

HYPOGLYCEMIC ACTIVITY OF *BAMBUSA ARUNDINACEA* LEAF AQUEOUS EXTRACT IN EUGLYCEMIC AND HYPERGLYCEMIC WISTAR RATS

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Summary

The hypoglycemic activity of the aqueous extract of the leaves of *Bambusa arundinacea* (Family: *Poaceae*) was evaluated. The extract was administered orally 500 mg/kg to normal and streptozotocin-induced (60 mg/kg body weight, i.v) diabetic rats. The hypoglycemic effect of the extract was statistically significant with an oral dose of 500 mg/kg in euglycemic rats at 30 minutes and 1000 mg /kg in hyperglycemic rats at 3 hours, and was comparable to that of standard antidiabetic agent, glibenclamide 0.9 mg/kg.

Key words: *Bambusa arundinacea*, Glucose tolerance test, Hypoglycemic activity, Streptozotocin

Introduction

Diabetes mellitus is considered as one of the five leading causes of death worldwide. India leads the way with its largest number of diabetic subjects and also with a great potential to provide natural resources to develop herbal remedies. It has been estimated that the incidence of diabetes in India is expected to increase, to target 57.2 million people by the year 2025¹. Throughout the world many traditional plants have been found to possess antidiabetic activity. The world health organization (WHO) has recommended scientific evaluation of the efficacy and toxicity of the traditional herbal remedies used for diabetes².

Bamboo is one of the precious plant resources of the earth. It has played a significant role in human civilization since ancient times. *Bambusa arundinacea* Willd. (Family: *Poaceae*) is distributed throughout India at an elevation of 2,100 m. The leaves, roots, grain and gum of this plant are used in traditional medicine. An ointment from the root is said to be a folk remedy for cirrhosis and hard tumors, especially tumors of the abdomen, liver, spleen and stomach³.

Chemical contents of *Bambusa arundinacea* young shoots have been reported as cholin, betain, urease, cyanogenetic glucosides, oxalic acid, and benzoic acid⁴. The leaves of *Bambusa arundinacea* have been reported to possess anti-inflammatory, antiulcer⁵, antioxidant⁶ and antifertility activity⁷.

Various plant extracts having efficacy to lower blood glucose in experimental diabetes e.g., Mulberry leaf extract in diabetic rats has been reported to restore the diminished beta cell number⁸. In traditional medicine *Ichnocarpus frutescens*⁹ and *Salvadora oleoides*¹⁰ are found to be useful in the management of diabetics and edible plant parts like *Brassica oleracea*¹¹ and fruit and seed of *Semecarpus anacardium*¹² have shown hypoglycemic activity in experimental studies. The most studied species in the management of diabetic mellitus are *Citrullus colocynthis*, *Opuntia streptacantha*, *Trigonella foenum greacum*, *Momordica charantia*, *Ficus bengalensis*, *Polygala senega* and *Gymnema sylvestre*¹³. Though, *Bambusa arundinacea* leaf decoction is widely used by traditional healers to treat diabetes mellitus, there are no scientific reports regarding its efficacy, however patients feedback is quite encouraging. The present study was therefore planned to investigate hypoglycemic activity of *Bambusa arundinacea* aqueous leaf extract in euglycemic and streptozotocin induced hyperglycemic rats.

Materials and methods

Collection of plant material

The leaves of *Bambusa arundinacea* were collected from forest area in and around Belgaum district. The plant material was identified and confirmed by Dr. Harsha Hegde, Taxonomist, Regional Medical Research Centre (ICMR), Belgaum, India. A voucher specimen (No.RMRC 404) was deposited in the herbarium of Regional Medical Research Centre, Belgaum for future reference.

Preparation of extract

The leaves of *Bambusa arundinacea* (BA) were shade dried and reduced to coarse to powder by mechanical grinding. The powdered material was macerated in distilled water for seven days with 2 ml of chloroform to avoid any fungal or bacterial contamination. The mixture was sonicated in cold water for 30 minutes before filtration. The sonicated mixture was filtered with the use of muslin cloth and the filtrate so obtained was lyophilized to get in powdered form. The powdered extract was stored in deep freezer at -20°C for experimental use.

Animals and housing condition

The healthy male Wistar rats (120-150 g body weight) used in the present study, were fed on commercial laboratory animal feed (Amrut brand, Sangli) and water *ad libitum*. The rats were housed in the laboratory for a week for acclimatization under 12:12 hrs natural light–dark cycle. The animals were starved overnight with water *ad libitum* prior to the day of experimentation. Ethical clearance was obtained from Institutional Animal Ethics Committee constituted as per CPCSEA guidelines.

