Investigation of biological activities of *Jasminum matthewii*

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The crude methanol extract of leaves of *Jasminum matthewii* as well as its hexane, carbon tetrachloride, chloroform and aqueous soluble partitionates were subjected to screening for antioxidant, cytotoxic, thrombolytic, membrane stabilizing, antimicrobial, analgesic, anti-diarrheal and central nervous system depressant activity assays. The antioxidant potential was evaluated in terms of total phenolic content and free radical scavenging activity using butylated hydroxytolune (BHT) and ascorbic acid as standards. Among the test samples of *J. matthewii*, the highest free radical scavenging activity was demonstrated by the aqueous soluble fraction (IC₅₀ = 41.55±0.51 µg/ml), whereas in case of brine shrimp lethality bioassay, the hexane soluble fraction revealed the highest cytotoxic activity with LC₅₀ value 0.19±0.32 µg/ml. In thrombolytic activity assay, the aqueous soluble fraction of *J. matthewii* extractives showed 62.29±0.29% of clot lysis, whereas standard streptokinase demonstrated 66.77% clot lysis. Among the test samples, the crude methanol extract inhibited 70.15±0.39% haemolysis of red blood cells induced by hypotonic solution. In case of heat-induced condition, the aqueous soluble fraction demonstrated 25.25±0.31% inhibition of haemolysis of red blood cells. None of the test samples revealed any zone of inhibition in disc diffusion assay. In peripheral analgesic activity assay, the crude methanol extract of *J. matthewii* demonstrated 51.02% inhibition of writhing at a dose of 400 mg/kg body weight dose compared to 74.49% inhibition by standard diclofenac sodium. In anti-diarrheal activity assay, the methanolic crude extract reduced diarrheal feces by 89.00±0.15% at 400 mg/kg dose. *J. matthewii* extractives potentiated phenobarbitone sodium-induced sleeping time in a dose dependent manner.

**Key words:** *Jasminum matthewii*, free radical scavenging activity, brine shrimp lethality, thrombolysis, membrane stabilization, hypotonic solution, zone of inhibition, writhing.

INTRODUCTION

Ethnobotanical and traditional uses of natural compounds of plant origin received much attention in recent years. According to the estimates of the WHO, more than 80% of people in developing countries depend on traditional medicine for their primary health needs (Kabir et al., 2015). The practice of herbal medicine is common in rural...
areas where western medicines are too expensive or not available (Adamu et al., 2004). Herbal preparations are generally believed to be safe for human use. Humans have frequently used plants to treat common infectious diseases and some of these traditional medicines are still part of the habitual treatment of various maladies. A recent survey shows that more than 60% of cancer patients use vitamins or herbs as therapy (Madhuri and Pandey, 2008; Sivalokanathan et al., 2005). People’s reliability on drugs from plant sources is continuously increasing. It is therefore essential for systematic evaluation of plants used in traditional medicine for various ailments. Hence, there is need to screen medicinal plants for promising biological activity (Chowdhury et al., 2009). Drugs derived from unmodified natural products or drugs semi-synthetically obtained from natural sources corresponded to 78% of the new drugs approved by the Food and Drug Administration (FDA) between 1983 and 1994 (Cragg et al., 1997).

Jasmine (taxonomic name *Jasminum*) is a genus of shrubs and vines in the olive family, Oleaceae. Jasmines are native to tropical and subtropical regions of Eurasia, Australasia and Oceania, although only one of the 200 species is native to Europe (Schmidt et al., 2002). Their center of diversity is in South Asia and Southeast Asia (Panda, 2005). Jasmines are widely cultivated for the characteristic fragrance of their flowers. *Jasminum matthewii* P.S.Green is an ornamental plant of *Jasminum* genus in the Oleaceae family. The plant is widely distributed in India. Many species of this genus possess significant medicinal properties and have been used as traditional medicines for years. For example, *Jasminum grandiflorum* is documented to possess beneficial effects as odontalgic, thermodenic, aphrodisiac, antiseptic, emollient, anthelmintic, deobstructant, suppurrative, tonic, in fixing loose teeth, ulcerative stomatitis, leprosy, skin diseases, otorhrea, otalgia, wounds, corns and aromatherapy (Warrier et al., 2004). The leaf and flower extract of *Jasminum officinale* Linn has blood purifying property and is traditionally used in cough and fever. Again the root and flower extract of *Jasminum humile* Linn is used as astringent and tonic (Haq et al., 2011). To the best of our knowledge from the literatures, the biological activities of *J. matthewii* were not explored extensively.

