OPEM
www.opem.org

Oriental Pharmacy and Experimental Medicine 2008 **8(2)**, 130-134
DOI 10.3742/OPEM.2008.8.2.130

KHUP

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

Tasmina Rahman[1], Khandaker Ashfaqur Rahman[1], Sultana Rajia[1,*], Mahiuddin Alamgir[2,4], Mahmud Tareq Hassan Khan[3] and M Shahabuddin Kabir Choudhuri[1]

[1]Department of Pharmacy, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh; [2]Pharmacy Discipline, Khulna University, Khulna-9208, Bangladesh; [3]Department of Pharmacy, University of Science and Technology, Chittagong, Bangladesh; [4]School of Chemistry, University of New South Wales, Sydney, NSW-2052, Australia

Received for publication June 05, 2007; accepted February 25, 2008

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 cardamomu*; 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

*Correspondence: Sultana Rajia, Department of Pharmacology, School of Medical Sciences, University of New South Wales, Sydney, NSW-2052, Australia. E-mail: pharm_rajia@yahoo.com

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=[% Respondents × Average number of stools]/Average latent period

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 ileoceccal junction). The percentage of inhibition compared with the control group was determined by using the following equation:

Inhibition %=[Extract - Control]× 100/Control

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 1. Effect of cardamom on the castor oil and magnesium sulphate induced diarrhoea in mice[a]

Groups	Latent period (*P* value)	Mean number of stools (Purging Index) Observation periods in hours					
		1 h	2 h	3 h	4 h	5 h	6 h
Castor oil-induced antidiarrhoeal test							
Control	93.95 ± 10.91	1.16 ± 0.39 (1.25)	2.95 ± 0.57 (3.13)	3.16 ± 0.61 (3.36)	1.83 ± 0.30 (1.94)	0.83 ± 0.28 (0.88)	0.66 ± 0.280 (0.70)
Cardamom	197.83 ± 48.92 (0.088)	0.00 ± 0.00[c] (0.00)	1.00 ± 0.63[b] (0.42)	1.33 ± 0.49[b] (0.56)	1.66 ± 1.05 (0.70)	0.66 ± 0.33 (0.28)	1.33 ± 0.614 (0.56)
Magnesium sulphate induced antidiarrhoeal test							
Control	33.77 ± 9.93	2.94 ± 0.64 (8.71)	2.50 ± 0.64 (7.40)	3.05 ± 0.52 (9.03)	2.0 ± 0.40 (5.92)	1.88 ± 0.55 (5.56)	2.61 ± 0.63 (7.72)
Cardamom	25.33 ± 18.15 (0.69)	2.33 ± 0.66 (9.20)	5.33 ± 0.76[b] (21.05)	1.16 ± 0.54[b] (4.60)	0.33 ± 0.21[d] (1.31)	0.33 ± 0.21[b] (1.31)	0.16 ± 0.16[d] (4.60)

[a]Values are mean ± S.E.M. (n = 6). [b]$P < 0.05$ vs control; [c]$P < 0.01$ vs control; [d]$P < 0.001$ vs control.

Table 2. Effect of cardamom on the gastrointestinal motility of barium sulphate milk in mice[a]

Groups	15 min		30 min	
	Traversed % (*P* value)	Inhibition %[b]	Traversed % (*P* value)	Inhibition %[b]
Control	43.18 ± 4.25	-	58.87 ± 4.37	-
Cardamom	58.78 ± 12.59 (0.396)	+36.12	72.69 ± 9.07 (0.264)	+23.47
Atropine phosphate (5 mg/kg)	26.86 ± 8.37 (0.178)	-37.80	38.75 ± 1.34 (0.005)	-34.18

[a]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 reabsorbtion. 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

Afroz S, Alamgir M, Khan MTH, Jabbar S, Nahar N, Choudhuri MSK. (2006) Antidiarrhoeal activity of the ethanol extract of *Paederia foetida* Linn. (Rubiaceae). *J. Ethnopharmacol.* **105**, 125-130.

Agbor GA, Leopold T, Jeanne NY. (2004) The antidiarrhoeal activity of *Alchornea cordifolia* leaf extract. *Phytother. Res.* **18**, 873-876.

