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Analgesic and antihyperglycemic activity evaluation of *Bambusa vulgaris* aerial parts

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ABSTRACT

Bambusa vulgaris, also known as 'Ora Bansh' in Bangladesh is grown throughout the country for housing and scaffolding purposes. As part of our analgesic and antihyperglycemic plants of Bangladesh screening program, it was of interest to evaluate the analgesic and antihyperglycemic potential of aerial parts of the plant. Methanolic extract of aerial parts (MEBV) at doses of 50, 100, 200 and 400 mg per kg significantly reduced the number of writhings in acetic acid-induced pain model Swiss albino mice by 25.9, 29.6, 37.0, and 44.4%, respectively compared to reductions of 40.7 and 51.9%, respectively, obtained with 200 and 400 mg per kg of a standard analgesic drug, aspirin. MEBV, at doses of 100, 200 and 400 mg per kg also significantly lowered blood glucose levels in mice, respectively, by 32.8, 45.8, and 55.3% compared to control mice. A standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg lowered blood glucose level by 50.8%. Taken together, the results indicate that the aerial parts of the plant possess considerable analgesic and antihyperglycemic potential, which can possibly be attributed to the presence of alkaloids and saponins in the extract.

INTRODUCTION

Bambusa vulgaris Schrad. ex J.C. Wendl. (Poaceae), known in English as Golden Bamboo and Ora Bansh in Bengali is an open clump-type bamboo species and is grown in Bangladesh primarily for construction and scaffolding purposes. The plant has ethnomedicinal uses in several parts of the world. In Trinidad and Tobago, the plant is used for cuts, injuries and swellings (Lans, 2007). The leaves are used in Ogun State, Nigeria for treatment of typhoid fever (Fadimu *et al.*, 2014). The plant is used to treat gonorrhea in Ethiope Council Area of Delta State, Nigeria (Idu and Ndukwu, 2006). It is used for treatment of malaria in the Dangme West District of Ghana (Asase *et al.*, 2010). Aqueous extract of the plant grown in Sri Lanka has been reported to significantly lower the fasting blood glucose level and markedly improve glucose tolerance in Sprague-Dawley rats (Fernando *et al.*, 1990). *In vitro* antimalarial activity against *Plasmodium falciparum* Ghana strain has been seen with hydroalcoholic extract of the plant (Valdés *et al.*, 2010). Extract of the plant also showed promising activity against the amastigote stage of *Leishmania amazonensis* (García *et al.*, 2012). We had been conducting an extensive pharmacological screening of medicinal plants of Bangladesh with analgesic and antihyperglycemic potential (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). Diabetes and pain are common afflictions within not only Bangladesh but also throughout the world. The rural people who lack adequate infrastructure in the form of easy communications and modern medical facilities often suffer due to lack of access to quality health-care centers and modern medicines. As such, analgesic and antihyperglycemic plants can form an easily accessible and affordable source for such analgesic and antihyperglycemic drugs in the crude form provided such plants have been validated by scientific research to have the relevant pharmacological activities and are non-toxic. The objective of the present study was to evaluate the analgesic and antihyperglycemic potential of *B. vulgaris*, which is readily available in the rural

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MATERIALS AND METHODS

Plant material collection

Aerial parts of *B. vulgaris* were collected during June 2014 from Dhaka, Bangladesh and taxonomically identified at the Bangladesh National Herbarium (Accession Number 39,565).

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 1:6, final weight of the extract 2.213g).

Chemicals and Drugs

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

Animals

Swiss albino mice, which weighed between 12-16g were used in the present study. The animals were obtained from International Centre for Diarrhoeal 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.

Analgesic activity evaluation through abdominal writhing test

Analgesic activity of methanolic extract of aerial parts (MEBV) 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 MEBV 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 MEBV, 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 MEBV administered mice (Groups 2-7), and control mice (Group 1), respectively.

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 (MEBV) 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 MEBV administered mice (Groups 2-6), 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 MEBV 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 ± 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).

Preliminary phytochemical screening

Preliminary phytochemical analysis of MEBV for presence of saponins, tannins, alkaloids, and flavonoids were conducted as described before (Kumar *et al.*, 2013).

RESULTS AND DISCUSSION

Toxicity evaluation

The crude extract (MEBV) 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.

Preliminary screening of phytochemicals

Various tests conducted for presence of phytochemicals in MEBV indicated the presence of alkaloids and saponins.