As part of our ongoing effort to investigate the medicinal plants of Bangladesh and assemble their activities for further systematic evaluation (Sharmin et al., 2013; Sarker et al., 2014), the crude methanol extract of leaves of *J. matthewii* growing in Bangladesh as well as its organic and aqueous soluble fractions were subjected to the study of antioxidant potential in terms of total phenolic content and free radical scavenging property; cytotoxic, thrombolytic, membrane stabilizing, antimicrobial, peripheral analgesic, anti-diarrheal activities and phenobarbitone sodium-induced sleeping time test for the first time and we, here in, report the results of our preliminary investigations.

**MATERIALS AND METHODS**

**Plant**

The leaves of *J. matthewii* were collected from Dhaka, Bangladesh, in May 2015. A voucher specimen (DUSH - 4569) for this plant has been maintained in Dhaka University Salar Khan Herbarium for future reference.

After collection of the plant materials, they were cleaned and sun dried. The powdered leaves (300 g) were macerated in 1.5 L of methanol for 7 days. Using fresh cotton bed and finally with Whatman filter paper number 1, the macerated plant material was filtered. The filtrate was then concentrated using a rotary evaporator at reduced temperature and pressure. 5 g of the concentrated methanol extract was fractionated by modified Kupchan (VanWagenen et al., 1993) partition protocol and the resultant partitionates were evaporated to dryness with rotary evaporator to yield hexane (HXSF, 1.0 g), carbon tetrachloride (CTCSF, 1.0 g), chloroform (CSF, 1.5 g) and aqueous (AQSF, 1.0 g) soluble materials. The residues were then refrigerated until further use.

**Animal**

Healthy Swiss-albino mice of either sex, aged 5 to 6 weeks were used for investigation on animal model to evaluate analgesic, antidiarrheal and sleep inducing properties. The Animal Resources Branch of the International Centre for Diarrhoeal Diseases and Research, Bangladesh (ICDDR, B) supplied the animals. After purchase, the animals were reserved under standard environmental condition and fed with ICDDR, B formulated rodent food and water. They were housed in isolation in cages and were kept at steady room temperature (25.0±3.0°C), humidity 35 to 60% and 12 h light and 12 h dark cycle to get them adapted with the new surroundings of the laboratory, before being employed in any experimentation (Hawk et al., 1954).

**Total phenolic content**

Using the method developed by Harbertson and Spayd (2006), the total phenolic content of the extractives was determined. Folin-Ciocalteau reagent was used in the test procedure.

**DPPH free radical scavenging assay**

According to the method developed by Brand-Williams et al. (1995), in DPPH free radical scavenging activity assay, butylated hydroxytoluene (BHT) and ascorbic acid were used as standards. The stable 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radical was utilized to assess antioxidant activity of the test samples.

**Brine shrimp lethality bioassay**

This single day *in vivo* assay was designed by Meyer et al. (1982). This method is useful for the estimation of toxic properties of different plant extractives prepared using dimethylsulfoxide (DMSO) against *Artemia salina* in a single day *in vivo* assay. In this assay, vincristine sulphate was used as positive control.

**Thrombolytic activity**

Following the method developed by Prasad et al. (2006), the
thrombolytic action of the plant extractives was determined. Streptokinase was used as positive control in this assay.

**Membrane stabilizing activity**

The membrane stabilizing potency of the extractives was determined by using the method developed by Omale et al. (2008). The test samples were evaluated by assessing their ability to inhibit hypotonic solution and heat induced haemolysis of human erythrocytes.

**Antimicrobial screening**

Disc diffusion method (Bayer et al., 1966) was used to determine the antimicrobial activity of the extractives.

