

## ANTIHYPERGLYCEMIC ACTIVITY OF *BAMBUSA ARUNDINACEA*

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### ABSTRACT

Ethanol extract of the root part of *Bambusa arundinacea* (Poaceae) was evaluated for its hypoglycemic potential in normoglycemic rats followed by alloxan and glucose loaded hyperglycemic rats by single dose and multidose administration. The plant extract was subjected to the determination of presence of different phytoconstituents by using standard qualitative chemical methods. The study report showed that the plant extract significantly ( $p < 0.05$  to  $p < 0.01$ ) reduces blood glucose level both in normoglycemic and hyperglycemic rats induced by alloxan and oral glucose loaded methods till the end of the course of experiment. The preliminary phytochemical study report revealed that the test extract contain flavonoids, tannins and phenolic compounds as phytoconstituents, The experimental results of the above studies indicate that the ethanolic extract of the root part of *Bambusa arundinacea* endowed with potential antihyperglycemic activity

**Keywords:** *Bambusa arundinacea*; Antihyperglycemic activity; Glibenclamide.

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### INTRODUCTION

Diabetes mellitus is a metabolic disorder, characterized by altered metabolisms of carbohydrate, lipid and lipoprotein, which not only lead to hyperglycaemia but also cause many complications, such as hyperlipidemia, hypertension and atherosclerosis. The selection of scientific and systematic approach for the biological evaluation of plant products based on their use in the traditional systems of medicine forms the basis for an ideal approach in the development of new drugs from plants. More than 1200 plants have been reported as hypoglycemic agents in various scientific and popular literatures<sup>1&2</sup>, as plant drugs are generally considered to be less toxic with lesser or rare side effects than those of synthetic ones<sup>3</sup>. *Bambusa arundinacea* (Poaceae) is commonly known as bans. The leaves of *Bambusa* are emmenagogue<sup>4</sup> and are used for the treatment of inflammatory diseases, wound healing, ulcers and paralytic complaints<sup>5-7</sup>. Further *in vitro* antioxidant activity of aqueous, methanol and butanolic extracts and hypoglycemic activity of the aqueous extract has also been reported<sup>8-9</sup>. Therefore, this present study was undertaken to evaluate the antihyperglycemic activity of ethanolic extract of root part of the plant *Bambusa arundinacea*.

### EXPERIMENTAL

#### Plant material

The root part of plant *Bambusa arundinacea* was collected from the rural belt of Salipur (Odisha) during the month of January and was authenticated by the Taxonomist of Botanical Survey of India, Howrah. The collected plant materials were washed under running tap to remove adhered dirt, and then shed dried. Then the plant material was ground into coarse powder.

#### Preparation of extract

The powdered plant material was defatted with petroleum ether (60-80°C) and then extracted with 80% ethanol using Soxhlet apparatus. The solvent was removed under reduced pressure to obtain dry extract, which gave a brownish coloured sticky residue. The extracts were stored in a desiccator for further use.

#### Phytochemical Screening

In this research work the ethanolic extract of *Bambusa arundinacea* was qualitatively tested for the presence of chemical constituents. It shows the presence of flavonoids, tannins and phenolic compounds<sup>10</sup>.

### Animals

Swiss albino mice (20–25 g) of either sex were used for acute toxicity study and adult wistar albino rats (150-200 g) of either sex were used for evaluation of pharmacological studies. The animals were kept in standard polypropylene cages at room temperature of  $34 \pm 2^\circ\text{C}$  and at 60-65 % relative humidity during the experimental work. The experiment has been performed in the CPCSEA approved laboratory of Institute of Pharmacy and Technology, Salipur (Regd. No. 1053/ac/07/CPCSEA) with the permission of Institutional animal ethics committee.

### Acute toxicity study

The acute toxicity of ethanolic extract of *Bambusa arundinacea* was determined as per the CPCSEA guideline no. 420 (fixed dose method). It was observed that the test extracts shows no mortality even at 2000 mg/kg dose hence, 1/10th (200 mg/kg) and 1/5th (400 mg/kg) of this dose was selected for further study.

