BIOACTIVE CONSTITUENTS FROM BARK OF PELTOPHORUM 
PTEROCARPUM BAKER EX K. HEYNE

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Abstract– In vitro antimicrobial and antioxidant activities of sequential bark extracts of Peltophorum pterocarpum Baker ex K. Heyne, was tested against four Gram negative, two Gram-positive bacteria and five fungal isolates. Antioxidant profile was investigated using 2, 2-Diphenyl-1-picryl-hydrazyl and reduction capability by ferric ion reducing antioxidant potentials method. Bark ethyl acetate extract showed significant activity against B. subtilis and P. aruginosa (IZ 18.33 ± 0.33 mm and 18.33 ± 0.57 mm with MIC of 62.5 and 31.25 µg/ml, respectively) similarly, higher antioxidant potentials with lower IC 50 value (5 µg/ml; % inhibition of 97.08 at 80 µg/ml), whereas in FRAP method, methanol extract (1463.33 ± 3.33 AAE/mg antioxidant potential) show better activity. Further, GC-MS analysis of the ethyl acetate extract confirmed 33 compounds. The main identified constituent was 1,2-benzenedicarboxylic acid, bis(2-ethylhexyl) ester with 48.9% availability.

INTRODUCTION

Antibiotic resistance is a type of drug resistance where a microorganism develops ability to survive in exposure of an antibiotic. Genes and evolutionary stress such as exposure to antibiotics selects its resistant trait, greater the duration of exposure, greater the risk of the resistance development (D’Costa et al., 2011). Some of the common resistant pathogens are Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis and Candida albicans. Resistance of these pathogenic strains increasing worldwide causing pneumonia, bacteremia, meningitis, sinusitis, peritonitis, food poisoning and arthritis. These problem demands renewed effort to seek new antibacterial agents, effective against pathogenic microorganisms resistant to current antibiotics (Donadio et al., 2008; Gulcin et al., 2009; Wang et al., 2009).

Plants have limitless ability to synthesize aromatic substances, most of which are phenols or their oxygen-substituted derivatives such as tannins. These substances serve as plant defense mechanisms against predation of microorganisms, insects and herbivores. Since long time, traditional healers using plants as medicaments to cure infectious conditions (Lu et al., 2007; Mbwambo et al., 2007). Many of these plants have been investigated for their antimicrobial and antioxidant activities where large number of plant products significantly inhibited growth of pathogenic bacteria and having antioxidant potentials (Senatore et al., 2007; Singh et al., 2007).

Peltophorum pterocarpum Baker ex K. Heyne is a semi-arid tree of 50 feet in height and grows in many part of India as an ornamental tree. Bark of the plant is used in dysentery, as a constituent of gargle, tooth powder, lotions, in eye trouble, muscular pain and sores (Deshaprabhu, 1966). On phytochemical investigation flavonoids from whole plant (Rahman et al., 1969; Varshney and Dubey, 1969); berginin from flowers (Sulochana et al., 1970); peltophorin, leucocyanidin, quercetin from bark, leaves, fruits and wood (Sastry et al., 1977); tannins from roots and essential oils were reported from pod extracts (Badami and Daulatabad, 1969; Menon et al., 1982).
Pharmacologically antimicrobial (Ahmad and Sultana, 2003; Duraiandiyian et al., 2006), antiinflammatory (Menon et al., 1982; Swarnlakshmi et al., 1984), enterohaemorrhagic effect (Voravuthikunchai et al., 2004) have been documented earlier.

This paper describes bioefficacies of *P. pterocarpum* successive extracts with its chemical investigation via GC-MS analysis.

**MATERIALS AND METHODS**

All the chemicals and solvents used in this study were of analytical grade and obtained from HiMedia Chemicals Mumbai, India.