**Peripheral analgesic activity**

Peripheral analgesic activity of the extractives was evaluated by determining their ability to inhibit acetic acid-induced abdominal writhing in mice (Kaushik et al., 2012).

**Anti-diarrheal activity**

Following the method of castor oil induced diarrhea in mice (Shoba and Thomas, 2001), the plant extractives were tested for having antidiarrheal potential.

**Phenobarbitone induced sleeping time**

Phenobarbitone induced sleeping time test was carried out according to the method of Williamson et al. (1996).

**Statistical analysis**

For all bioassays, three replicates of each sample were used for statistical analysis and the values are reported as mean ± standard deviation (SD).

**RESULTS**

The intend of the study was to estimate different organic and aqueous soluble materials of the crude methanol extract of *J. matthewii* for antioxidant, cytotoxic, thrombolytic, membrane stabilizing, antimicrobial, peripheral analgesic, anti-diarrheal activities and phenobarbitone sodium-induced sleeping time test.

Different extractives of *J. matthewii* demonstrated free radical scavenging potential with IC$_{50}$ values ranging from 41.55 to 123.21 μg/ml. The highest free radical scavenging activity was demonstrated by the aqueous soluble fraction (IC$_{50}$ = 41.55±0.51 μg/ml) which could be correlated to its phenolic content 44.13±0.53 mg of gallic acid equivalent (GAE)/g of extractives (Table 1).

In case of brine shrimp lethality bioassay, all the fractions demonstrated significant cytotoxic potential against *A. salina* with LC$_{50}$ values ranging from 0.19 to 0.43 μg/ml. The hexane soluble fraction revealed maximum cytotoxic activity with LC$_{50}$ value 0.19±0.32 μg/ml. All the other test subjects also revealed noteworthy cytotoxic potentials as compared to LC$_{50}$ value 0.45 μg/ml for Vincrelactine sulphate (Table 1).

The extractives of *J. matthewii* demonstrated moderate to significant potential to promote thrombolyis. The aqueous soluble fraction showed 62.29±0.29% of clot lysis whereas streptokinase, used as standard in the assay, demonstrated 66.77% clot lysis (Table 2).

*J. matthewii* extractives significantly inhibited the haemolysis of red blood cell (RBC) induced by hypotonic solution and heat at concentration 1.0 mg/ml which is comparable to the standard acetyl salicylic acid (0.10 mg/ml). The crude methanol extract inhibited 70.15±0.39% haemolysis of RBCs induced by hypotonic solution, whereas under heat-induced condition, the aqueous soluble fraction was proven to inhibit 25.25±0.31% haemolysis of RBCs as compared to 71.90 and 42.12% by acetyl salicylic acid, respectively (Table 3).

In disc diffusion assay, none of the *J. matthewii* test samples demonstrated any zone of inhibition. Therefore, the plant may not posses any antimicrobial potential.

At a dose of 400 mg/kg body weight, *J. matthewii* leaf

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**Table 1.** Total phenolic content, free radical scavenging activity and cytotoxic activity of *J. matthewii*.

<table>
<thead>
<tr>
<th>Sample/Standard</th>
<th>Total phenolic content (mg of GAE/g of dried extract)</th>
<th>Free radical scavenging activity IC$_{50}$ (μg/ml)</th>
<th>Brine shrimp lethality bioassay LC$_{50}$ (μg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>8.25±0.12</td>
<td>49.34±0.45</td>
<td>0.33±0.44</td>
</tr>
<tr>
<td>HXSF</td>
<td>3.32±0.44</td>
<td>83.20±0.39</td>
<td>0.19±0.32</td>
</tr>
<tr>
<td>CTCSF</td>
<td>2.63±0.11</td>
<td>58.54±0.44</td>
<td>0.31±0.25</td>
</tr>
<tr>
<td>CSF</td>
<td>1.56±0.34</td>
<td>123.21±0.80</td>
<td>0.43±0.53</td>
</tr>
<tr>
<td>AQS F</td>
<td>44.13±0.53</td>
<td>41.55±0.51</td>
<td>0.32±0.11</td>
</tr>
<tr>
<td>VS</td>
<td>-</td>
<td>-</td>
<td>0.45±0.04</td>
</tr>
<tr>
<td>BHT</td>
<td>-</td>
<td>27.50±0.54</td>
<td>-</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>-</td>
<td>5.80±0.21</td>
<td>-</td>
</tr>
</tbody>
</table>