### Screening for hypoglycaemic activity (Single dose study)

Hypoglycemic activity of ethanolic extract (200 and 400 mg/kg, p.o.) of root part of *Bambusa arundinacea* was performed on Wistar Albino rats and glibenclamide (2.5 mg/ kg, p.o.) was used as reference standard.

### Using normoglycemic rats

In this test the animals were allowed for free access to water before and throughout the duration of experiment was allowed the acclimatized animals were fasted for 18 h<sup>11</sup>. The end of the fasting period was taken as zero time (0 h), and the collection of blood was done by tail vein method of each rat under mild anesthesia<sup>12</sup>. The blood glucose level was measured with Senso card blood glucose meter supplied by M/s Avecon Health Care Pvt. Ltd., Himachal Pradesh. The normal rats were then divided into four groups of six animals in each. Negative control was designated as group I and received vehicle (2 ml/kg) through oral route. Group-II received glibenclamide (2.5 mg/kg p.o.). Group-III received ethanolic extract of *B. arundinacea* (200 mg/kg, p.o.), Group-IV received ethanolic extract of *B. arundinacea* (400 mg/kg, p.o). After 1, 2, 4 and 8 h of administration of single dose of test sample blood glucose levels was measured (Table-1).

### Oral glucose tolerance test (OGTT) in rats

In this test fasted rats were divided into four groups of six rats each group. Group I served as a control and received only vehicle (2 ml/kg) through oral route. Group-II received glibenclamide (2.5 mg/kg, p.o). Group-III received ethanolic extract of *B. arundinacea* (200 mg/kg, p.o.), Group-IV received ethanolic extract of *B. arundinacea* (400 mg/kg, p.o). Blood samples were collected before and at 30, 60, 150 and 180 min after glucose administration as per the method described earlier<sup>13</sup> (Table-2).

### Using hyperglycemic rats

In this method acclimatized animals after fasting for 24 hours with water *ad libitum* and then intraperitoneal injection of a dose of 150 mg/kg of alloxan monohydrate in normal saline was given. The animals were provided standard laboratory diet *ad libitum* after one hour. Under mild anesthesia the blood was withdrawn from the tip of the tail of each rat and the blood glucose level was checked before alloxanisation and 24 h after alloxanisation. The blood glucose level was measured as stated above. Rats having the blood glucose level above 225 mg/dl were selected and grouped into four groups consisting of six animals each<sup>14</sup>. This condition was observed at the end of 48 h after alloxanisation. Orally 1% Tween 80 solution (2 ml/kg p.o) was received by the Group-I which served as diabetic control, glibenclamide (2.5 mg/kg) was received by Group-II, Group-III received ethanolic extract of *B. arundinacea* (200 mg/kg, p.o.), Group-IV received ethanolic extract of *B. arundinacea* (400 mg/kg, p.o.), After 1, 2, 4 and 8 h of administration of single dose of test samples, blood glucose levels were measured (Table-3).

### Screening for hypoglycaemic activity (Multi dose study)

### Using hyperglycaemic rats

In this method the acclimatized animals after fasting for 24 hours with water *ad libitum* received intraperitoneal injection of a dose of 150 mg/kg p.o of alloxan monohydrate in normal saline. The animals were provided standard laboratory diet *ad libitum* after one hour. Under mild anesthesia the blood was withdrawn from the tip of the tail of each rat and the blood glucose level was checked before alloxanisation and 24 h after alloxanisation<sup>15</sup>. The blood glucose level was measured as stated above. Rats having the blood glucose level above 225 mg/dl were selected. The blood glucose level was measured with Senso card blood glucose meter supplied by M/s Avecon Health Care Pvt. Ltd., Himachal Pradesh. Wistar albino rats of weighing 125-150g were graded to six animals per group. Group I served as control, which received only vehicle (2 ml/kg, p.o.), Group II received glibenclamide (2.5 mg/kg, p.o.), Group-III received ethanolic extract of *B. arundinacea* (200 mg/kg, p.o.), Group-IV received ethanolic extract of *B. arundinacea* (400 mg/kg, p.o.). The samples under test were administered to the selected animals once daily for 21 days and blood glucose was measured on 1<sup>st</sup>, 7<sup>th</sup>, 14<sup>th</sup> and 21<sup>th</sup> days respectively (Table-4).

