In vitro antioxidant and antibacterial efficacy of *Feronia elephantum* Correa fruit

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The present investigation was formulated to screen the *in vitro* antioxidant and antibacterial potential of ethanolic extract of Wood apple, *Feronia elephantum* Correa fruit. Antioxidant ability of the fruit extract was assessed by estimating total phenols, flavonoids, tannins, total antioxidant capacity and iron chelating activity. The extract was also examined for its antibacterial efficacy against the bacterial isolates of clinical significance. The results suggested that the extract exhibited dose-dependent antioxidant ability and broad-spectrum antibacterial activity which might possibly be due to the presence of phenolic constituents of the fruit.

Keywords: Antibacterial, Antioxidant, *Feronia elephantum*, Wood apple, Phenols.
IPC code; Int. cl.™ A61K 36/00, A61K 36/75, A61P 31/00, A61P 31/04, A61P 39/06

**Introduction**

Medicinal plants have been screened widely for their antioxidant and anti-microbial properties in order to find an efficient remedy for diseases associated with oxidative stress and infections. Medicinal plants encompass phytochemicals including phenolics, vitamins and terpenoids exhibiting antioxidant properties. The ability of phenolic substances including flavonoids and phenolic acids to act as antioxidants has been reported. Tannins have been reported to have strong antioxidant property. Thus, it is important to screen and characterize different types of medicinal plants for their antioxidant and antimicrobial properties.

*Feronia elephantum* Correa commonly known as Wood apple (Plate 1) chosen for present investigation is a tropical fruit plant native to Myanmar, India, Malaysia and Sri Lanka. The ripe fruit is popularly used as a dessert and a source of beverages and jellies. The fruit and stem bark is used in ethnomedical preparations for the treatment of a variety of human disorders. The fruit pulp is applied externally as a remedy for certain insect bites. Leaves and stem bark have also been studied for antitumour and larvicidal properties. Literature survey revealed that no scientific research has been so far carried out on the antioxidant activity of *F. elephantum*. The present study was therefore, undertaken to appraise the

**Plant material**

The ripe fruit of *F. elephantum* was procured from a local market in Coimbatore district, Tamil Nadu, India. The fruit pulp was dried under shade and then powdered with a mechanical grinder. 100 g of dried powder was cold macerated with 150 ml of 50% ethanol for 3 days with constant stirring. The suspension was filtered and evaporated to dryness in a rotary evaporator. Dark brown coloured crystals of approximately 6 g thus obtained were used for further analysis.

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Plate 1 —-*Feronia elephantum* fruit
Results and Discussion

Phytochemicals

The total phenolic content of the plant extract was found to be 10.17±0.20 mg of pyrocatechol/g plant tissue. Plant phenols constitute a major group of compounds that act as primary antioxidant. They can react with active oxygen radicals, such as hydroxyl radicals, superoxide anion radicals and lipid peroxyl radicals and inhibit lipid peroxidation at an early stage. This is because of scavenging ability of the hydroxyl groups of phenolic compounds.

The flavonoid content of plant extract was recorded to be 2.3±0.08 mg of catechin/g plant tissue. Flavonoids are secondary metabolites in plants, reported to possess antioxidant and antiradical properties. They terminate the action of free radicals by scavenging or chelating process. The protective role of flavonoids involves several mechanism of actions-direct antioxidant effect, inhibition of enzymes of oxygen-reduction pathways and sequestration of transient metal cations.

Tannin content of the plant extract was calculated as 0.045±0.002 mg of tannic acid/g plant tissue. Tannins are the major group of phenolic compounds that act as the free radical scavengers or primary antioxidants.

Total antioxidant capacity

Reducing power assay is based on the transformation of Fe$^{3+} \rightarrow$ Fe$^{2+}$ in the presence of various concentrations (10, 100, 500, 1000 µg/ml) of plant extract and ascorbate (Table 1). The reducing power of the extract incremented with increasing concentration of sample indicating that some compounds in the plant material could serve as electron donors and could react with free radicals to convert them into more stable radicals thus terminating the chain reactions. The maximum reducing power of ascorbate and plant extract as indicated by its absorbance was found to be 1.91 and 1.25 at 1000 µg/ml, respectively. This assay suggests that the reducing ability of the plant extract was comparable to that of ascorbate. Reducing power assay is a convenient and rapid screening method for measuring the antioxidant potential. Reducing power of a compound is related to electron transfer ability of the compound. Therefore, the reducing capacity of a compound may serve as a significant indicator of its potential antioxidant activity.