ME: Methanolic crude extract; HXSF: hexane soluble fraction; CTCSF: carbon tetrachloride soluble fraction; CSF: chloroform soluble fraction; AQS F: aqueous soluble fraction; VS: vincristine sulfate; BHT: butylated hydroxytolune
Table 2. Thrombolytic activity of *J. matthewii*.

<table>
<thead>
<tr>
<th>Sample/Standard</th>
<th>% of lysis of RBCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>26.03±0.47</td>
</tr>
<tr>
<td>HXSF</td>
<td>24.62±0.39</td>
</tr>
<tr>
<td>CTCSF</td>
<td>49.09±0.22</td>
</tr>
<tr>
<td>CSF</td>
<td>27.59±0.53</td>
</tr>
<tr>
<td>AQSF</td>
<td>62.29±0.29</td>
</tr>
<tr>
<td>Water</td>
<td>3.79±0.55</td>
</tr>
<tr>
<td>Streptokinase</td>
<td>66.77±0.36</td>
</tr>
</tbody>
</table>

ME: Methanolic crude extract; HXSF: hexane soluble fraction; CTCSF: carbon tetrachloride soluble fraction; CSF: chloroform soluble fraction; AQSF: aqueous soluble fraction.

Table 3. Effect of different extractives of leaf of *J. matthewii* on heat and hypotonic solution-induced haemolysis of erythrocyte membrane.

<table>
<thead>
<tr>
<th>Sample/Standard</th>
<th>% Inhibition of haemolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat induced</td>
</tr>
<tr>
<td>Hypotonic medium</td>
<td></td>
</tr>
<tr>
<td>ME</td>
<td>1.60±0.19</td>
</tr>
<tr>
<td>HXSF</td>
<td>1.80±0.82</td>
</tr>
<tr>
<td>CTCSF</td>
<td>12.86±0.24</td>
</tr>
<tr>
<td>CSF</td>
<td>10.65±0.43</td>
</tr>
<tr>
<td>AQSF</td>
<td>25.25±0.31</td>
</tr>
<tr>
<td>ASA</td>
<td>42.12±0.38</td>
</tr>
</tbody>
</table>

ME: Methanolic crude extract; HXSF: hexane soluble fraction; CTCSF: carbon tetrachloride soluble fraction; CSF: chloroform soluble fraction; AQSF: aqueous soluble fraction; ASA: acetyl salicylic acid.

Table 4. Effect of the crude methanol extract of *J. matthewii* on acetic acid-induced writhing in mice.

<table>
<thead>
<tr>
<th>Groups (n = 5)</th>
<th>Dose (mg/kg)</th>
<th>Number of writhing*</th>
<th>Inhibition of writhing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10 ml/kg</td>
<td>19.6</td>
<td>-</td>
</tr>
<tr>
<td>Diclofenac sodium</td>
<td>50</td>
<td>5.00±0.68</td>
<td>74.49</td>
</tr>
<tr>
<td>ME</td>
<td>400</td>
<td>9.60±0.12</td>
<td>51.02</td>
</tr>
<tr>
<td>ME</td>
<td>200</td>
<td>15.0±0.26</td>
<td>23.47</td>
</tr>
</tbody>
</table>

ME: Methanolic crude extract. *Values are Mean ± SEM.

eextractives exposed significant analgesic activity. The mean number of writhing was significantly lower in mice when compared with the negative control but higher than that of the standard diclofenac sodium used in the assay. At 400 mg/kg body weight dose, the crude methanol extract demonstrated 51.02% inhibition of writhing whereas the standard diclofenac sodium was found to produce 74.49% inhibition of acetic acid induced writhing in the test animals (Table 4).

