Evaluation of antidiarrhoeal activity of Cardamom (Elettaria cardamomum) on mice models

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SUMMARY

Diarrhoea is a major health care problem in developing countries. Elettaria cardamomum Maton fruits, commonly known as cardamom are widely used for flavoring purposes in food. In this study we evaluated the antidiarrhoeal activity of hot water extract of cardamom against experimental diarrhoeal models on mice. Cardamom extract showed significant antidiarrhoeal activity against castor oil and magnesium sulphate induced models. Whereas, the gastrointestinal motility was slightly increased.

Key words: Antidiarrhoeal; Cardamom; Elettaria cardamomum; Gastrointestinal

INTRODUCTION

In developing countries diarrhoea is a major public health problem and therefore it is important and useful to identify plants with antidiarrhoeal activity. Diarrhoea ranks second to respiratory diseases as the cause of non-surgical paediatric admission and causes one fourth of the avoidable deaths in hospitalized children. It is one of the leading causes of morbidity and mortality in all age groups, particularly in infants and children under the age of three. The incidence of diarrhoeal diseases still remains high despite the efforts of any governments and international organizations (e.g. WHO) to curb it (Agbor et al., 2004).

Cardamom, the fruits of Elettaria cardamomum Maton. (Zingiberaceae), are widely used for flavoring purposes in food and as carminative. In Unani system of medicine it is used to treat gastrointestinal disorders (Jamal et al., 2006). Despite its wide uses little information has been reported on their pharmacological properties, which showed antioxidant (Hinneburg et al., 2006; Vasavada et al., 2006) and anti-inflammatory activity (Al-Zuhair et al., 1996). Antimicrobial activity of cardamom was attributed to its essential oil (Ramadan et al., 1994; Garg and Jain, 2001). Recently, cardamom showed gastroprotective effects against aspirin and ethanol induced lesions in rats (Jamal et al., 2006). The seeds also showed activity against Helicobacter pylori (Nostro et al., 2005). Cardamom is usually added to the food preparations...
either raw or crushed paste and cooked at high
temperatures, the present study was undertaken to
evaluate the hot water extract of cardamom against
antidiarrhoeal activity on different mice models.

MATERIALS AND METHODS

Plant materials and extract
Cardamom (*Elettaria cardamomum* Maton.) were
collected from traditional herbal shops from
Dhaka, Bangladesh and were authenticated by the
Bangladesh National Herbarium, Mirpur, Dhaka,
where voucher specimen was preserved. The seeds
were then dried and powdered by a grinder (Mesh
size #80). The cardamom extract was prepared by
boiling 100 g of the powdered plant materials in
1,600 ml water and was filtered and evaporated to
give 400 ml of hot water extract.

Animals
Mice (Male, Swiss-webstar strain, 20 - 25 g body
weight) bred in the animal house of the Department of
Pharmacy, Jahangirnagar University, were used
for the experiments. The animals were provided
with standard laboratory food and tap water ad
libitum and maintained at natural day night cycle.
The animals were grouped (n = 6) according to
body weight and were fasted 18 h prior to their
use. The test extract was administered orally at a
dose of 10 ml/kg. The research was carried out
according to the rules governing the use of
laboratory animals as acceptable internationally.

Antidiarrhoeal activity test by castor oil-induced
diarrhoea
The method of Yegnanarayan and Shrotri (1982)
was followed. All the mice were screened initially
by giving 0.25 ml of castor oil orally and only those
showing diarrhoea were selected for further study.
Cardamom extract pre-treatment was given orally
one hour before the mice were administered with
the standard dose of 0.25 ml of castor oil. The
animals were caged individually; the latent period
was noted and examined for the presence of
diarrhoea hourly for six hours after the castor oil
challenge. Diarrhoea was defined as the presence
of fluidy material in the stool, which stained the
absorbent paper placed beneath the cage. The
number of respondents and the number of stools
passed during the 6-hour period were noted for
each mouse. Purging index (PI) was calculated as
follows:

\[
Purging\ index, \ PI = \left( \frac{\% \ Respondents \times \text{Average }\ \text{number of stools}}{\text{Average latent period}} \right)
\]

