ORIGINAL ARTICLE

Antihyperglycemic and antinociceptive activities of methanolic extract of *Colocasia esculenta* (L.) Schott stems: a preliminary study

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**ABSTRACT**

The antihyperglycemic and antinociceptive potentials of methanolic extract of *Colocasia esculenta* (L.) Schott (Araceae) stems were studied, respectively, by oral glucose tolerance tests and acetic acid-induced gastric pain constriction model in Swiss albino mice. In oral glucose tolerance tests conducted with glucose-loaded mice, the extract when administered at doses of 50, 100, 200 and 400 mg per kg body weight in mice resulted in inhibitions of rise in blood glucose concentrations, respectively, by 20.7, 24.7, 33.0 and 37.5%. The fall in blood glucose concentrations were both dose-dependent and statistically significant. A standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, resulted in a drop of blood glucose level by 46.1%. The results suggest that the extract possess quite good antihyperglycemic activity and the stems could be used for further investigations towards isolation of possibly potent antihyperglycemic component(s). Antinociceptive activity of the extract was studied by induction of gastric pain in mice through intraperitoneal injection of acetic acid, which resulted in abdominal constrictions. The extract, when administered at the afore-mentioned four doses caused dose-dependent and statistically significant inhibitions in the number of abdominal constrictions. The percent inhibitions at doses of 50, 100, 200 and 400 mg extract per kg body weight were, respectively, 50.0, 53.3, 56.7, and 63.3. By comparison, a standard antinociceptive drug, aspirin, when administered at doses of 200 and 400 mg per kg body weight reduced the number of abdominal constrictions by 36.7 and 56.7%, respectively. The results suggest that the extract is more potent than aspirin in its antinociceptive potential and could be used for alleviation of pain. Studies are ongoing for isolation and identification of the responsible antinociceptive component(s) from stems.

**Key words:** *Colocasia esculenta*, antihyperglycemic, antinociceptive, Araceae.

**Introduction**

Diabetes is a disease which is rapidly becoming endemic throughout the world because of changes in life style and food habits of human beings. The early symptoms of this disease include high blood sugar levels, and with the progress of this disease, it can cause serious disorders like cardiovascular problems, diabetic retinopathy, neuropathy, and nephropathy. The disease has no known cure in allopathic medicine and desperately needs new drugs to completely cure the disease, if possible.

Pain, arising from various causes, is an affliction countered by millions of people throughout the world. While some pains may be minor or acute, other diseases like rheumatoid arthritis can cause chronic pain. Existing over the counter pain killers like aspirin or paracetamol suffer from problems like causing gastric ulceration or hepatotoxicity from prolonged usage or over-dosage. As a result, it is important to find newer drugs, which can alleviate pain.

*Colocasia esculenta* (L.) Schott is a plant belonging to the Araceae family. It is widely available in Bangladesh and can be found growing in the wild in wetlands, as well as cultivated. It is a popular vegetable, and all parts of the plant including corms, stems and leaves are edible. The plant is particularly popular among the poorer sections of the people because of its high nutritional content, ready availability, and cheap prices. The plant is known in Bengali as ‘pani kochu’, and in English as taro or eddoe. The stems of the plant are known in Bengali as ‘kochur loti’, while the corms are known as ‘kochur mukhi’. Folk medicinal practitioners of Bangladesh advises consumption of leaves, stems, and corms of the plant for alleviation of pain and for lowering blood sugar levels in diabetic patients, and the plant is considered a medicinal plant and used for treatment of a number of ailments like anemia and gastrointestinal disorders by the folk medicinal practitioners.
In an accompanying paper, we have shown antihyperglycemic and antinociceptive properties in methanolic extract of leaves of the plant. Notably, anti-diabetic activity of ethanol extract of leaves of the plant has been shown in alloxan-induced diabetic rats (Kumawat et al., 2010). Aqueous extract of the leaves have been shown to demonstrate anti-hypertensive and diuretic effects (Vasant et al., 2012). Phytochemical investigations on leaves have revealed the presence of phytochemicals like orientin, isoorientin, isovitexin, orientin-7-O-glucoside, isovitexin-3’-O-glucoside, and luteolin-7-O-glucoside (Halligudi, 2013). Anti-cancer effects of corms of the plant on colonic adenocarcinoma cells in vitro have been reported (Brown et al., 2005).

Our research group has been conducting studies on ethnomedicinal surveys (Rahmatullah et al., 2009a-c; Rahmatullah et al., 2010a-g; Rahmatullah et al., 2011a,b; Rahmatullah et al., 2012a-d) followed by screening of the plants obtained for antihyperglycemic, antinociceptive and cytotoxic activities (Anwar et al., 2010; Jahan et al., 2010; Khan et al., 2010; Mannan et al., 2010; Rahman et al., 2010; Rahmatullah et al., 2010h; Shoha et al., 2010; Ali et al., 2011; Barman et al., 2011; Hassan et al., 2011; Jahan et al., 2011; Rahman et al., 2011; Sutradhar et al., 2011; Ahmed et al., 2012; Arefin et al., 2012; Haque et al., 2012; Sathi et al., 2012). As part of the screening process to locate plants or plant parts with antihyperglycemic and antinociceptive properties, this study was conducted to evaluate the above two properties of methanolic extract of stems of Colocasia esculenta in Swiss albino mice.