The crude methanol extract of *J. matthewii* showed highly significant antidiarrhoal property in castor oil induced diarrhea in mice. The methanolic crude extract at 400 mg/kg doses reduced diarrheal feces by 89.00±0.15% whereas the same extract at 200 mg/kg dose showed 82.00±0.39% reduction of diarrheal feces. Both of these assessments were found to be more significant when compared with the standard loperamide (71.42%) (Table 5).

*J. matthewii* extract was found to potentiate the phenobarbitone sodium-induced sleeping time in a dose dependent manner. The time of onset of sleep was 15.8 min in control group, whereas in experimental group it
was 29.4 and 12.6 min at doses of 200 and 400 mg/kg body weight, respectively. The total sleeping time was about 126.2 and 159.2 min at 200 and 400 mg/kg, respectively, while it was 118.6 min in the control group (Table 6).

### DISCUSSION

The potential of the plant under investigation *J. matthewii* for different biological activities have been explored for the first time. Although, many other plants under the same genus have been used from generation to generation for medicinal purposes, such folkloric uses of *J. matthewii* have not been reported yet. Therefore, the findings in our investigation can only be correlated with those of the plants of the same genus. Besides, plants belonging to Oleaceae family are rich sources of various pharmacologically active substances. However, the identity of many of these phytoconstituents and their mechanisms of action are not still clear (Rahman et al., 2014). These species including *J. matthewii* may contain very important secondary plant metabolites that may contribute to their biological activities.

*J. matthewii* extractives demonstrated mild to moderate free radical scavenging and highly significant cytotoxic potential in brine shrimp lethality bioassay. According to literature study, the essential oil and the crude methanol extract from *Jasminum sambac*, another species of the same genus, have *in vitro* antioxidant activities (Abdoullatif et al., 2010). *J. sambac* also fashioned very prominent cytotoxic activity in brine shrimp lethality bioassay. Several Jasminium species have been reported to be used in cancers (Rahman et al., 2011). Plants belonging to Oleaceae family contain very important compounds like alkaloids, flavonoids, tannins, etc. (Rahman et al., 2014) that were reported to have cytotoxicity in different cell lines (Bun et al., 2009; Matsuo et al., 2005; Jiang et al., 2008). These compounds may contribute to the antioxidant and cytotoxic potentials of the plant under exploration.

The extractives of *J. matthewii* showed significant thrombolytic potential in our investigation. This may be a key finding that may have imperative implications in cardiovascular diseases (Hussain et al., 2014), because blood clot formation is considered to be a serious event in which endothelial cell surfaces or blood vessels are clogged by the deposition of fibrin, platelets and tissue factor (Furie and Furie, 2008). In addition, this finding may indicate the possibility of developing novel thrombolytic agents from the flowers of the plant. The presence of phytochemicals like tannins and alkaloids have been reported for plants under the genus *Jasminum* and these compounds are the probable reason for demonstrating the thrombolytic activity.

*J. matthewii* extractives significantly inhibited haemolysis of RBC induced by hypotonic solution and heat. Human red blood cell membranes resemble lysosomal membrane components (Mounnissamy et al., 2008). Therefore, the inhibition of hypotonic solution and heat induced haemolysis of red blood cell can be considered as a measure of the mechanism of anti-inflammatory effect of the plant extract. Membrane stabilization results from prevention of leakage of serum proteins and fluids into the tissues during phases of augmented permeability caused by inflammatory mediators (Chaitanya et al., 2011). Phytochemical screening of other plant extracts of the same genus *Jasminum* came to the findings that these plants contain flavonoids which may have reportable anti-inflammatory

### Table 5. Effect of methanolic crude extract of *J. matthewii* on castor oil (1 ml/mice) induced diarrhea in mice.

<table>
<thead>
<tr>
<th>Groups (n=5)</th>
<th>Treatment</th>
<th>Dose (mg/kg)</th>
<th>Number of diarrheal faeces</th>
<th>% Reduction of diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Control (saline)</td>
<td>10 ml/kg</td>
<td>16.8±0.48</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>Standard (loperamide)</td>
<td>50</td>
<td>4.8±0.76</td>
<td>71.42±0.42</td>
</tr>
<tr>
<td>III</td>
<td>Methanolic extract</td>
<td>200</td>
<td>2.20±0.24</td>
<td>82.00±0.39</td>
</tr>
<tr>
<td>IV</td>
<td>Methanolic extract</td>
<td>400</td>
<td>1.80±0.62</td>
<td>89.00±0.15</td>
</tr>
</tbody>
</table>

Values are expressed as Mean ± SD from the experiments.