Antidiarrhoeal activity test by magnesium sulphate-
induced diarrhoea
The cardamom extract was administered to groups
of six mice, 60 min before the administration of the
cathartic agent magnesium sulphate per oral in a
dose of 4 g/kg (15% magnesium sulphate in 0.5%
sodium carboxymethyl cellulose suspension).
Following the administration of the magnesium
sulphate, the animals were placed separately in
acrylic cages with filter paper, which was changed
every hour. The latent period was measured and
the severity of diarrhoea was assessed each hour
for six hours (Zavala *et al*., 1998). The number of
respondents and the number of stools passed
during the six-hour period were noted for each
mouse and PI was calculated as previously
described.

Gastrointestinal motility test with barium sulphate
milk
Barium sulphate milk (15% barium sulphate in
0.5% sodium carboxymethyl cellulose suspension)
was given orally to the mice after 15 min of
administration of cardamom extract (Afroz *et al*.,
2006). Atropine phosphate (5 mg/kg) was used as
a positive control. Each group of mice (n = 6) were
sacrificed 15 and 30 min after the administration of
barium sulphate milk (10 ml/kg). The distance
traversed by barium sulphate milk was measured
and expressed as a percentage of the total length of
small intestine (from pylorus to the ileocecal junction). The percentage of inhibition compared with the control group was determined by using the following equation:

\[
\text{Inhibition} \% = \frac{\text{Extract} - \text{Control}}{\text{Control}} \times 100
\]

**Statistical analysis**

Statistical analyses were performed by SPSS 10.0 for Windows. Independent samples t-test was done as the test of significance. Values were considered significantly different if \( P < 0.05 \). Data were expressed as mean ± S.E.M.

**RESULTS**

Cardamom extract non-significantly increased the latent period of the diarrhoea on the castor oil model. The mean number of stools was significantly lowered up to 3 h on the experiment and the purging index values were lowered up to 5 h (Table 1). On the magnesium sulphate induced diarrhoea model the extract had no effect on the latent period compared to control. Cardamom extract exhibited significant antidiarrhoeal activity from 3 h to 6 h experimental period (Table 1). Cardamom extract slightly increased the gastrointestinal motility of the barium sulphate milk on both at 15 and 30 min intervals. However, the increments were not statistically significant. Whereas, the atropine sulphate showed significant reduction at the 30 min interval (Table 2).

**DISCUSSION**

Generally, the conventional treatment for diarrhoea involves the use of antibacterial, oral rehydration salt, anti-motility drugs, etc. These are the classical allopathic drugs and sometimes these are not always available in the remote places of under-developed countries. Moreover they exert few side effects, which are not desirable and thus

<table>
<thead>
<tr>
<th>Groups</th>
<th>Latent period (P value)</th>
<th>Mean number of stools (Purging Index)</th>
<th>Observation periods in hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>93.95 ± 10.91 (1.25)</td>
<td>1.16 ± 0.39 (1.25)</td>
<td>1.00 ± 0.63 (0.42)</td>
</tr>
<tr>
<td>Cardamom</td>
<td>197.83 ± 48.92 (0.088)</td>
<td>0.00 ± 0.00 (0.00)</td>
<td>1.00 ± 0.63 (0.42)</td>
</tr>
<tr>
<td>Magnesium sulphate induced antidiarrhoeal test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>33.77 ± 9.93 (8.71)</td>
<td>2.94 ± 0.64 (7.40)</td>
<td>3.05 ± 0.52 (9.03)</td>
</tr>
<tr>
<td>Cardamom</td>
<td>25.33 ± 18.15 (0.69)</td>
<td>2.33 ± 0.66 (9.20)</td>
<td>5.33 ± 0.76 (21.05)</td>
</tr>
</tbody>
</table>