Analgesic activity evaluation results

MEBV 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 MEBV led to respectively, 25.9, 29.6, 37.0, and 44.4% 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, 40.7 and 51.9% reductions in the number of writhings. Thus, at the highest dose of 400 mg per kg, MEBV administration showed better analgesic activity than 200 mg aspirin per kg. The results are shown in Table 1 and suggest that the methanolic crude extract of MEBV can be used for analgesic purposes.

Table 1: Analgesic effect of crude methanol extract of *B. vulgaris* aerial parts (MEBV) in acetic acid-induced pain model mice.

Treatment	Dose (mg/kg body weight)	Mean number of abdominal constrictions	% inhibition
Control	10 ml	5.4 ± 0.24	-
Aspirin	200 mg	3.2 ± 0.58	40.7*
Aspirin	400 mg	2.6 ± 0.40	51.9*
(MEBV)	50 mg	4.0 ± 0.32	25.9*
(MEBV)	100 mg	3.8 ± 0.37	29.6*
(MEBV)	200 mg	3.4 ± 0.24	37.0*
(MEBV)	400 mg	3.0 ± 0.32	44.4*

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

Antihyperglycemic activity evaluation results

In oral glucose tolerance tests, MEBV when administered at doses of 50, 100, 200 and 400 mg per kg body weight, dose-dependently reduced the amount of blood glucose in experimental animals. At these four doses, MEBV, respectively, decreased blood glucose levels by 8.4, 32.8, 45.8, and 55.3%. However, the results at the dose of 50 mg MEBV per kg were not statistically significant. A standard antihyperglycemic drug, glibenclamide when administered at a dose of 10 mg per kg body weight, reduced blood glucose levels by 50.8%. Thus MEBV at the highest dose tested showed better antihyperglycemic activity than glibenclamide. The results are shown in Table 2 and suggest that MEBV can be used to reduce blood glucose levels in hyperglycemic subjects. Presence of alkaloids and saponins in MEBV can be responsible for the observed analgesic and antihyperglycemic effects. The analgesic activity of methanolic extract of *Microcos paniculata* barks and fruits has been attributed to presence of alkaloids, saponins, tannins, flavonoids and triterpenoids (Aziz, 2015). Analgesic activity of methanolic leaf extract of *Dalbergia saxatilis* has been reported in rat and mice models. The extract was found to contain a mixture of alkaloids, flavonoids, tannins, saponins, cardiac glycosides, and triterpenes (Hassan *et al.*, 2015). Root bark extract of *Xeromphis nilotica* also reportedly showed analgesic and anti-inflammatory efficacy using *in vivo* models of pain and inflammation in mice and rats. Important bioactive constituents present in the extract included coumarin, alkaloids, flavonoids, saponins, and terpenes (Adzu *et al.*, 2014). The antinociceptive activity of ethanolic extract of *Curcuma zedoaria* rhizome has also been attributed to presence of tannins, saponins, flavonoids, gums & carbohydrates, steroids, alkaloids, reducing sugars and terpenoids in the extract (Ullah *et al.*, 2014).

Table 2: Effect of crude methanol extract of *B. vulgaris* aerial parts (MEBV) 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	5.24 ± 0.22	-
Glibenclamide	10 mg	2.58 ± 0.21	50.8*
(MEBV)	50 mg	4.80 ± 0.43	8.4
(MEBV)	100 mg	3.52 ± 0.31	32.8*
(MEBV)	200 mg	2.84 ± 0.17	45.8*
(MEBV)	400 mg	2.34 ± 0.21	55.3*

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

Antidiabetic and antihyperlipidemic effects of an ethanolic extract of the whole plant of *Tridax procumbens* has been observed in streptozotocin-induced diabetic rats. Preliminary phytochemical analysis of the extract showed presence of alkaloids, tannins, flavonoids, saponins, and phenolic compounds (Petchi *et al.*, 2013).

Antihyperglycemic activity of the stem-bark extract of *Tamarindus indica* has been observed in experimentally induced hyperglycaemic and normoglycaemic Wistar rats. Phytochemical screening revealed the presence of carbohydrates, glycosides, saponins, flavonoids, cardiac glycosides, tannins, alkaloids and triterpenes (Yerima *et al.*, 2014). The exact nature of the bioactive component(s) responsible for the observed analgesic and antihyperglycemic effects is currently being undertaken in our laboratory.

CONCLUSION

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

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