

ASSESSMENT OF GLYCEMIC POTENTIAL OF *MUSA PARADISIACA* STEM JUICE

Santosh Kumar Singh, Achyut Narayan Kesari, Prashant Kumar Rai and Geeta Watal

Alternative Therapeutics Unit, Drug Development Division, Medicinal Research Lab,
Department of Chemistry, University of Allahabad, Allahabad, India – 211002

ABSTRACT

The present study reveals the effect of *Musa paradisiaca* stem juice on blood glucose level (BGL) of normal & diabetic rats. The dose of 500 mg/kg bodyweight produces a significant rise of 28.3% in blood glucose level after 6h of oral administration in normal rats. Whereas, in sub diabetic rats the same dose produces a rise of 16.4% in blood glucose levels within 1h during glucose tolerance test (GTT) and a rise of 16% after 4 h in fasting blood glucose levels of severe diabetic cases. These results were unexpected and important to report as other species of *Musa* like *Musa sapientum* has been reported for its hypoglycemic effect.

KEY WORD

Blood Glucose level, Glucose Tolerance Test, *Musa paradisiaca*, Stem juice, Streptozotocin.

INTRODUCTION

Diabetes is a metabolic disorder characterized by fast elevation of blood sugar level. The incidence of diabetes mellitus is on rise all over the world, especially in Asia. Many synthetic oral hypoglycemic agents, such as Biguanides and sulfonylurea are available along with insulin for the treatment of diabetes mellitus. In the indigenous system of medicine many plants have been claimed to be useful in the treatment of diabetes mellitus (1-4). *Musa paradisiaca* (Family: Musaceae) is a perennial tree like herb. It is commonly known as banana or kela in Hindi and is widely found in northern India. Ayurvedic physician of Karnataka and Kerala recommended *Musa paradisiaca* for the treatment of urinary stones (5). The stem juices of *Musa paradisiaca* have been reported for dissolving pre-formed stones and in preventing the formation of stones in the urinary bladder of rats (6-7). Stem juice is also used in nervous affectations like epilepsy, hysteria and in dysentery and diarrhoea. Several oligosaccharides comprising fructose, xylose, galactose, glucose and mannose occur naturally in banana, making it an excellent prebiotic for the selective growth of beneficial bacteria in the intestine (8). The potential use of

banana fruit pulp to treat ulcers have been explored by a number of investigators (9-12). Since, the flowers and the roots of *Musa sapientum* showed hypoglycemic effect on normal fasting rabbits (13-14) and the chloroform extract of its flowers showed a reduction in blood glucose, glycosylated hemoglobin and an increase in total haemoglobin (15-16). Therefore the present investigation was under taken to evaluate the effect of *M. paradisiaca* stem juice on blood glucose level (BGL) of normal and streptozotocin induced diabetic rats in order to assess its glycemic potential.

MATERIALS AND METHODS

Chemicals : Streptozotocin was purchased from Sigma-Aldrich Co. USA. BGL (blood glucose level) for FBG (fasting blood glucose) and GTT (glucose tolerance test) studies were assayed using Kits from Bayer Diagnostics, India. One touch (Accu-chek sensor) of Roche Diagnostics, Germany. Solvents from E.Merk.

Animals : Male albino wistar rats of body weight about 170-220 gm were used in the experiments. Animals were kept in animal house at an ambient temperature of 25 -30°C and 45-55% relative humidity with a 12h each of dark and light cycle. Animals were fed pellet diet (Golden feed, New Delhi) and water *ad-libitum*. For experimental purpose the animals were kept fasting overnight but were allowed to free access to water "Principles of laboratory animals care" (NH publication no. 85-23, revised 1985) were followed.

Address for Correspondence :

Dr. Geeta Watal

Alternative Therapeutics Unit, Drug Development Division,
Medicinal Research Lab, Department of Chemistry,
University of Allahabad, Allahabad - 211002
E-mail : geetawatal@gmail.com

Preparation of stem juice extract : The stem of *Musa paradisiaca* was collected and identified by Prof. B. D. Singh, taxonomist, Allahabad Agriculture Institute, Naini, Allahabad, India .A voucher specimen (AA.443) has been submitted. Green part of the stem was peeled off and its white inner portion was cut into small pieces. The pieces were mechanically crushed and the juice about 5.0 liter was extracted. The extracted juice was filtered and concentrated in rotavapour under reduced pressure. The concentrated juice was finally lyophilized to get a powder (yield 12.8% w/w) for the study.

Estimations : Blood glucose levels were estimated by glucose oxidase method (17) using standard kits from Bayer diagnostics, India.

