Assessment of Antimicrobial Activity of Ethanol Extracts of *Commiphora africana* and *Boswellia dalzielii*

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**Abstract**

This study assessed the comparatively antimicrobial activity of ethanol extracts of *Commiphora Africana* and *Boswellia dalzielii*. The crude ethanol extracts of their dried stem bark were obtained by macerating powdered in ethanol for 72 h. The extracts were evaluated using modified agar-well diffusion technique. All extracts showed strong activity against the test gram-positive and gram-negative microorganisms. *C. Africana* (IZD, 20 mm and 15 mm) exhibited greater potency than *B. dalzielii* (IZD, 12 mm and 10 mm) against *S. aureus* and *P. aeruginosa*, respectively at the same concentration (100 mg/mL). *S. aureus* showed greatest susceptibility while *P. aeruginosa* was the least for both extracts. The stem bark extract of *C. Africana* possess greater antituberculosis activity compared to *B. dalzielii*.

1 Introduction

Pathogenic microorganisms have unfavourable effects on the quality and safety of life. Synthetic chemicals are widely used against the microorganisms. Unfortunately, they develop resistance to many antimicrobial agents. The reason for this high resistance to commonly used antimicrobial agents may not be unconnected with the worldwide and indiscriminate use in the environment. In addition, these antimicrobials sometimes cause allergic reaction and immunity suppression. Presently, the herbal drugs play chief role for substitution of synthetic drugs due to fewer side effects and immunity resistance. The use of essential oils and plant extracts are less damaging the human health and environment. Plants provided an arsenal of chemicals to survive attack by microbial invasion.

*Boswellia dalzielii* Hutch is a deciduous tree in the savanna region of West Africa, growing up to 12 m high. The English name is Frankincense tree, and belongs to the family of Burseraceae. The phytochemical analysis of *Boswellia dalzielii* revealed the absence of alkaloids, while saponins, tannins, flavonoids, cardiac glycosides, steroids and terpenes are present.
presence of phytochemicals such as methylisopropenyl furnace, sesquiterpenes, commiphoric acid, tannins, alkaloids, flavonoids and saponins).

This present study was aimed to compare the antimicrobial effects of ethanol extracts of the stem bark of two highly reputed theological gift items, *Boswellia dalzielii* *Commiphora africana*.

**2 Materials and Methods**

2.1 Collection and identification of plant materials

The plants *Boswellia dalzielii* and *Commiphora Africana* were collected from Owerri, Imo State, Nigeria and official identification was done by Pharm F. N. Osuala, Department of Pharmacognosy, Madonna University, Elele, Nigeria where a voucher specimen has been deposited in the herbarium.

2.2 Preparation of extracts

The fresh stem bark of the two plants were air-dried at room temperature (26 °C) for 14 days; and separately pulverized into powder using mortar and pestle. The powder (1 kg) was extracted with ethanol (Sigma Adrich, Germany) by the maceration process for 72 h. The extracts were filtered, and evaporated using rotary evaporator (RV 05 Basic IB, IKA Staufen, and Germany) at reduced pressure. The concentrated extracts further oven-dried and stored in a refrigerator at 4 °C until they were ready for use.

2.3 Test microorganisms

Pure chemical isolates of *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Escherichia coli*, *Klebsiella pneumonia* and *Staphylococcus aureus* were obtained from Medical Laboratory Unit of Madonna University Teaching Hospital, Elele, Nigeria.

2.4 Determination of sensitivity test and inhibitory zone diameter (IZD)

The modified agar-well diffusion technique was employed. Each of the test microorganisms was streaked on the surface of the different sterile sensitive agar media. Wells were bored on the agar media using sterile cork borer of 6 mm diameter. Exactly 2 drops of the extract prepared as described earlier were accordingly put into the wells and then allowed to stand for 30 min for proper diffusion. Standard drug (Gentamicin 40 µg/ml) was served as control. The plates were then incubated aerobically at 37 °C for 24 h.