### Table 6. Effect of the crude methanol extract of *J. matthewii* on phenobarbitone sodium—induced sleep.

<table>
<thead>
<tr>
<th>Groups (n=5)</th>
<th>Treatment</th>
<th>Dose (mg/kg)</th>
<th>Time of onset of sleep (min)</th>
<th>Total sleeping time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Control</td>
<td>10 ml/kg</td>
<td>15.8±1.19</td>
<td>118.6±2.81</td>
</tr>
<tr>
<td>II</td>
<td>Methanolic extract</td>
<td>200</td>
<td>29.4±2.20</td>
<td>126.2±2.85</td>
</tr>
<tr>
<td>III</td>
<td>Methanolic extract</td>
<td>400</td>
<td>12.6±1.76</td>
<td>159.2±3.21</td>
</tr>
</tbody>
</table>

Values are expressed as Mean ± SD from the experiments.
property. The anti-inflammatory activity is probably due to the inhibitory effect on enzymes involved in the production of the chemical mediators of inflammation and metabolism of arachidonic acid (Oweyele et al., 2005).

Although, *J. matthewii* extractives showed no antimicrobial activity, many other species under the same genus like leaves of *Jasminum multiflorum* or *J. sambac* have been reported to have significant antimicrobial activity (Abdoul-Latif et al., 2010; Ankita et al., 2014). This justifies our attempt to assess *J. matthewii* extractives whether they possess any antimicrobial activity or not.

*J. matthewii* extractives showed considerable analgesic and anti-diarrheal properties. Such results can be correlated with similar findings with plant of the same genus, *Jasminum amplexicaule*. By tradition, this plant has been commonly used in ailments like dysentery, diarrhea and bellyache in China. The crude methanol extract of *J. amplexicaule* and different fractions of this extract were studied for anti-diarrheal and analgesic activities by Jia et al. (2008). The anti-diarrheal potential of the plant was tested using castor oil-induced, magnesium sulphate-induced diarrhoea models, anti-entero-pooling assay and gastrointestinal motility models in mice. By means of hot-plate, writhing and formalin models in mice, the analgesic activities were studied. Jia et al. (2008) found that at the doses of 100, 200 and 400 mg/kg, the crude methanol extract of *J. amplexicaule* showed significant and dose-dependent anti-diarrheal and analgesic activities in these models. These results supported its traditional use in diarrhea and pain. The leaf extract of another species under the same genus, *J. sambac* also demonstrated significant writhing inhibition in acetic acid-induced writhing in mice (Rahman et al., 2011). Other studies also showed that *J. sambac* root has analgesic effect (Bhoumik et al., 2013). Such findings support the traditional use of its root in ancient China to treat headaches, insomnia, and pain due to dislocated joints and broken bones (Rahman et al., 2011).

*J. matthewii* extractives potentiated phenobarbitone sodium-induced sleeping time in a dose dependent manner. Other *Jasminum* species like *J. sambac* extract is traditionally used as sedative (Rahman et al., 2011). The ethanol extract of *J. multiflorum* showed marked CNS depressant action (Pal et al., 2007). Species under the same genus may possess same phytochemicals that may contribute to their similar biological properties.

**Conclusion**

Jasmines are plants with variety of biological potentials. Although the plant under our investigation has not been explored for bioactivities to that extent, it is clearly evident from the aforementioned findings that the test samples of *J. matthewii* possess different types of bioactivities. The phytoconstituents which are mainly responsible for these biological activities can be isolated, purified and identified by different chromatographic and spectroscopic techniques. Therefore, the plant is a good candidate for the isolation, characterization and evaluation of biological activities of the isolated phytoconstituents to correlate with the findings in our investigation.

**Conflict of Interests**

The authors have not declared any conflict of interests.

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