Al-Zuhair H, El-Sayeh B, Ameen HA, Al-Shoora H. (1996) Pharmacological studies of cardamom oil in

animals. *Pharmacol. Res.* **34**, 79-82.
Ammon HV, Thomas PJ, Phillips S. (1974) Effect of the oleic acid and recinolic acid on net jejunal water and electrolyte movement. *J. Clin. Invest.* **53**, 374-379.
Capasso F, Mascolo N, Autore G, Romano V. (1986) Laxatives and the production of autacoids by rat colon. *J. Pharm. Pharmacol.* **38**, 627-629.
Capasso F, Mascolo N, Izzo AA, Gaginella TS. (1994) Dissociation of castor oil-induced diarrhea and intestinal mucosal injury in rat: effect of NG-nitro-L-arginine methyl ester. *Br. J. Pharmacol.* **113**, 1127-1130.
El-Tahir KEH, Shoeb H, Al-Shora H. (1997) Exploration of some pharmacological activities of cardamom seed (Elettaria cardamomum) volatile oil. *Saudi Pharm. J.* **5**, 96-102.
Gaginella TS, Bass P. (1978) Laxatives: an update on mechanism of action. *Life Sci.* **23**, 1001-1009.
Galvez J, Zarzuelo A, Crespo ME, Lorente MD, Ocete MA, Jimenez J. (1993) Antidiarrheal activity of *Euphorbia hirta* extract and isolation of an active flavonoid constituent. *Planta Med.* **59**, 333-336.
Garg SC, Jain RK. (2001) Antimicrobial efficacy of essential oil of Elettaria cardamomum. *Indian Perfumer* **45**, 115-117.
Hinneburg I, Dorman HJD, Hiltunen R. (2006) Antioxidant activities of extracts from selected culinary herbs and spices. *Food Chem.* **97**, 122-129.
Huang Y, Yen G, Sheu F, Lin J, Chau C. (2007) Dose effects of the food spice cardamom on aspects of hamster gut physiology. *Mol. Nutr. Food Res.* **51**, 602-608.
Izzo AA. (1996) Castor oil: an update on mechanism of action. *Phytother. Res.* **10**, S109-S111.
Jamal A, Javed K, Aslam M, Jafri MA. (2006) Gastroprotective effect of cardamom, Elettaria cardamomum Maton. fruits in rats. *J. Ethnopharmacol.* **103**, 149-153.
Kumar A, Tandon S, Ahmad J, Yadav A, Kahol AP. (2005) Essential oil composition of seed and fruit coat of *Elettaria cardamomum* from South India. *J. Essent. Oil-Bear. Plants* **8**, 204-207.
Mascolo N, Izzo AA, Autore G, Barbato F, Capasso F. (1994) Nitric oxide and castor oil-induced diarrhea. *J. Pharmacol. Exp. Ther.* **268**, 291-295.
Mascolo N, Izzo AA, Gaginella TS, Capasso F. (1996) Relationship between nitric oxide and platelet-activating factor in castor-oil induced mucosal injury in the rat duodenum. *Naunyn Schmiedebergs Arch. Pharmacol*. **353**, 680-684.
Nostro A, Cellini L, di Bartolomeo S, di Campli E, Grande R, Cannatelli MA, Marzio L, Alonzo V. (2005) Antibacterial effect of plant extracts against Helicobacter pylori. *Phytother. Res.* **19**, 198-202.
Pinto A, Autore G, Mascolo N, Sorrentino R, Biondi A, Izzo AA, Capasso F. (1992) Time course of PAF formation by gastrointestinal tissue in rats after castor oil challenge. *J. Pharm. Pharmacol.* **44**, 224-226.
Ramadan A, Afifi NA, Fathy MM, El-Kashoury EA, El-Naeneey EV. (1994) Some pharmacodynamic effects and antimicrobial activity of essential oils of certain plants used in Egyptian folk medicine. *Vet. Med. J. Giza* **42**, 263-270.
Skocibusic M, Bezic N. (2003) Chemical Composition and Antidiarrhoeal Activities of Winter Savory (*Satureja montana* L.) Essential Oil. *Pharm. Biol.* **41**, 622-626.
Vasavada MN, Dwivedi S, Cornforth D. (2006) Evaluation of garam masala spices and phosphates as antioxidants in cooked ground beef. *J. Food Sci.* **71**, C292-C297.
Velazquez C, Calzada F, Torres J, Gonzalez F, Ceballos G. (2006) Antisecretory activity of plants used to treat gastrointestinal disorders in Mexico. *J. Ethnopharmacol.* **103**, 66-70.
Yegnanarayan R, Shrotri DS. (1982) Comparison of antidiarrhoeal activity of some drugs in experimental diarrhoea. *Indian J. Pharmacol.* **14**, 293-299.
Zavala MA, Perez S, Perez C, Vargas R, Perez RM. (1998) Antidiarrhoeal activity of *Waltheria americana*, *Commelina coelestis* and *Alternanthera repens*. *J. Ethnopharmacol.* **61**, 41-47.