Materials and Methods

Stems of Colocasia esculenta were collected from Dhaka district, Bangladesh during April 2013. The plant was taxonomically identified at the Bangladesh National Herbarium at Dhaka (Accession Number 38,363). The sliced and air-dried stems of Colocasia esculenta were grounded into a fine powder and 43g of the powder was extracted with 300 ml methanol for 48 hours. The extract was evaporated to dryness at 40°C. The final weight of the extract was 2.33g.

Chemicals:

Glacial acetic acid was obtained from Sigma Chemicals, USA; aspirin, glibenclamide and glucose were obtained from Square Pharmaceuticals Ltd., Bangladesh.

Animals:

In the present study, Swiss albino mice (male), which weighed between 19-22 g were used. The animals were obtained from International Centre for Diarrheal Disease Research, Bangladesh (ICDDR,B). All animals were kept under ambient temperature with 12h light followed by a 12h dark cycle. The animals were acclimatized for three days prior to actual experiments. The study was conducted following approval by the Institutional Animal Ethical Committee of the University of Development Alternative, Dhaka, Bangladesh.

Antihyperglycemic activity:

Glucose tolerance property of methanol extract of Colocasia esculenta stems was determined as per the procedure previously described by Joy and Kuttan (1999) with minor modifications. In brief, fasted mice were grouped into six groups of six mice each. The various groups received different treatments like Group 1 received vehicle (1% Tween 80 in water, 10 ml/kg body weight) and served as control, group 2 received standard drug (glibenclamide, 10 mg/kg body weight). Groups 3-6 received methanol extract of Colocasia esculenta stems at doses of 50, 100, 200 and 400 mg per kg body weight. Each mouse was weighed and doses adjusted accordingly prior to administration of vehicle, standard drug, and test samples. All substances were orally administered. Following a period of one hour, all mice were orally administered 2 g glucose/kg of body weight. Blood samples were collected 120 minutes after the glucose administration through puncturing heart. Blood glucose levels were measured by glucose oxidase method (Venkatesh et al., 2004).

Antinociceptive activity:

Antinociceptive activity of the methanol extract of Colocasia esculenta stems was examined using previously described procedures (Shanmugasundaram and Venkataraman, 2005). Briefly, mice were divided into seven groups of six mice each. Group 1 served as control and was administered vehicle only. Groups 2 and 3 were orally administered the standard antinociceptive drug aspirin at a dose of 200 and 400 mg per kg body weight, respectively. Groups 4-7 were administered methanolic stem extract of Colocasia esculenta at doses of 50, 100, 200 and 400 mg per kg body weight, respectively. Following a period of 60 minutes after oral administration of standard drug or extract, all mice were intraperitoneally injected with 1% acetic acid at a dose
of 10 ml per kg body weight. A period of 15 minutes was given to each animal to ensure bio-availability of acetic acid, following which period the number of abdominal constrictions (writhings) was counted for 10 min.

**Statistical analysis:**

Experimental values are expressed as mean ± SEM. Independent Sample t-test was carried out for statistical comparison. Statistical significance was considered to be indicated by a p value < 0.05 in all cases.

**Results and Discussion**

In oral glucose tolerance tests conducted with glucose-loaded mice, the extract when administered at doses of 50, 100, 200 and 400 mg per kg body weight in mice resulted in inhibitions of rise in blood glucose concentrations, respectively, by 20.7, 24.7, 33.0 and 37.5%. The fall in blood glucose concentrations were both dose-dependent and statistically significant. A standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, resulted in a drop of blood glucose level by 46.1%. The results are shown in Table 1. The results further suggest that the extract possess quite good antihyperglycemic activity and the stems could be used for further investigations towards isolation of possibly potent antihyperglycemic component(s).

Antinociceptive activity of the extract was studied by induction of gastric pain in mice through intraperitoneal injection of acetic acid, which resulted in abdominal constrictions. The extract, when administered at the afore-mentioned four doses caused dose-dependent and statistically significant inhibitions in the number of abdominal constrictions. The percent inhibitions at doses of 50, 100, 200 and 400 mg extract per kg body weight were, respectively, 50.0, 53.3, 56.7, and 63.3. By comparison, a standard antinociceptive drug, aspirin, when administered at doses of 200 and 400 mg per kg body weight reduced the number of abdominal constrictions by 36.7 and 56.7%, respectively. The results are shown in Table 2. The results further suggest that the extract is more potent than aspirin in its antinociceptive potential and could be used for alleviation of pain. It is interesting to note that juice obtained from *Colocasia esculenta* is orally administered in some parts of India for treatment of pain (Halligudi, 2013).