Table 2 illustrates the antioxidant efficacy of plant extract and vitamin E at different concentrations (10, 100, 500, 1000 µg/ml) determined by thiocyanate method which measures the peroxide levels during the initial stages of lipid peroxidation on linoleic acid system. Antioxidant potential was found to be surged
in a dose-dependent manner which might be attributed to the presence of flavonoids which might possibly be involved in the reduction of hydroperoxides, inactivation of free radicals or complexation with metal ions. IC₅₀ values were found to be 900 μg/ml for plant extract and 650 μg/ml for vitamin E, respectively.

The total antioxidant capacity was measured as 610 mg of ascorbate/g plant tissue by phosphomolybdic acid method which is based on the ability of the plant extract to form phosphomolybdenum complex by the transformation of Mo (VI) to Mo (V).

The FRAP value for the plant extract was calculated as 78 mM equivalents of FeSO₄/g plant tissue. The ferric reducing ability of ascorbate was found to be 55.1 mM equivalents of FeSO₄/g tissue. The ferric reducing ability of the plant extract to form phosphomolybdenum complex was ascertained from FRAP assay based on their ability to reduce TPTZ-Fe (II) complex by the transformation of Mo (VI) to Mo (V). The antioxidant potential of Flavonoids and phenols found to be more susceptible to the ethanolic extract of *F. elephantum* with the maximum zone of inhibition of 9.13 mm whereas for *E. coli* it was noted to be 8.90 mm. The standard antibiotic Ampicillin was also tested and the zone of inhibition against *E. coli* and *K. pneumoniae* was observed to be 10.42 and 9.40 mm at 50 μg/ml, respectively.

Ethanolic extract of *F. elephantum* was found to inhibit the growth of *S. aureus, S. pyogenes* and *P. vulgaris*. *S. aureus* was more susceptible with the maximum zone of inhibition of 9.80 mm and *P. vulgaris* displayed the zone of inhibition of 8.32 mm. The zone of inhibition for *S. pyogenes* was ranging from 4.85 mm. Ampicillin exerted a zone of inhibition of 12.02 mm for *S. aureus*, 11.20 mm for *S. pyogenes* and 10.85 mm for *P. vulgaris* at 50 μg/ml which was used as a reference control. The results supported that plant extract was found to be inhibitory for both Gram positive and Gram negative organisms.

Minimum inhibitory concentration (MIC) of *K. pneumoniae* was 440 and 940 μg/ml, respectively. The present results evidenced that plant extract was found to be inhibitory for both Gram positive and Gram negative organisms.

Iron chelating activity of *F. elephantum* was noted to be 8.7 and 8.5 μg/ml, respectively. Iron can stimulate lipid peroxidation by Fenton reaction and can also accelerate lipid peroxidation by decomposing lipid hydroperoxide into peroxyl and alkoxyl radicals that can perpetuate the chain reaction. Studies reported that chelating activity of plant extract might be due to the presence of phenols and flavonoids.

### Table 3 — Non-enzymatic Hb-glycosylation potential of ethanolic extract of *Feronia elephantum*

<table>
<thead>
<tr>
<th>Conc. of plant extract/ascorbate (μg/ml)</th>
<th>% inhibition of Hb-glycosylation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Plant extract</td>
</tr>
<tr>
<td>10</td>
<td>21.75±1.34</td>
</tr>
<tr>
<td>100</td>
<td>38.37±1.78</td>
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<tr>
<td>500</td>
<td>43.54±3.24</td>
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<tr>
<td>1000</td>
<td>34.86±1.17</td>
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</table>

The values are Mean±SD (n=3)

<table>
<thead>
<tr>
<th>Conc. of plant extract/EDTA (μg/ml)</th>
<th>% chelation of metal ions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant extract</td>
</tr>
<tr>
<td>10</td>
<td>57.94±1.68</td>
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<tr>
<td>100</td>
<td>76.61±4.28</td>
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<tr>
<td>500</td>
<td>89.41±2.47</td>
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<tr>
<td>1000</td>
<td>92.02±3.41</td>
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</tbody>
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The values are Mean±SD (n=3)

### Table 4 — The iron chelating activity of *Feronia elephantum*
may be due to the differences in cell wall composition of \textit{E. coli} and \textit{K. pneumoniae}.

Among the Gram positive organisms tested, \textit{S. aureus} was more susceptible to plant extract with the MIC of 400 µg/ml. MIC displayed by the plant extract against \textit{S. pyogenes} and \textit{P. vulgaris} was recorded as 960 and 1000 µg/ml, respectively. The data revealed that \textit{S. aureus} was the most sensitive organism among the various bacterial isolates tested. The results indicated that the extract possess antibacterial effect against bacterial isolates of clinical significance and confirms the medicinal value of extract.

**Conclusion**

The present study evidenced that the ethanolic extract of \textit{F. elephantum} fruit exhibited antioxidant and antibacterial activity which might possibly be due to the presence of phenolic compounds. These compounds might be helpful in preventing the diseases associated with oxidative stress and infectious diseases.

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