibiotics when compared to the extract (Table 7).

It is worthy to note that *P. aeruginosa* was susceptible to several antibiotics (e.g., Ciprofloxacin: 16 mm) (Table 6), and the antibiotics showed stronger efficacy when compared to the extract for the same organism. Fungal isolates displayed higher sensitivity (8 mm) to a standard antifungal like Fluconazole for *C. albicans*, and minimal resistance (5 mm) for *A. Niger*. No resistance was observed for Nystatin against the two organisms, however, minimal resistance (4 mm) was observed against *C. albicans* for Miconazole (Animashaun *et al*., 2023). The *Parinari excelsa* extract has limited antifungal performance when compared to the antifungal drugs, although it can function as natural antimicrobial alternative. These results suggest that the phytoconstituents as observed in the plant compounds are more effective at disrupting bacterial cell membranes than fungal cell walls, possibly due to structural differences and sample's concentrations (Olawale and Nnamdi, 2023; Onunkwo and Ezechi, 2025) Generally, the antimicrobial activity showed that *Parinari excelsa* has a promising application for combating *S. aureus* and *Bacillus subtilis* infections, particularly in the context of increasing antibiotics resistance. However, the reduced activity at some concentrations; and its limited antifungal efficacy, highlights the need for formulation improvements, for the sample's bioavailability. Additionally, the antibiotics can also be improved in the same perspective against resistant strains during administration, especially against *E. coli*. Overall, these findings emphasize the potentials of *P. excelsa* extract had to be used as targeted antimicrobial agent, justifying therapeutic and traditional applications (Olawale and Nnamdi, 2023).

## Conclusion

This research explored the phytochemical richness, antioxidant potential, and antimicrobial activity of the n-hexane extract of *Parinari excelsa* seed, a plant recognized in ethnomedicine for its therapeutic benefits. Gas Chromatography-Mass Spectrometric analysis carried out on the extract revealed the presence of several bioactive constituents in the plant, with notable quantities of omega-3 fatty acids (eicosapentadecanoic methyl ester), 1,15-Pentadecanediol, fatty acids amide (palmitic acid amide and Z-9-Octadeceamide), lauric acid derivative, and other compounds of health importance. Greater scavenging activity was observed with ABTS, followed by $H_2O_2$, and DPPH, indicating its complementary use as a plant rich in antioxidant properties for managing diseases and mopping up free radicals that lead to oxidative stress. The plant also demonstrated greater effectiveness against the bacteria than fungi investigated, especially with *B. subtilis* and *E. coli*.

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