Dose determination

Based on the preliminary studies carried out in euglycemic animals, in the present study the dose of 500 mg/kg and 1000 mg/kg of the extract were selected. Rat equivalent dose 0.9 mg/kg of glibenclamide, a standard hypoglycemic used in the present study, was calculated using conversion table devised by Paget and Barnes¹⁴.

Studies in euglycemic rats

The animals were fasted for 18 hours prior to the experiment, and allowed to free access of water. Fasted rats were divided into three groups of six animals in each group. Group I served as vehicle control which received saline p.o. The group II received aqueous leaf extract orally at a dose of 500 mg/kg and group III received glibenclamide 0.9 mg/kg. The glucose in the dose of 2g/kg was administered orally after 30 minutes of various treatments. Blood samples were collected from tail vein at 0, 30, 60, 90 and 120 minutes post dose to estimate blood glucose using glucometer^{15,16} (One touch, sure step, Life Scan, Inc, Milpitas, CA 95035 USA).

Studies in streptozotocin induced hyperglycemic rats

The animals were fasted overnight and 60 mg/kg streptozotocin (STZ) dissolved in freshly prepared citrate buffer (0.1 M, pH 4.5) was given intravenously in a volume of 1 ml/kg. After 6 hrs 200 mg/kg glucose was given orally to protect from hypoglycemia. After a gap of one day the fasting blood glucose was estimated with the help of standard glucometer and those having blood glucose more than 300 mg/dl were included in the study. Selected animals were divided in three groups (n=6, in each group) to receive different treatments orally. Group I received vehicle, group II received BA leaf extract 500 mg/kg and group III received glibenclamide 0.9 mg/kg 30 minutes prior to oral glucose challenge in the dose of 2g/kg. Blood samples were collected from tail vein at 0, 30, 60, 90 and 120 minutes after glucose challenge to estimate blood glucose^{15,16}. In another group (n=6) of hyperglycemic rat, BA extract was used in the dose of 1000 mg/kg to determine its onset and duration of hypoglycemic activity. Blood samples were collected at 0, 1, 3 and 5 hrs to determine the glucose level.

Statistical Analysis

The data were expressed as Mean \pm SEM and analyzed by ANOVA followed by Dunnet's post hoc test and $P \leq 0.05$ was considered significant.

Results

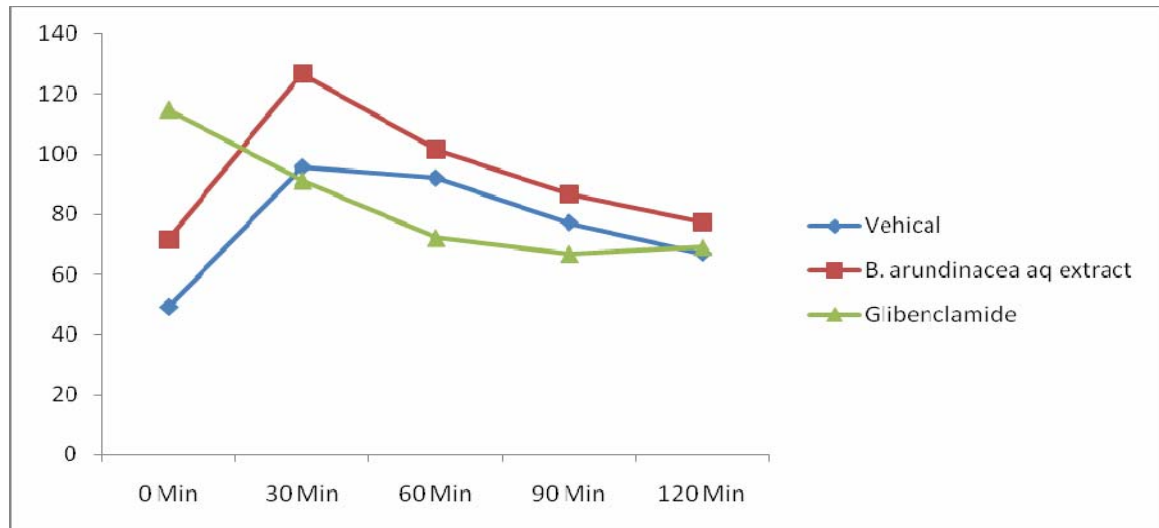
In OGTT carried out in euglycemic rats the extract though prevented the rise in blood glucose, throughout, there was no significant change from the corresponding values of control group. In fact the extract increased blood glucose significantly at 30 minutes (Fig 1. A). In glibenclamide group there was consistent fall in blood glucose (Fig 1. B) throughout the study.