Induction of diabetes in rats : A freshly prepared solution (0.15-0.25ml) of STZ (45 mg/kg bw) 0.1 M in citrate buffer pH = 4.5 was injected intraperitoneally to overnight- starved rats (18). FBG level was estimated at the time of induction of diabetes and PPG (Post Prandial Glucose) was checked regularly till stable hyperglycemia was attained. It took 6 to 8 days to attain stable hyperglycemia. Depending on their glucose levels the animals were divided randomly in the two groups, sub diabetic animals, with normal FBG of 80-120 mg/dl but showing abnormal glucose tolerance and severely diabetic animals with FBG above 250 mg/dl.

Statistical Analysis : All the groups were statistically evaluated using student's 't' test expressed as the mean \pm SD from six rats in each group. P value of 0.05 or less was considered to be significant.

Experimental Design :

Assessment of glycemic potential of *M. paradisiaca* stem juice in normal healthy rats : Eighteen normal healthy male

rats were fasted overnight .The fasted animals were divided equally into three groups of six rats each. Pretreatment FBG (fasting blood glucose) levels of each group were evaluated. Group I served as untreated control given vehicle (distilled water with tween 80 only (0.1ml)) whereas, Group II and III were given lyophilized stem juice suspended in distilled water using a drop or two of tween 80, orally at doses of 250 and 500 mg/kg bw, respectively. Blood samples were collected for estimation of BGL from the tail vein at 2, 4 and 6h after giving the extract.

Assessment of glycemic potential of *M. paradisiaca* stem juice in severely diabetic rats : After checking the FBG in overnight fasted diabetic rats, they were divided into three groups of six rats each. Control rats (group IV) received vehicle (distilled water with tween 80 only (0.1ml)) while groups V and VI received lyophilized stem juice suspended in distilled water using a drop or two of tween 80, orally at doses of 250 and 500 mg/kg bw, respectively and their effects on BGL were studied upto 6 h at the interval of every 2h.

Assessment of glycemic potential of *M. paradisiaca* stem juice on glucose tolerance in sub-diabetic rats : The effect of *M. paradisiaca* stem juice was also assessed in sub diabetic rats by glucose tolerance test. The rats were divided into three groups (VII, VIII and IX). Diabetic control (group VIII) received vehicle (distilled water with tween 80 only (0.1ml)) whereas variable doses of 250 and 500 mg/kg bw of stem juice suspended in distilled water using a drop or two of tween 80 were administered orally to groups VIII and IX respectively. 2g/ kg bw glucose was given to all the groups of rats just after 90 minutes of the stem juice administration. Blood samples were collected just prior to glucose administration taken as 0h value and after 1 and 2h of glucose loading and their glucose levels were measured by glucose oxidase method (17).

Table 1 : Effect of graded doses of *M. paradisiaca* stem juice on BGL of normoglycemic rats (mean \pm SD)

Experimental animals (Six in each group)	Treatment (stem juice)	Blood glucose levels (mg/dl)			
		Pre-treatment	Post-treatment		
		FBG	2h	4h	6h
Control	Distilled water + tween 80	72.4 \pm 8.2	71.8 \pm 8.4	72.2 \pm 7.9	71.4 \pm 8.9
Treated	250 mg/kg + tween 80	75.5 \pm 8.1	82.2 \pm 9.6	88.7 \pm 8.8	98.28 \pm 8.3
Treated	500 mg/kg + tween 80	73.8 \pm 7.7	78.4 \pm 7.9	87.6 \pm 8.5*	99.6 \pm 7.5*

* P < 0.01 as compared to control.

Table 2: Effect of graded doses of *M. paradisiaca* stem juice on FBG level in severely diabetic rats. (mean ± SD)

Experimental animals (Six in each group)	Treatment (stem juice)	Blood glucose levels (mg/dl)			
		Pre-treatment	Post-treatment		
		FBG	2h	4h	6h
Control	Distilled water + tween 80	262.4 ± 5.8	260.8 ± 5.6	258.9 ± 5.2	257.7 ± 4.8
Treated	250 mg/kg + tween 80	268.8 ± 4.3	279.6 ± 5.4*	304.6 ± 6.1*	290.5 ± 4.9
Treated	500 mg/kg + tween 80	263.6 ± 5.3	283.5 ± 6.5*	308.5 ± 5.2*	296.8 ± 5.6

* P < 0.01 as compared to control.

RESULTS

Effect of *M. paradisiaca* stem juice on FBG in normoglycemic rats : Table 1 shows the hyperglycemic effect of a single oral administration of two doses 250, and 500 mg/kg bw of stem juice of *M. paradisiaca* in normal healthy rats. Rats treated with 250 mg/kg bw showed a maximum rise of 27.3% in BGL after 6h of oral administration whereas, maximum rise of 28.3% was observed in BGL levels from a dose of 500 mg/kg bw after 6h of oral administration. However, the increase in BGL from the doses of 250 mg/kg bw at 2 and 4 h was 12.6 and 18.6% respectively whereas, from the dose of 500 mg/kg bw the observed rise was 8.4 and 17.5% only after same interval of times.

