

Antihyperglycemic and analgesic activity studies with *Bambusa spinosa* aerial parts

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ABSTRACT

Bambusa spinosa (Poaceae) is a common type of bamboo found in Bangladesh where it is known as Kata bash. It was of interest to evaluate the antihyperglycemic and analgesic potential of its aerial parts as part of our antihyperglycemic and analgesic plant screening program. In oral glucose tolerance tests, methanol extract of aerial parts of the plant (MEBS) significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 37.5, 52.8, 58.3, and 66.8%, respectively, at doses of 50, 100, 200 and 400 mg per kg in comparison to a standard antihyperglycemic drug, glibenclamide, which reduced blood glucose levels by 60.7% at a dose of 10 mg per kg. In acetic acid induced writhing tests in mice, MEBS at the afore-mentioned doses significantly reduced the number of writhings, respectively, by 23.3, 36.7, 46.7, and 60.0% versus the 40.0 and 46.7% reductions observed with a standard analgesic drug, aspirin, at doses of 200 and 400 mg per kg, respectively. MEBS thus demonstrated considerable antihyperglycemic and analgesic properties and may be considered for use to alleviate high blood sugar levels and pain.

INTRODUCTION

Bambusa spinosa Roxb. (Poaceae) is a common type of bamboo species found in Bangladesh. It is known as kata bash in Bengali and as kauayan-tinik in the Philippines, where it is also common. Not much is known about the traditional medicinal uses or pharmacological properties of the plant. In our ongoing screening program for antihyperglycemic and analgesic plants of Bangladesh (Morshed *et al.*, 2010; Rahmatullah *et al.*, 2010; Ahmed *et al.*, 2011; Shahreen *et al.*, 2012; Haque *et al.*, 2013; Rahmatullah *et al.*, 2013a,b; Ghosh *et al.*, 2014; Hossain *et al.*, 2014; Jahan *et al.*, 2014; Rahman *et al.*, 2014; Tazin *et al.*, 2014), it was of interest to conduct such antihyperglycemic and analgesic studies on *B. spinosa*. The plant belongs to the *Bambusa* genera and some *Bambusa* genera plants have been reported previously for their antihyperglycemic and antiinflammatory potential (Bapat *et al.*, 1969; Muniappan and Sundararaj, 2003; Joshi *et al.*, 2009). Also, since the plant is readily available, even a crude extract can be useful in alleviating high blood sugar levels in diabetic patients and pain in other

individuals suffering from it, diabetes and pain being common afflictions of people throughout the world. Antihyperglycemic and analgesic activity tests on methanolic extract of *B. spinosa* were conducted through oral glucose tolerance test (OGTT) and acetic acid-induced writhing method, respectively.

MATERIALS AND METHODS

Plant material collection

Aerial parts of *B. spinosa* were collected during November 2014 from savar in Dhaka district, Bangladesh and taxonomically identified at the Bangladesh National Herbarium (Accession Number 39,564).

Preparation of methanolic extract of aerial parts

Aerial parts were cut into small pieces, air-dried in the shade, and 100g of dried and powdered aerial parts were extracted with methanol (w:v ratio of 1:5, final weight of the extract 4.87g).

Chemicals and Drugs

Glibenclamide, aspirin, and glucose were obtained from Square Pharmaceuticals Ltd., Bangladesh. All other chemicals were of analytical grade.

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Animals

Swiss albino mice, which weighed between 11-15g were used in the present study. The animals were obtained from International Centre for Diarrheal Disease Research, Bangladesh (ICDDR,B). The animals were acclimatized for three days prior to actual experiments. The study was conducted following approval by the Institutional Animal Ethical Committee of University of Development Alternative, Dhaka, Bangladesh.

Oral glucose tolerance tests for evaluation of antihyperglycemic activity

Oral glucose tolerance tests (OGTT) were carried out as per the procedure previously described by Joy and Kuttan (1999) with minor modifications. Briefly, fasted mice were grouped into six groups of five 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 methanolic aerial part extract (MEBS) at doses of 50, 100, 200 and 400 mg per kg body weight. All substances were orally administered.

Following a period of one hour, all mice were orally administered 2g 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). The percent lowering of blood glucose levels were calculated according to the formula described below.

Percent lowering of blood glucose level = $(1 - W_e/W_c) \times 100$, where W_e and W_c represents the blood glucose concentration in glibenclamide or MEBS administered mice (Groups 2-6), and control mice (Group 1), respectively.

Analgesic activity evaluation through abdominal writhing test

Analgesic activity of methanolic extract of aerial parts (MEBS) was examined as previously described (Shanmugasundaram and Venkataraman, 2005). Mice were divided into seven groups of five mice each. Group 1 served as control and was administered vehicle only. Groups 2 and 3 were orally administered the standard analgesic drug aspirin at doses of 200 and 400 mg per kg body weight, respectively. Groups 4-7 were administered MEBS 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 MEBS, all mice were intraperitoneally injected with 1% acetic acid at a dose of 10 ml per kg body weight. A period of 5 minutes was given to each animal to ensure bioavailability and onset of chemically induced irritation of acetic acid (Akter *et al.*, 2014), following which period, the number of abdominal constrictions (writhings) was counted for 10 min. The percent inhibitions of abdominal constrictions were calculated according to the formula given below.

$$\text{Percent inhibition} = (1 - W_e/W_c) \times 100$$

where W_e and W_c represents the number of writhings in aspirin or MEBS administered mice (Groups 2-7), and control mice (Group 1), respectively.