### Statistical analysis

All the results were statistically analyzed using one way ANOVA followed by Dunnet's t-test. Values are expressed as mean±S.E. (n=6). \*P<0.05 and \*\*P<0.01 compared with control was considered as significant.

## RESULTS AND DISCUSSION

The roots of *Bambusa arundinacea* have been used by the local tribes for the treatment of diabetes mellitus since time immemorial and they claim for its promising activity. Results of antidiabetic activity of *Bambusa arundinacea* root extract established the scientific basis for the utility of this plant in the treatment of diabetes. The test extract has shown significant reduction in blood glucose levels in both normal and alloxan induced diabetic's rats at the tested dose levels. In all the models, the activity of the extract was found to be in a dose dependant manner (Table -1, 2, 3 and 4). In normoglycaemic study it is observed that the control group (Group-I) has almost similar blood glucose levels throughout the experiment; whereas the tested groups (Group-III and IV) showed significant reduction in blood glucose concentration from 2 h of administration at tested dose levels in normoglycaemic animals, but glibenclamide (Group-II) showed the activity from 1h. Single administration (single dose) of the methanol extract of *B. arundinacea* root (200 and 400 mg/kg, p.o.) in diabetic rats showed significant reduction in blood glucose level after 2, 4 and 6 h interval. Maximum reduction was seen at doses of 200 and 400 mg/kg (34.08% and 48.94% decrease respectively) after 8 h of extract administration. It also shows significant hypoglycemic activity in multi dose study. The result of the ethanolic extract is comparable to that of the reference standard glibenclamide. The hypoglycaemic activity reveals the dose dependant nature of the extract.

Table-1: Blood Glucose Concentration (mg / dl) of single dose treated normoglycemic rats.

| Group | Treatment         | Dose      | Fasting    | Time (h) after treatment |              |              |              |
|-------|-------------------|-----------|------------|--------------------------|--------------|--------------|--------------|
|       |                   |           |            | 1 hour                   | 2 hour       | 4 hour       | 8 hour       |
| I     | Control           | 2 ml/kg   | 96.83±2.84 | 97.67±2.10               | 98.16±2.05   | 97.83±2.12   | 98.16±1.99   |
| II    | Glibenclamide     | 2.5 mg/kg | 96.5±2.95  | 87.16±2.69*              | 81.83±2.31** | 75.34±3.18** | 70.00±2.60** |
|       | % Reduction       |           |            | 9.67%                    | 15.20%       | 21.92%       | 27.46%       |
| III   | Ethanolic extract | 200 mg/kg | 99.83±2.84 | 95.66±2.70               | 92.83±2.75   | 82.17±3.68** | 81.5±2.81**  |
|       | % Reduction       |           |            | 4.17%                    | 7.01%        | 17.69%       | 18.36%       |
| IV    | Ethanolic extract | 400 mg/kg | 98.66±2.21 | 93.67±3.68               | 84.50±2.26** | 79.33±1.70** | 73.67±5.71** |
|       | % Reduction       |           |            | 5.05%                    | 14.35%       | 19%          | 25.32%       |

Values are expressed as mean±S.E. (n=6). \*P<0.05 and \*\*P<0.01 compared with vehicle control (ANOVA followed by Dunnet's t-test).

Table-2: Blood Glucose Concentration (mg / dl) of single treated oral glucose tolerance test.