**Plant material**

Arial parts of *P. pterocarpum* were collected at full flowering stage from the campus, University of Rajasthan, Jaipur, in the months of July-Aug 2010 and authenticated from the Herbarium of the Department itself. Voucher specimen have been deposited (Herbarium Sheet No. 20707) in the Herbarium and Laboratory for further reference. For experiment, bark of *P. pterocarpum* collected in the months of July-August, shade-dried and powdered. The powdered plant material was extracted separately in pet. ether, dichloromethane (DCM), ethyl acetate and methanol successively. These extracts were concentrated using vacuum desiccator and stored at 4 °C for further use.

**Antimicrobial activity**

In *In vitro* preliminary analysis, successive extracts were dissolved in DMSO (4 mg/mL concentration). Muller-Hinton agar for antimicrobial and Sabourod Dextrose agar were used for antifungal activities. Pure cultures of Gram +ve bacteria (*Bacillus subtilis*, MTCC 441; *Staphylococcus aureus*, MTCC 740), Gram -ve bacteria (*Escherichia coli*, MTCC 443; *Pseudomonas aeruginosa*, MTCC 741; *Enterobacter aerogenes*, MTCC 111; *Raoultella planticola*, MTCC 530) and fungal strains (*Aspergillus flavus* ATCC 16870; *A. niger* ATCC 322, *Candida albicans* ATCC 4718, *Penicillium chrysogenum* ATCC 5476 and *Tricophyton rubrum* ATCC 2327) were obtained from Institute of Microbial Technology, Chandigarh. These cultures were grown and maintained on Nutrient broth (NB) at 37 °C for 24 h in case of bacteria and Sabouraud Dextrose Broth (SDB) medium at 24 °C for 48 h in case of fungi. Agar well diffusion method (Boyanova et al., 2005) was used for antimicrobial potentials. Briefly, the surface of the agar medium was punched using a sterile cork borer (diameter 6 mm). A 40 µl of extract was dropped into the wells and kept in incubator for 24 h. Following incubation, the inhibition zone in all well was read and diameter expressed in mm. Gentamycin (10 µg/ml) in case of bacteria and ketoconozole (100 units/ml) in case of fungi, were used as positive control. DMSO used as a negative control. Minimum Inhibitory Concentration (MIC) was defined as the lowest concentration of the extract resulted in complete inhibition of visible growth of tested microbes in inoculated plates. Agar well diffusion method was used for MIC determination.

**Antioxidant activity**

1,1-Diphenyl-2-picrylhydrazyl radical scavenging assay

The scavenging effect of the different fractions on the DPPH radical was measured using a modified version of the method (Fogliano et al., 1999). In brief, the extract solution in methanol at different concentrations (80, 60, 40, 20, 10 µg/ml) were added to 2.5 ml of 0.02 % (w/v) solution of DPPH in methanol. The scavenging activities on DPPH radical were determined by measuring the absorbance at 517 nm after 30 min of incubation. The DPPH radical scavenging activity % inhibition was calculated using the following formula:

\[
\text{% Inhibition} = \left( \frac{\text{OD Control} - \text{OD Sample}}{\text{OD Control}} \right) \times 100
\]

Where OD Control is the absorbance of the blank (containing all reagents except the extract solution) and OD Sample is the absorbance of the test sample. The DPPH radical scavenging activity of quercetin was also assayed for comparison. All tests were performed in triplicate.

**Reducing power assay**

Reducing power was determined according to the method of Yen and Chen (1995). Each of the extract (1000, 500, 250, 125, 62.5 µg/ml, 1ml) in ethanol was mixed with 2.5 ml of 0.2 M phosphate buffer (pH 6.6) and 2.5 ml of 1% potassium ferricyanide (Sigma) and the mixture was incubated at 50 °C for 20 min. After incubation, 2.5 ml of 10% trichloroacetic acid was added. The upper layer of 2.5 mL was mixed with 2.5 ml deionized water and 0.1% ferric chloride (0.5 ml). Optical density was measured at 700 nm. A higher absorbance indicates a greater reducing
power. Ascorbic acid used as positive control.