**Table 2.** Effect of cardamom on the gastrointestinal motility of barium sulphate milk in mice

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traversed % (P value)</th>
<th>Inhibition %</th>
<th>Traversed % (P value)</th>
<th>Inhibition %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>43.18 ± 4.25</td>
<td>-</td>
<td>58.87 ± 4.37</td>
<td>-</td>
</tr>
<tr>
<td>Cardamom</td>
<td>58.78 ± 12.59 (0.396)</td>
<td>+36.12</td>
<td>72.69 ± 9.07 (0.264)</td>
<td>+23.47</td>
</tr>
<tr>
<td>Atropine phosphate (5 mg/kg)</td>
<td>26.86 ± 8.37 (0.178)</td>
<td>-37.80</td>
<td>38.75 ± 1.34 (0.005)</td>
<td>-34.18</td>
</tr>
</tbody>
</table>

Values are mean ± S.E.M. (n = 6). \( b \) % inhibition compared with the gastrointestinal motility of control group.
sometimes cause complications (Velazquez et al., 2006). Cardamom is a well known sweet spice throughout the world for centuries and used predominantly as flavoring agent. The fruit has carminative properties and used for gastrointestinal problems (Jamal et al., 2006), hot water extract has been investigated in this study for its antidiarrhoeal properties.

Several mechanisms have been previously proposed to induce the diarrhoeal effect of castor oil (Izzo, 1996). These include inhibition of intestinal Na⁺, K⁺-ATPase activity to reduce normal fluid absorption (Gaginella and Bass, 1978), activation of adenylate cyclase or mucosal cAMP mediated active secretion (Capasso et al., 1994), stimulation of prostaglandin formation (Capasso et al., 1986), platelet activating factor (Pinto et al., 1992; Mascolo et al., 1996) and most recently nitric oxide has been claimed to contribute to the diarrhoeal effect of castor oil (Mascolo et al., 1996). Despite the fact that these numerous mechanisms have been proposed, it has not been possible to define castor oil’s correct mechanism of action (Mascolo et al., 1994). However, it is well documented that castor oil produces diarrhoea due to its most active component recinoleic acid by a hypersecretory response (Ammon et al., 1974). Since the hot water extract of cardamom successfully inhibited the castor oil-induced diarrhoea (Table 2), the extract might have exerted its antidiarrhoeal action by antisecretory mechanism. This was also evident from the reduction of total number of wet faeces in the test groups in the experiment.

On the other hand, magnesium sulphate has been reported to induce diarrhoea by increasing the volume of intestinal content through prevention of reabsorption of water. It has also been demonstrated that magnesium sulphate promotes the liberation of cholecystokinin from the duodenal mucosa, which increases the secretion and motility of small intestine and thereby prevents the reabsorption of sodium chloride and water (Galvez et al., 1993; Zavala et al., 1998). The extract was found to significantly alleviate the diarrhoeic condition in this model.

As cardamom extract have effect on both the castor oil and magnesium sulphate induced diarrhoeal models, thus it can be said that the extract most probably have an effect on the electrolyte reabsorption. As the gastrointestinal transit has been slightly increased, the movements were not considered responsible for the observed antidiarrhoeal activity. Huang et al. (2007) recently reported pectic polysaccharide rich black cardamom extract (Amomum villosum) shortened gastrointestinal motility and increased fecal moisture contents. Previously the volatile oils from cardamom showed rabbit jejunum contraction on a small doses and relaxation on large doses (El Tahir et al., 1997). We consider volatile oils may play a role for the observed intestinal transit activity. Species or extraction procedure difference may also responsible for the observed variation.

Moreover, essential oils produced by aromatic plants have been used traditionally for the prevention and therapy of the enteric tract infections, especially common diarrhoea (Skocibusic and Bezic, 2003). Kumar has found the essential oil is rich in cineole, limonene, terpineol and terpinyl acetate (Kumar et al., 2005). The antimicrobial activity (Ramadan et al., 1994; Garg and Jain, 2001) of cardamom may have beneficial effect on diarrhoea associated with the microbes.

To conclude, the cardamom hot water extract showed antidiarrhoeal activity on experimental mice models and further studies are suggested.

REFERENCES