The observed lowering of blood sugar following administration of the extract could be due to a number of mechanisms. Glucose absorption in gut may be inhibited by a compound or compounds present within the stems, as observed with *Mangifera indica* L. (Anacardiaceae) stem-barks (Bhowmik *et al*., 2009). Alternately, any bio-active compound or compounds present in the extract may lower blood sugar either through potentiating the pancreatic secretion of insulin or increasing the glucose uptake, as has been observed in studies with *Artemisia* extract and extract of *Ageratum conyzoides* L. (Asteraceae), respectively (Farjou *et al*., 1987; Nyunai *et al*., 2009). Another possible mechanism can possibly be increase of peripheral glucose consumption induced by the extract, as has been seen with ethanolic extract of *Sapindus trifoliatus* L. (Sapindaceae) (Sahoo *et al*., 2010). In either of these mechanisms or a combination of these mechanisms, the resultant effect will be reduction of sugar levels in the blood. The exact mechanism whereby the extract caused lowering of blood sugar was not elucidated in this preliminary study and further experiments are necessary to determine the mechanism. Nevertheless, the potential for finding an anti-diabetic component or components within stems of this plant remain high as indicated by the results.

Analogesia may be of two types and both central and peripheral analgesia can be detected with the test of acetic acid-induced gastric pain, followed by measurement of the number of abdominal constrictions (Shanmugasundaram and Venkataraman, 2005), as has been done in the present study. Increases in the expression of prostaglandins [mainly prostacyclines (PGI2) and prostaglandin- (PG-E)] have been shown to be responsible for excitation of Adelta-nerve fibers, leading to the sensation of pain (Reynolds, 1982; Rang and Dale, 2003). As such, the antinociceptive activity exhibited by crude methanolic extract of the stems may be due to the extract’s ability to inhibit further expression of prostaglandins, which may in turn be mediated through inhibition of cyclooxygenase and/or lipoxygenase activities. Notably, a similar mechanism has been proposed for antinociceptive activity of *Ficus deltoidea* Jack (Moraceae) aqueous extract in acetic acid-induced gastric pain model (Sulaiman *et al*., 2008), and this may also be the mechanism operating in the present study.

In conclusion the results of the present study validates the use of the plant in Bangladesh for treatment of pain and further suggests that strong anti-diabetic and analgesic components may be present in the plant, which deserves further isolation and identification.
Table 1: Effect of methanol extract of *Colocasia esculenta* stems on blood glucose level in hyperglycemic mice following 120 minutes of glucose loading.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose (mg/kg body weight)</th>
<th>Blood glucose level (mmol/l)</th>
<th>% lowering of blood glucose level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Group 1)</td>
<td>10 ml</td>
<td>4.45 ± 0.12</td>
<td>-</td>
</tr>
<tr>
<td>Glibenclamide (Group 2)</td>
<td>10 mg</td>
<td>2.40 ± 0.35</td>
<td>46.1*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 3)</td>
<td>50 mg</td>
<td>3.53 ± 0.12</td>
<td>20.7*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 4)</td>
<td>100 mg</td>
<td>3.35 ± 0.19</td>
<td>24.7*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 5)</td>
<td>200 mg</td>
<td>2.98 ± 0.30</td>
<td>33.0*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 6)</td>
<td>400 mg</td>
<td>2.78 ± 0.24</td>
<td>37.5*</td>
</tr>
</tbody>
</table>

All administrations were made orally. Values represented as mean ± SEM, (n=6); *P < 0.05; significant compared to hyperglycemic control animals.

Table 2: Antinociceptive effect of crude methanol extract of *Colocasia esculenta* stems in the acetic acid-induced gastric pain model mice.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose (mg/kg body weight)</th>
<th>Mean number of writhings</th>
<th>% inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Group 1)</td>
<td>10 ml</td>
<td>6.00 ± 0.84</td>
<td>-</td>
</tr>
<tr>
<td>Aspirin (Group 2)</td>
<td>200 mg</td>
<td>3.80 ± 0.66</td>
<td>36.7*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 3)</td>
<td>400 mg</td>
<td>2.60 ± 1.08</td>
<td>56.7*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 4)</td>
<td>50 mg</td>
<td>3.00 ± 1.14</td>
<td>50.0*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 5)</td>
<td>100 mg</td>
<td>2.80 ± 1.20</td>
<td>53.3*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 6)</td>
<td>200 mg</td>
<td>2.60 ± 0.51</td>
<td>56.7*</td>
</tr>
<tr>
<td><em>Colocasia esculenta</em> (Group 7)</td>
<td>400 mg</td>
<td>2.20 ± 0.80</td>
<td>63.3*</td>
</tr>
</tbody>
</table>

All administrations (aspirin and extract) were made orally. Values represented as mean ± SEM, (n=6); *P < 0.05; significant compared to control.

References