**Statistical analysis**

All data were subjected to one-way analysis of variance in a statistical analysis system. Duncan’s multiple range tests was performed to compare significant differences ($P < 0.05$) in variables between groups. Each set of experiments were conducted in triplicate.

**Gas chromatography-Mass spectrophotometry analysis**

Ethyl acetate extract was used for Gas chromatography-Mass spectrophotometry (GC-MS) analysis due to its higher phenolic contents (higher intensities on FeCl₃ spray). GC-MS (Model; QP2010 series, Shimadzu, Tokyo, Japan) equipped with a VF-5ms fused silica capillary column of 30 cm length, 0.25 mm diameter and 0.25µm film thickness was use for the analysis. For detection, an electron ionization system with ionization energy of 70eV was used. Helium gas (99.99%) was used as a carrier gas at a constant flow rate of 1.51 ml/min. injector and mass transfer line temperature were set at 200 and 240 °C respectively. The oven temperature was programmed from 70 to 220 °C at 10 °C/min, held isothermal for 1min and finally raised to 300 °C at 10 °C/min. 2 ml of respective diluted samples was manually injected in the split less mode, with split ratio of 1:40 and with mass scan of 50-600 amu. Total running time of GC-MS is 35 min. The relative percentage of the each extract constituents was expressed as percentage with peak area normalisation.

The identity of the components in the extracts was assigned by the comparison of their retention indices and mass spectra fragmentation patterns with those stored on the computer library and also with published literatures. NIST08.LIB [9], WILEY8.LIB [10], PESTEI_3.LIB, and FA_ME.LIB library sources were used for matching the identified components from the plant material.

**RESULTS AND DISCUSSION**

**Antimicrobial activity**

Antimicrobial activity and MIC of the extracts was measured using agar well diffusion method (Table 1). Bark extract was active against most of the tested extracts. The extract exhibits higher to moderate activity towards B. subtilis, P. aruginosa, R. planticola with inhibition zone of 18.33 ± 0.33, 18.33 ± 0.57 and 16.00 ± 0.57 mm and MIC of 62.5, 31.25 µg/ml in last two cases respectively. Further dichloromethane extract also exhibited appreciable activity against B. subtilis, E.coli and P. aeruginosa (IZ of 19.33 ± 0.88, 16.00 ± 0.57 and 18.00 ± 0.57 mm respectively with MIC 125, 15.62 and 125 µg/ml respectively). The result revealed that ethyl acetate extract exhibited potentials similar to positive control.

**Antioxidant activity**

**1,1-Diphenyl-2-picrylhydrazyl radical scavenging assay**

ROS are formed as natural byproducts of normal metabolism and have important role in cell signaling. The effects of ROS on the cell metabolism have been well documented in variety of species (Osawa and Namiki, 1981; Dorman et al., 2003).

The DPPH radical is a stable free radical, which has been widely accepted as a tool for estimating free radical scavenging activities of antioxidants (Sanchez-Moreno, 2002). When DPPH radicals are scavenged, the color of reaction mixture changes from purple to yellow and absorbance at 517 nm decreases. Ethyl acetate extract demonstrated lower IC₅₀ value i.e. 5 µg/ml with % inhibition of 97.08 at 80 µg/ml concentration followed by methanol extract (IC₅₀ 5.5 µg/ml; % inhibition 96.06) (Table 2).

**Reducing power assay**

The reduction of Fe (III) ions is often used as a indicator of electron donating activity, which is an important mechanism of the phenolic antioxidant action, and strongly correlated with other antioxidant properties. Among the tested extracts, methanol extract showed appreciable reduction with 1463.33 ± 3.33 AAE/mg dw antioxidant potential (Table 3). Another potential extract was ethyl acetate extract (895.33 ± 3.78 AAE/mg dw), indicating similar reductive potentials to standard ascorbic acid.