2.5 Determination of minimum inhibitory concentration (MIC)

MIC was determined using the micro both dilution technique. The extracts were incorporated at varying concentrations (100, 50, 25, 12.5 and 6.25 mg/mL) into nutrient broth respectively containing the test microorganisms in the test tubes. The control experiments containing the growth medium and each of the test microorganisms excluding the growth were also set. The experiments were incubated at 37 °C for 24 h. The lowest concentration of extract that did not allow microbial growth within the incubation period was taken to be the MIC.

**3 Results**

The ethanol extracts of the stem bark of *Boswellia dalzielii* and *Commiphora africana* showed activity against gram-positive and gram-negative bacteria. The minimum inhibitory concentration of the extracts on the five microorganisms that showed sensitivity and IZD are as shown in the tables 1 and 2. *Staphylococcus aureus* showed greatest susceptibility while *Pseudomonas aeruginosa* was the least, on the activity of both extracts with *C. Africana* exhibiting greater potency. The results of agar diffusion bioassay of the diluted standard drug (Gentamicin) for MIC determination against the susceptible microorganisms are as shown in table 3. Like the extracts of *Boswellia dalzielii* and *Commiphora africana*, the diluted standard drug showed that it was most active against *Staphylococcus aureus*, followed by *Escherichia coli*, while *Pseudomonas aeruginosa* was the least.

**4 Discussions**

The solvent extraction of the stem bark of *Boswellia dalzielii* and *Commiphora africana* yielded the crude ethanol extracts.

The study revealed that antimicrobial efficacy of *B. dalzielii* and *C. africana* against clinical isolates of gram-positive and gram-negative bacteria responsible for the majority of the multi-drug resistant infections in Nigeria. This is in agreement with the report that *B. dalzielii* has a broad spectrum of activity. Another study reported that aqueous extract of the stem bark of *B. dalzielii* showed no antimicrobial activity. In this case, solvent (aqueous) of extraction may be the limiting factor. As an organic solvent, ethanol extracted more of the phytochemicals recognizing that the active components are both polar and non-polar, and they are extracted mainly via organic solvent medium. This agrees with organic solvent extractions being suitable in verifying antimicrobial properties of medicinal plants.

Extrapolations from the graph of IZD against log concentration of extracts and standard antimicrobial gave their MIC values. From the result of minimum inhibitory concentration (MIC), it was observed that the greater inhibition zone diameter produced, the lower the MIC and the more potent the agent. Hence, *C. africana* (IZD, 20 mm and 15 mm) exhibited greater potency than *B. dalzielii* (IZD, 12 mm and 10 mm) against *S. aureus* and *P. aeruginosa* respectively at the same concentration (100 mg/mL). *S. aureus* showed greatest susceptibility while *P. aeruginosa* was the least for both extracts. This finding agreed with the susceptibility of the microbes to different plant extracts. This could be explained by the fact that the cell wall of gram-positive bacteria is less complex and lack the natural sieve effect against large
molecules unlike lipopolysaccharide envelop of gram-negative microorganisms.

Table 1: Result of IZD (mm) and IZD² (mm²) of ethanol extract of the stem bark of *Boswellia dalzielii*

<table>
<thead>
<tr>
<th>Conc. (mg/mL)</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
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<tr>
<td>K. pneumoniae</td>
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<td>121</td>
<td>10</td>
<td>100</td>
<td>9.0</td>
<td>81</td>
<td>6.0</td>
<td>36</td>
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<tr>
<td>P. mirabilis</td>
<td>12</td>
<td>144</td>
<td>9.0</td>
<td>81</td>
<td>8.0</td>
<td>64</td>
<td>6.0</td>
<td>36</td>
</tr>
<tr>
<td>E. coli</td>
<td>12</td>
<td>144</td>
<td>10</td>
<td>100</td>
<td>8.0</td>
<td>64</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>10</td>
<td>100</td>
<td>7.0</td>
<td>49</td>
<td>6.0</td>
<td>36</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S. aureus</td>
<td>12</td>
<td>144</td>
<td>8.0</td>
<td>64</td>
<td>6.0</td>
<td>36</td>
<td>4.4</td>
<td>19.3</td>
</tr>
</tbody>
</table>