In hyperglycemic rats glibenclamide did not produce hypoglycemia but prevented the rise in blood glucose and antihyperglycemic effect was significant ($p < 0.05$) at 90 and 120 minutes (Fig 2 A and B) as compared to the corresponding values of control group. Similarly, BA extract prevented the rise in blood glucose, there was no significant difference when compared to the corresponding values of the control group.

Hyperglycemic rats with blood glucose of 391.2 ± 35.10 mg/dl when treated with higher (1000 mg/kg) dose of BA extract, blood glucose decreased at 1, 3 and 5 hr. the reduction in blood glucose was significant ($p < 0.05$) only at 3rd hr (Table 1). Similarly, glibenclamide also decreased blood glucose and the significant ($p < 0.05$) decrease was observed at 3 and 5 hr (Table 1).

Fig 1: OGTT in euglycemic rats treated with *Bambusa arundinacea* extract.

A: Mean change in blood glucose (mg/dl)



B: Percent change in blood glucose

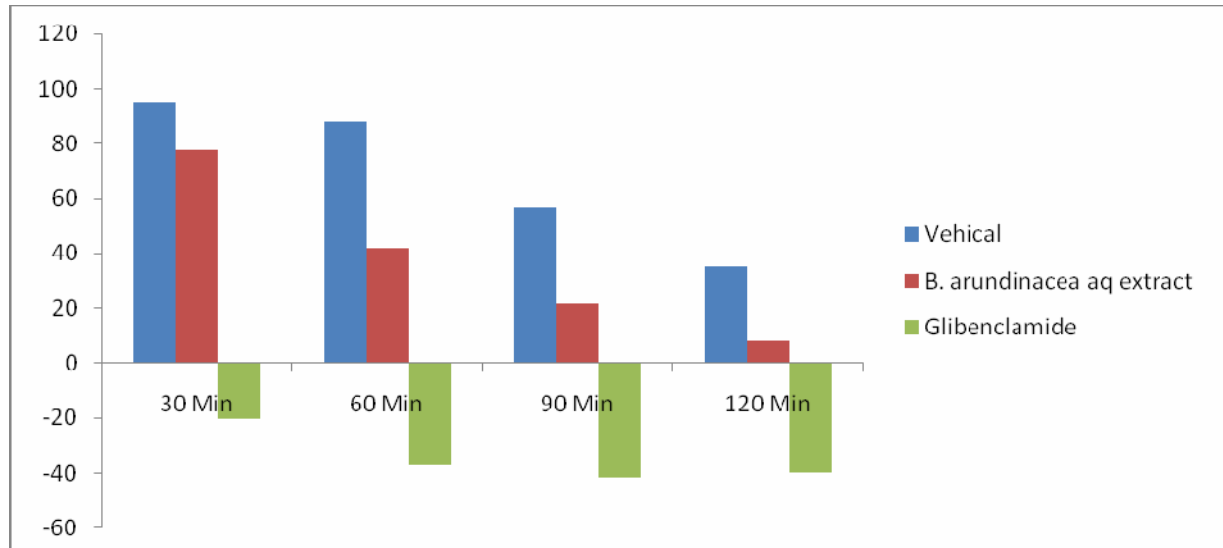
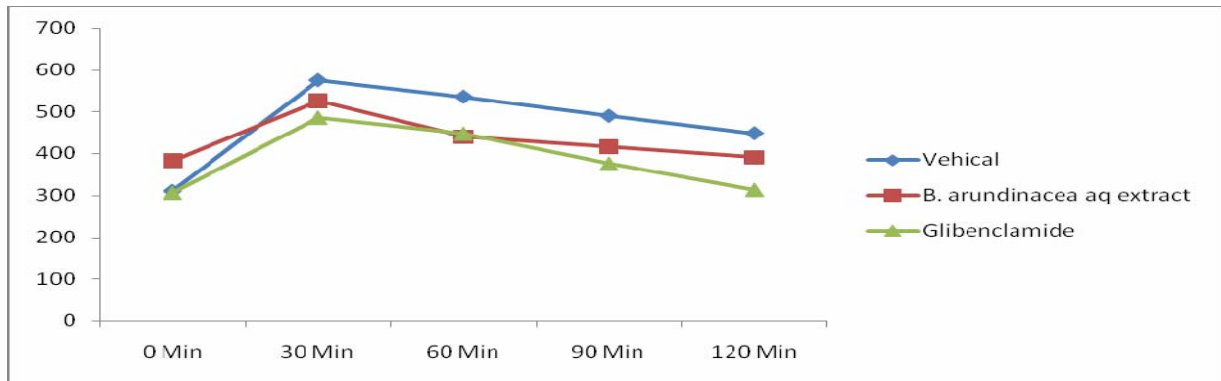