On the basis of activities ethyl acetate extracts were analyzed for GC-MS analysis where, 49 distinct peaks were identified through the NIST08 L database (Table 4). The major compound present in the extract was 1,2-benzenedicarboxylic acid, bis(2-ethylhexyl) ester with RT: 25.28, area 48.47 % (molecular formula: C₂₆H₃₈O₄, MW: 390). Other major components were β-caryophyllene (RT: 10.51, area 5.80%), cedryl methyl ester (RT: 12.85, area 5.80%) 9-octadecenoic acid (Area 6.65%), ethyl docosonate(3.81%), hexadecanoic acid (Area 3.24%),
Table 1. Antibacterial activity of *P. pterocarpum* bark.

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Nature of extract</th>
<th>Pet. ether</th>
<th>DCM*</th>
<th>Ethyl acetate</th>
<th>Methanol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. subtilis</strong></td>
<td>IZ&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.66 ± 0.33</td>
<td>19.33 ± 0.88</td>
<td>18.33 ± 0.33</td>
<td>15.00 ± 0.57</td>
</tr>
<tr>
<td></td>
<td>MIC&lt;sup&gt;b&lt;/sup&gt;</td>
<td>125</td>
<td>125</td>
<td>62.5</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>AI&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.80</td>
<td>0.87</td>
<td>0.83</td>
<td>0.68</td>
</tr>
<tr>
<td><strong>E. aerogenes</strong></td>
<td>IZ</td>
<td>13.00 ± 0.00</td>
<td>14.33 ± 0.33</td>
<td>13.00 ± 0.57</td>
<td>13.33 ± 0.66</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>250</td>
<td>62.5</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.92</td>
<td>1.02</td>
<td>0.92</td>
<td>0.95</td>
</tr>
<tr>
<td><strong>E. coli</strong></td>
<td>IZ</td>
<td>15.00 ± 0.57</td>
<td>16.00 ± 0.57</td>
<td>15.66 ± 0.33</td>
<td>14.00 ± 0.57</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>125</td>
<td>15.62</td>
<td>31.25</td>
<td>31.25</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.78</td>
<td>0.72</td>
<td>0.71</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>P. aruginosa</strong></td>
<td>IZ</td>
<td>15.33 ± 0.33</td>
<td>18.00 ± 0.57</td>
<td>18.33 ± 0.33</td>
<td>15.66 ± 0.33</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>125</td>
<td>31.25</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.76</td>
<td>0.90</td>
<td>0.91</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>R. planticola</strong></td>
<td>IZ</td>
<td>15.33 ± 0.66</td>
<td>15.00 ± 0.57</td>
<td>16.00 ± 0.57</td>
<td>15.00 ± 0.57</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>125</td>
<td>125</td>
<td>31.25</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.69</td>
<td>0.68</td>
<td>0.72</td>
<td>0.68</td>
</tr>
<tr>
<td><strong>S. aureus</strong></td>
<td>IZ</td>
<td>14.66 ± 0.33</td>
<td>15.33 ± 0.33</td>
<td>14.66 ± 0.70</td>
<td>13.33 ± 0.88</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>500</td>
<td>125</td>
<td>250</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.51</td>
<td>0.73</td>
<td>0.69</td>
<td>0.63</td>
</tr>
<tr>
<td><strong>A. flavus</strong></td>
<td>IZ</td>
<td>14.00 ± 0.57</td>
<td>13.33 ± 0.67</td>
<td>-</td>
<td>12.84 ± 0.56</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>250</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.69</td>
<td>0.49</td>
<td>-</td>
<td>0.46</td>
</tr>
<tr>
<td><strong>A. niger</strong></td>
<td>IZ</td>
<td>10.33 ± 0.33</td>
<td>12.33 ± 0.33</td>
<td>11.00 ± 0.66</td>
<td>11.00 ± 1.00</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>500</td>
<td>62.5</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.45</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>C. albicans</strong></td>
<td>IZ</td>
<td>13.66 ± 0.66</td>
<td>14.66 ± 0.88</td>
<td>15.66 ± 0.88</td>
<td>12.66 ± 0.66</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>62.5</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.50</td>
<td>0.66</td>
<td>0.71</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>P. chrysogenum</strong></td>
<td>IZ</td>
<td>13.33 ± 0.66</td>
<td>13.33 ± 0.66</td>
<td>15.33 ± 0.33</td>
<td>12.66 ± 0.66</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>125</td>
<td>250</td>
<td>250</td>
<td>62.5</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.63</td>
<td>0.63</td>
<td>0.73</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>T. rubrum</strong></td>
<td>IZ</td>
<td>13.33 ± 0.33</td>
<td>12.66 ± 0.33</td>
<td>14.33 ± 0.33</td>
<td>12.66 ± 0.66</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
<td>250</td>
<td>250</td>
<td>62.50</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>0.45</td>
<td>0.45</td>
<td>0.49</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Test samples 4 mg/well. Standard test drugs: Gentamycin for bacteria, Ketonicazol for fungi (10 mcg/disc). DCM*=Dichloromethane.
IZ<sup>a</sup>=Inhibition zone (in mm) including the diameter of well (6 mm). MIC<sup>b</sup>= Minimum inhibitory concentration in µg/ml. AI<sup>c</sup>= Activity index = Inhibition zone of the sample/Inhibition zone of the standard.