Acute toxicity test

Acute toxicity test was conducted as previously described (Ganapaty *et al.*, 2002). Mice were divided into nine groups, each group consisting of six animals. Group 1 was given 1% Tween 80 in normal saline (2 ml per kg body weight). The other eight groups (Groups 2-9) were administered, respectively, 100, 200, 300, 600, 800, 1000, 2000 and 3000 mg of MEBS per kg body weight. All animals were closely observed for the next 8 hours to notice any behavioral changes or mortality and were kept under close observation for the next two weeks.

Statistical analysis

Experimental values are expressed as mean \pm 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 (Hossain *et al.*, 2014).

RESULTS AND DISCUSSION

Toxicity evaluation

The crude extract (MEBS) did not show any toxicity in mice even at the highest dose tested. There were no changes in behavioral pattern and mortality was not observed.

Antihyperglycemic activity evaluation results

In oral glucose tolerance tests, MEBS when administered at doses of 50, 100, 200 and 400 mg per kg body weight, dose-dependently and significantly reduced the amount of blood glucose in experimental animals. At these four doses, MEBS, respectively, decreased blood glucose levels by 37.5, 52.8, 58.3, and 66.8%. A standard antihyperglycemic drug, glibenclamide when administered at a dose of 10 mg per kg body weight, reduced blood glucose levels by 60.7%.

Table 1: Effect of crude methanol extract of *B. spinosa* aerial parts (MEBS) on blood glucose level in hyperglycemic mice following 120 minutes of glucose loading.

Treatment	Dose (mg/kg body weight)	Blood glucose level (mmol/l)	% lowering of blood glucose level
Control	10 ml	7.58 \pm 0.22	-
Glibenclamide	10 mg	2.98 \pm 0.42	60.7*
(MEBS)	50 mg	4.74 \pm 0.65	37.5*
(MEBS)	100 mg	3.58 \pm 0.35	52.8*
(MEBS)	200 mg	3.16 \pm 0.28	58.3*
(MEBS)	400 mg	2.52 \pm 0.18	66.8*

All administrations were made orally. Values represented as mean \pm SEM, (n=5); * $P < 0.05$; significant compared to hyperglycemic control animals.

Thus MEBS at the highest dose tested showed better antihyperglycemic activity than glibenclamide, and even at a dose of 200 mg per kg showed comparable results to glibenclamide. The results are shown in Table 1 and suggest that MEBS has

potent antihyperglycemic activity and can be used to reduce blood glucose levels in hyperglycemic subjects.

Analgesic activity evaluation results

MEBS exhibited dose-dependent and significant analgesic activity in acetic acid-induced writhing tests. At doses of 50, 100, 200 and 400 mg per kg, administration of MEBS led to respectively, 23.3, 36.7, 46.7, and 60.0% reductions in the number of writhings in experimental mice compared to control animals. A standard analgesic drug, aspirin, when administered to mice at doses of 200 and 400 mg per kg, led to, respectively, 40.0 and 46.7% reductions in the number of writhings. Thus, at the highest dose of 400 mg per kg, MEBS administration showed better analgesic activity than 400 mg aspirin per kg, and at a dose of 200 mg per kg, MEBS showed comparable activity to 400 mg per kg aspirin. The results are shown in Table 2 and suggest that the methanolic crude extract of MEBS is a potent analgesic extract and can be used for alleviation of pain.

Table 2: Analgesic effect of crude methanol extract of *B. spinosa* aerial parts (MEBS) in acetic acid-induced pain model mice.

Treatment	Dose (mg/kg body weight)	Mean number of abdominal constrictions	% inhibition
Control	10 ml	6.0 ± 0.32	-
Aspirin	200 mg	3.6 ± 0.24	40.0*
Aspirin	400 mg	3.2 ± 0.37	46.7*
(MEBS)	50 mg	4.6 ± 0.40	23.3*
(MEBS)	100 mg	3.8 ± 0.37	36.7*
(MEBS)	200 mg	3.2 ± 0.58	46.7*
(MEBS)	400 mg	2.4 ± 0.24	60.0*

All administrations (aspirin and extract) were made orally. Values represented as mean ± SEM, (n=5); *P < 0.05; significant compared to control.

Various Poaceae family plants (to which family *B. spinosa* belongs) are known for their antihyperglycemic potential or have use in antidiabetic drugs. The roots of *Imperata cylindrica* are used in the drug 'Trinpanchmool', which drug is used for treatment of diabetes (Jayalakshmi *et al.*, 2010). Hypoglycemic activity has been reported for polysaccharide fractions containing β-glucan isolated from *Rhynchelytrum repens* (De Paula *et al.*, 2005). Various other Poaceae family plants like *Axonopus compressus* have been mentioned as giving hypoglycemic effects (Arumugam *et al.*, 2013). Antihyperglycemic effect of *Vetiveria zizanioides* root extract has been seen in alloxan diabetic rats (Karan *et al.*, 2012). The hypoglycemic activity of *Bambusa arundinacea* leaf extract has been observed in euglycemic and hyperglycemic Wistar rats (Joshi *et al.*, 2009).

Analgesic activity has also been reported previously for several Poaceae family plants like *Dactyloctenium australe* (Qayum *et al.*, 2013); *Setaria megaphylla* (Okokon *et al.*, 2006); *Chrysopogon zizanioides* (Lima *et al.*, 2012); *Dendrocalamus giganteus* (Haque *et al.*, 2014); and *Chloris barbata* (Swathy *et al.*, 2010). The present study thus adds to the list of Poaceae family plants, and more so plants belonging to the *Bambusa* genera having antihyperglycemic and analgesic potential.

CONCLUSION

The results suggest that methanolic extract of *B. spinosa* aerial parts can be used for lowering of blood glucose and for alleviating pain.

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