Fig 2: OGTT in hyperglycemic rats treated with *Bambusa arundinacea* extract.

A: Mean change in blood glucose (mg/dl)



B: Percent change in blood glucose

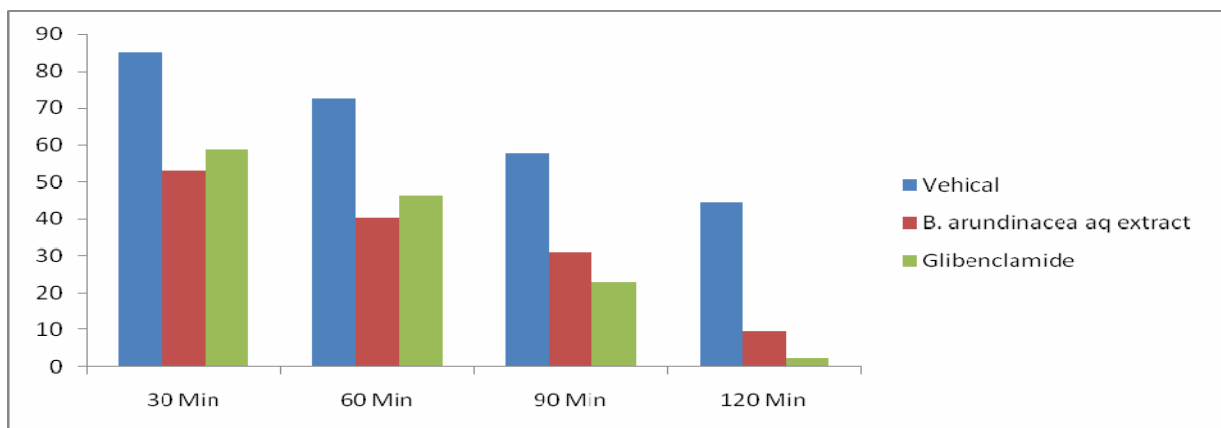


Table 1. Effect Of *Bambusa arundinacea* aqueous extract on blood glucose of stz induced diabetic rats.

Treatment groups ↓	Blood glucose mg/dl (Mean ± SEM)			
	0 hr	1hr	3hr	5hr
Vehicle	310.83 ± 23.04	317.61 ± 4.87	318.16 ± 3.34	320.83 ± 4.35
<i>B. arundinacea</i> (1000mg/kg)	391.2 ± 35.10	335.4 ± 34.96	260.6 ± 21.84*	285.2 ± 33.87
Glibenclamide (0.9mg/kg)	322.8 ± 3.26	310.6 ± 4.2	303.00 ± 3.74*	261.4 ± 7.71**

** = P<0.01, * = P<0.05

Discussion

The results of the present study indicated that, BA extract has hypoglycemic activity in STZ induced hyperglycemic rats, though the effect was short lasting. Similar reports regarding BA extract could not be traced in available literature. In comparison with glibenclamide, it has weaker hypoglycemic activity.

The hypoglycemic activity of BA extract could be attributed to its constituents like phenolic acids and flavonoids⁵, which possess antioxidant activity⁶. Antioxidants have been reported to beneficially improve pancreatic β -cell function by preventing or delaying β -cell dysfunction due to glucose toxicity¹⁷.

The finding that hypoglycemic activity of BA extract of the present study corroborate the beneficial effect of BA decoction in diabetic patients treated by traditional healers. Short duration of hypoglycemic effect of the extract as observed in the present study, in contrast of its sustained effect in humans, (as claimed by traditional practitioners) could be due to larger dose (2-3 cups), frequent (three times a day) and prolonged (months together) administrations. It is worthwhile investigating the hypoglycemic activity of larger and repeated doses of BA extract in chronic studies.

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