Table 2. Antioxidant activity of *P. pterocarpum* bark by DPPH method.

<table>
<thead>
<tr>
<th>Nature of extract</th>
<th>IC&lt;sub&gt;50&lt;/sub&gt;</th>
<th>10</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet. ether</td>
<td>6.5</td>
<td>78.07 ± 2.80</td>
<td>90.62 ± 1.95</td>
<td>93.81 ± 0.76</td>
<td>94.58 ± 0.28</td>
<td>94.88 ± 0.68</td>
</tr>
<tr>
<td>DCM</td>
<td>6</td>
<td>84.10 ± 0.39</td>
<td>85.99 ± 0.06</td>
<td>89.59 ± 0.10</td>
<td>91.13 ± 0.28</td>
<td>94.63 ± 0.11</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>5</td>
<td>96.26 ± 0.19</td>
<td>96.57 ± 0.08</td>
<td>96.93 ± 0.18</td>
<td>96.95 ± 0.26</td>
<td>97.08 ± 0.31</td>
</tr>
<tr>
<td>Methanol</td>
<td>5.5</td>
<td>86.54 ± 0.30</td>
<td>93.48 ± 0.76</td>
<td>95.80 ± 0.09</td>
<td>96.01 ± 0.06</td>
<td>96.06 ± 0.11</td>
</tr>
<tr>
<td>Quercetin</td>
<td>4</td>
<td>62.42</td>
<td>80.58</td>
<td>93.38</td>
<td>93.82</td>
<td>94.71</td>
</tr>
</tbody>
</table>

<sup>s</sup>% Inhibition = 1-(Absorbance of the sample/Absorbance of the control) × 100
Bioactive Constituents from Bark of *Peltophorum pterocarpum* Baker Ex K. Heyne

### Table 3. Antioxidant activity of *P. pterocarpum* bark by FRAP method.

<table>
<thead>
<tr>
<th>Nature of extract</th>
<th>Antioxidant activity in bAAE /mg dw (concentration in µg/ml)</th>
<th>bAAE/g = Ascorbic acid equivalent/ mg extract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>62.5</td>
<td>125</td>
</tr>
<tr>
<td>Pet. ether</td>
<td>37.00 ± 3.00</td>
<td>151.00 ± 0.00</td>
</tr>
<tr>
<td>DCM</td>
<td>41.66 ± 4.41</td>
<td>47.00 ± 3.51</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>85.00 ± 5.78</td>
<td>179.00 ± 10.11</td>
</tr>
<tr>
<td>Methanol</td>
<td>113.33 ± 7.27</td>
<td>160.00 ± 15.29</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>62.5</td>
<td>125</td>
</tr>
</tbody>
</table>