| Group | Treatment          | Dose      | Fasting    | 30 min.     | 60 min.       | 150 min.      | 180 min.      |
|-------|--------------------|-----------|------------|-------------|---------------|---------------|---------------|
| I     | Control            | 2ml/kg    | 91.5±1.02  | 125.66±2.31 | 147.66±3.84   | 155.66±8.50   | 152.33±2.81   |
| II    | Glibenclamide      | 2.5 mg/kg | 91.16±1.70 | 127.16±3.10 | 104.16±1.83** | 93.83±4.57**  | 80.83±5.65**  |
|       | % Reduction        |           |            |             | 18.08%        | 26.21%        | 36.43%        |
| III   | Ethanollic extract | 200 mg/kg | 92.33±1.68 | 128.83±2.57 | 118.16±2.95** | 107.66±5.02** | 104.33±3.93** |
|       | % Reduction        |           |            |             | 8.28%         | 16.43%        | 19.01%        |
| IV    | Ethanollic extract | 400 mg/kg | 93.16±2.08 | 127.33±1.87 | 105.83±3.32** | 100.83±3.59** | 87.83±4.48**  |
|       | % Reduction        |           |            |             | 16.88%        | 20.81%        | 31.02%        |

Values are expressed as mean±S.E. (n=6). \*P<0.05 and \*\*P<0.01 compared with vehicle control (ANOVA followed by Dunnet's t-test).

Table-3: Blood Glucose Concentration (mg / dl) of single dose treated hyperglycemic rats.

| Group | Treatment          | Dose      | 0 hour      | 1 hour       | 2 hour         | 4 hour        | 8 hour         |
|-------|--------------------|-----------|-------------|--------------|----------------|---------------|----------------|
| I     | Control            | 2ml/kg    | 234.00±8.21 | 239.17±6.61  | 246.50±6.17    | 252.51±5.65   | 255.67±4.33    |
| II    | Glibenclamide      | 2.5 mg/kg | 232.34±4.06 | 205.67±7.84* | 178.5±3.79**   | 122.83±6.27** | 102.5±8.95**   |
|       | % Reduction        |           |             | 11%          | 23.17%         | 47.13%        | 55.88%         |
| III   | Ethanollic extract | 200 mg/kg | 229.83±9.69 | 218.83±8.21  | 192.67±7.45**  | 176.33±7.13** | 151.50±1.35**  |
|       | % Reduction        |           |             | 4.78%        | 16.16%         | 23.27%        | 34.08%         |
| IV    | Ethanollic extract | 400 mg/kg | 238.33±3.44 | 215.17±6.16  | 167.83±11.49** | 130.67±10.9** | 121.68±10.57** |
|       | % Reduction        |           |             | 9.71%        | 29.58%         | 45.17%        | 48.94%         |

Values are expressed as mean±S.E. (n=6). \*P<0.05 and \*\*P<0.01 compared with vehicle control (ANOVA followed by Dunnet's t-test).

Table-4: Blood glucose concentration (mg / dl) of multi dose treated hyperglycemic rats.

| Group | Treatment          | Dose      | 1st day       | 7th day       | 14th day      | 21st day      |
|-------|--------------------|-----------|---------------|---------------|---------------|---------------|
| I     | Control            | 2ml/kg    | 254.16±4.40   | 274.66±4.68   | 288.50±3.74   | 294.50±5.16   |
| II    | Glibenclamide      | 2.5 mg/kg | 237.33±2.34** | 184.00±9.04** | 149.33±2.38** | 104.50±3.67** |
|       | % Reduction        |           |               | 22%           | 37.07%        | 55.96%        |
| III   | Ethanollic extract | 200 mg/kg | 234.66±4.03** | 218.83±3.00** | 174.16±5.27** | 124.83±3.98** |
|       | % Reduction        |           |               | 6.74%         | 25.78%        | 46.80%        |
| IV    | Ethanollic extract | 400 mg/kg | 235.33±4.88** | 208.66±4.22** | 164.66±3.29** | 112.66±4.76** |
|       | % Reduction        |           |               | 11.33%        | 30.03%        | 52.12%        |

Values are expressed as mean±S.E. (n=6). \*P<0.05 and \*\*P<0.01 compared with vehicle control (ANOVA followed by Dunnet's t-test).

## CONCLUSION

The results of the present study justify the use of the roots of *Bambusa arundinacea* for treating diabetes as suggested in the folklore remedies. The comparable effect of the extracts with glibenclamide may suggest similar mode of action, since alloxan permanently destroys the pancreatic  $\beta$ -cells and the extract lowered blood sugar level in alloxanised rats, indicating that the extract possesses extra pancreatic effects.

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