Effect of *M. paradisiaca* stem juice on FBG in severely diabetic rats : Table 2, depicts the hyperglycemic effect of a single oral administration of stem juice of *M. paradisiaca* at doses of 250 and 500 mg/kg bw in severely diabetic rats. The dose of 250 mg/kg bw produced a maximum rise of 15% in

FBG, after 4h of oral administration. Maximum rise in BGL from a dose of 500 mg/kg bw was found to be practically the same i.e. 16% as that of 250 mg/kg bw after 4 h of treatment. However after 6h of treatment rise in BGL decreased slightly to 11.2 and 13.1% respectively as compare to that of 4 h.

Effect of *M. paradisiaca* stem juice on GTT in sub-diabetic rats : Table 3, reveals the hyperglycemic effect of graded doses of 250 and 500 mg/kg bw of *M. paradisiaca* stem juice on glucose tolerance in sub diabetic rats. The maximum rise of 12.2% and 16.4% was observed from doses of 250 and 500 mg/kg bw respectively in BGL after 1h of glucose administration whereas, the doses of 250 and 500mg/kg bw decreased this rise in BGL and brings it down to 9.4 and 14.9% respectively after 2h of glucose administration.

DISCUSSION

Various species of Musa have been used for the treatment of diabetes mellitus (13-16). Dhar et al (19) showed that 50%

Table 3 : Effect of graded dose of *M. paradisiaca* stem juice on the glucose tolerance in sub- diabetic rats (mean ± SD)

Experimental animals (Six in each group)	Treatment (stem juice)	Blood glucose levels (mg/dl)			
		Pre-treatment	Post-treatment		
		FBG	2h	4h	6h
Control	Distilled water + tween 80	88.6 ± 8.2	88.1 ± 8.4	358. 4 ± 7.9	192. 6 ± 8.9
Treated	250 mg/kg + tween 80	84. 8 ± 7.7	89.2 ± 7.9	408.6 ± 8.5*	212.8 ± 7.5*
Treated	500 mg/kg + tween 80	86. 2± 9.1	92.4 ±10.4	428.8 ±11.2*	226.4 ± 8.8*

* P < 0.01 as compared to control.

ethanolic extract of *M. paradisiaca* leaves had no biological and hypoglycemic activity. The present study reveals with almost similar findings in the stem juice extract of *M. paradisiaca* as no hypoglycemic activity has been observed in it, but the contrary hyperglycemic activity was found. Though other parts of the plant like fruits & flowers were reported to have antidiabetic activity (14-16) which made us to start this study on stem juice, which was not worked up till date but the results were unexpected. The FBG studies were carried out firstly in normal rats and then in severely diabetic rats but since the effect was not hypoglycemic as of our expectation and on the contrary it was hyperglycemic therefore, further long-term study in severe cases was not pursued. However, GTT studies were carried out with sub-diabetic rats and the results were again found similar as that of FBG studies of normal as well as severely diabetic rats that means hyperglycemic.

The observed data suggest that the increase in BGL levels with both the doses of 250 and 500 mg/kg bw was gradual and reached to its maximum value after 6 h of administration of *M. paradisiaca* stem juice extract. The rise in BGL levels of normal rats was 12.6, 18.6 and 27.3% after 2, 4 and 6 h of 250 mg/kg bw dose administration respectively whereas, observed rise at the same interval of times was 8.4, 17.5 and 28.3% respectively with the dose 500 mg/kg bw. The data reveals that there is not much difference in the efficacy of both the doses however, the dose of 250 mg/kg showed sudden initial rise after 2h in comparison to 500 mg/kg whereas, the dose of 500 mg/kg showed a maximum of it after 6h which was little higher than the 250 mg/kg dose.

The dose of 500 mg/kg bw produces a maximum rise of 28.3% in BGL after 6 h of oral administration in normal rats whereas, the same dose produces a rise of about 16% in BGL after 4 h in severely diabetic cases. However, this rise was only gradual upto 4 h with both the doses in case of severely diabetic rats. This was found to be 6.7 and 15% after 2 and 4 h of administration with the dose of 250 mg/kg bw but and 8 and 16% after 2 and 4 h of administration with the dose of 500 mg/kg bw.

The study has its own significance as the presence of hyperglycemic effect do not rule out the possibility of its antidiabetic potential in patients with type 2 diabetes mellitus. This is because any indirect mechanism like inhibition of glucose absorption in small intestine may still work in those patients just like metformin (20), the only ethical plant derived drug approved for diabetes.

In conclusion the presence of hyperglycemic effect of the stem juice of *M. paradisiaca* suggests that it can be useful in controlling hypoglycemia caused due to insulin and other hypoglycemic drugs.

ACKNOWLEDGEMENT

The authors are thankful to UGC, New Delhi, India for providing financial assistance.

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