*AAE/g = Ascorbic acid equivalent/ mg extract*

Gas chromatography-Mass spectrophotometry analysis

### Table 4. GC-MS spectra of bark ethyl acetate extract of *P. pterocarpum*.

<table>
<thead>
<tr>
<th>Peak</th>
<th>R.Time</th>
<th>Area%</th>
<th>Name</th>
<th>Properties known</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.517</td>
<td>5.80</td>
<td>β-caryophyllene</td>
<td>Anti-inflammatory</td>
</tr>
<tr>
<td>2</td>
<td>10.952</td>
<td>2.57</td>
<td>α-humulene, α-caryophyllene</td>
<td>Antitumor, antimicrobial</td>
</tr>
<tr>
<td>3</td>
<td>12.023</td>
<td>0.71</td>
<td>Elemol</td>
<td>Neruropharmological properties</td>
</tr>
<tr>
<td>4</td>
<td>12.854</td>
<td>5.80</td>
<td>Cedryl methyl ester</td>
<td>Flavor, antitumor, insecticidal</td>
</tr>
<tr>
<td>5</td>
<td>14.055</td>
<td>1.10</td>
<td>Benzene, ethylphenoxy-ar-ethylphenyl phenyl ether</td>
<td>Anti-inflammatory, antimicrobial</td>
</tr>
<tr>
<td>6</td>
<td>14.732</td>
<td>0.26</td>
<td>2-phenyldecane</td>
<td>Anti-carcinoma</td>
</tr>
<tr>
<td>7</td>
<td>14.909</td>
<td>0.35</td>
<td>6-Phenyltridecane</td>
<td>&quot;</td>
</tr>
<tr>
<td>8</td>
<td>14.986</td>
<td>0.23</td>
<td>Heptadecane</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>9</td>
<td>15.534</td>
<td>0.37</td>
<td>Nonadecane</td>
<td>Antimicrobial, antiradical, spasmyotic</td>
</tr>
<tr>
<td>10</td>
<td>15.789</td>
<td>2.81</td>
<td>2-Phenyltridecane</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>16.272</td>
<td>2.96</td>
<td>Hexadecanoic acid</td>
<td>Antioxidant, hypocholesteremic, eminematicide, pesticide, lubricant, antiandrogenic, flavor</td>
</tr>
<tr>
<td>12</td>
<td>16.827</td>
<td>0.41</td>
<td>(1-methylnonadecyl) benzene</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>17.668</td>
<td>0.17</td>
<td>9-Octadecanoic acid</td>
<td>Fungicidal, reduce muscular tension in cardiac muscle</td>
</tr>
<tr>
<td>14</td>
<td>18.730</td>
<td>0.68</td>
<td>Octadecane</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>15</td>
<td>20.415</td>
<td>0.20</td>
<td>10-12-Pentacosadiynoic acid</td>
<td>Antiviral</td>
</tr>
<tr>
<td>16</td>
<td>21.056</td>
<td>0.26</td>
<td>abiesta-9(11),8(14),12-trien-12-ol</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>22.690</td>
<td>1.62</td>
<td>2,4-bis(1-phenylethyl)phenol</td>
<td>Molting hormone</td>
</tr>
<tr>
<td>18</td>
<td>25.287</td>
<td>48.47</td>
<td>1,2-benzeneedicarboxylic acid</td>
<td>Antimicrobial, antitick, allelopathic</td>
</tr>
<tr>
<td>19</td>
<td>26.054</td>
<td>0.51</td>
<td>Ethyl docosanoate</td>
<td>Antibody production</td>
</tr>
<tr>
<td>20</td>
<td>28.109</td>
<td>0.40</td>
<td>Tetracontane</td>
<td>Antibacterial, antioxidant</td>
</tr>
<tr>
<td>21</td>
<td>28.630</td>
<td>0.38</td>
<td>Tetracosanoic acid methyl ester</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>29.501</td>
<td>1.05</td>
<td>Ethyl docosanoate</td>
<td>Antibody production</td>
</tr>
<tr>
<td>23</td>
<td>30.009</td>
<td>0.47</td>
<td>Squalene, Spinacene</td>
<td>Antibacterial, antioxidant</td>
</tr>
<tr>
<td>24</td>
<td>30.823</td>
<td>0.27</td>
<td>Tetraatriacontane</td>
<td>Antioxidant, antimicrobial</td>