(·): means no inhibition

Table 2: Result of IZD (mm) and IZD² (mm²) of ethanol extract of the stem bark of *Commiphora africana*

<table>
<thead>
<tr>
<th>Conc. (mg/mL)</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
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<td>K. pneumoniae</td>
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<td>256</td>
<td>11.5</td>
<td>132.2</td>
<td>9.0</td>
<td>81</td>
<td>6.0</td>
<td>36</td>
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<td>16</td>
<td>256</td>
<td>12</td>
<td>144</td>
<td>11</td>
<td>121</td>
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<td>81</td>
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<tr>
<td>E. coli</td>
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<td>256</td>
<td>14</td>
<td>196</td>
<td>11</td>
<td>121</td>
<td>10</td>
<td>100</td>
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<tr>
<td>P. aeruginosa</td>
<td>15</td>
<td>225</td>
<td>14</td>
<td>196</td>
<td>10</td>
<td>100</td>
<td>9.0</td>
<td>81</td>
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<tr>
<td>S. aureus</td>
<td>20</td>
<td>400</td>
<td>18</td>
<td>324</td>
<td>16</td>
<td>256</td>
<td>15</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 3: Result of IZD (mm) and IZD² (mm²) of *gentamicin* (Concentration of stock = 40 µg/mL)

<table>
<thead>
<tr>
<th>Conc. (mg/mL)</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
<th>IZD²</th>
<th>IZD</th>
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<td>K. pneumoniae</td>
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<td>484</td>
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<td>256</td>
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<td>196</td>
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<td>100</td>
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<tr>
<td>P. mirabilis</td>
<td>22</td>
<td>484</td>
<td>18</td>
<td>334</td>
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<td>256</td>
<td>14</td>
<td>196</td>
</tr>
<tr>
<td>E. coli</td>
<td>25</td>
<td>625</td>
<td>21</td>
<td>441</td>
<td>18</td>
<td>334</td>
<td>17</td>
<td>289</td>
</tr>
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<td>P. aeruginosa</td>
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<td>256</td>
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<tr>
<td>S. aureus</td>
<td>26</td>
<td>676</td>
<td>25</td>
<td>625</td>
<td>24</td>
<td>576</td>
<td>21</td>
<td>441</td>
</tr>
</tbody>
</table>

The standard antimicrobial (Gentamicin) showed very good activity against all the tested microorganisms. The greater activity or potency observed with the use of higher dilution (lowest concentration) of the standard antimicrobial when compared with the crude extracts, was due to their high purity level thus devoid of impurities or contaminant that may antagonized its activities unlike the plants sample extracts. The higher potency exhibited by *C. africana* over *B. dalzielii* may not be unconnected with the presence of alkaloids in the former but lacking in the latter. Alkaloids-rich plants have been shown to possess antimicrobial activity against a number of microorganisms. The inhibitory activities associated with the alkaloids tend to corroborate reports in which the antimicrobial properties of plants had been linked to the presence of tannins, alkaloids, flavonoids and saponins.
5 Conclusions
The ethanol stem bark extracts of C. africana (Myrrh) and B. dalzielii (Frankincense) possess antimicrobial activity with the former being more potent.

6 Conflict of interest
No conflict of interest declared.

7 Author’s contributions
SCO, LUA, FNO and SI participated in collection of data and arranged in tabular form. All authors read and approved the final manuscript.

8 References
24. Natarajan D, Britto JS, Srisnvasan K, Nagamurugan N, Mohanasundari C, Perumal G. Antibacterial activity of