</tr>
<tr>
<td>25</td>
<td>30.907</td>
<td>0.23</td>
<td>1-Eicosanol</td>
<td>Antidiabetic, antioxidant, anticholinesterase</td>
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<tr>
<td>26</td>
<td>33.242</td>
<td>1.97</td>
<td>2,4,6-Tris-(1-phenylethyl)-phenol</td>
<td>Pesticide</td>
</tr>
<tr>
<td>27</td>
<td>33.500</td>
<td>2.45</td>
<td>Acetic acid, 7-isopropyl-3a,3b,9b-trimethyl-2-phenyl-dodecahydro-6-oxa-cyclopenta[a]phenanthren-3-yl ester</td>
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</tr>
<tr>
<td>28</td>
<td>34.439</td>
<td>0.83</td>
<td>β-Sitosterol</td>
<td>Antimicrobial, anti-inflammatory, analgesic, antipyretic</td>
</tr>
<tr>
<td>29</td>
<td>37.496</td>
<td>0.28</td>
<td>Stigmasta-5,22-dien-3-ol</td>
<td>Antitumor, anti-inflammatory, Antioxidant</td>
</tr>
<tr>
<td>30</td>
<td>38.761</td>
<td>0.19</td>
<td>Stigmast-5-en-3-ol</td>
<td>Insecticidal, fungicidal, antioxidant</td>
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<tr>
<td>31</td>
<td>40.308</td>
<td>0.24</td>
<td>Lupeol</td>
<td>Antibacterial, Antioxidant, Antitumor</td>
</tr>
<tr>
<td>32</td>
<td>42.209</td>
<td>0.23</td>
<td>Stigmast-4-en-3-one</td>
<td>Antioxidant</td>
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<tr>
<td>33</td>
<td>43.463</td>
<td>0.40</td>
<td>3-Hydroxy-4-propenyl-4,8a-dimethyl-octahydro-2-naphthalenyl acetate</td>
<td>-</td>
</tr>
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</table>
benzene, 2-phenyltridecane (RT: 15.78, area 2.81%), tricontane (1.35%), β-sitosterol (0.83%), heptadecane (0.76%), tricosane (0.68%) and octacosane (0.60%). Further, properties of identified compounds have been given in Table 4.

Several plants reported elevated antimicrobial potentials due to presence of long chain (C6 to C10) alcohols and aldehydes like hepadecane, nonadecane, hexadecanoic acid, tricosane and triacontane (30). Hydrophobicity enables these compounds to partition the lipids of the bacterial cell membrane, disturbing the cell structures and rendering them more permeable (Sikkema et al., 1994). Extensive leakage from bacterial cells or the exit of critical molecules and ion will lead to death (Denyer and Hugo, 1991). Long chain (C6 to C10) alcohols were particularly active against Gram-positive bacteria (Delaquis et al., 2002), the antimicrobial properties of alcohols were known to increase with molecular weight (Morton, 1983). Further purification and bioactivities are in active progress.

New antimicrobial agents against bacterium are very valuable, especially in multidrug resistant strain. Present investigation for antibacterial, antioxidant and chemical investigation supports traditional use of bark infusion as therapeutic agent. Further, the plant can be used as antibacterial supplement in the developing countries towards the development of new drug of natural origin. Additional in vivo studies and clinical trials will also be needed to justify the potentials of ethyl acetate extract in topical and oral applications.

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**REFERENCES**


Bioactive Constituents from Bark of *Peltophorum pterocarpum* Baker Ex K. Heyne


