

Glycaemic evaluation of *Psidium guajava* in rats

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Background & objectives: Many plant polysaccharides exhibit hypoglycaemic effect. Though the fruit of *Psidium guajava* is known to contain free sugars, the fruit extract showed hypoglycaemic effect in alloxan treated mice and human subjects. The present study was aimed to determine the glycaemic potential of *P. guajava* fruit peel extract on blood glucose level (BGL) of normal and streptozotocin-induced sub-diabetic rats during fasting blood glucose (FBG) and glucose tolerance test (GTT).

Methods: Female albino Wistar rats (n=42) were divided into seven equal groups, and were given different doses of fruit peel extract. Diabetes was induced by streptozotocin injection (ip) at a dose of 45 mg/kg body weight. Blood glucose levels were measured after collecting the blood from tail veins.

Results: The diabetic and sub-diabetic models showed hyperglycaemic effect from a single oral administration of variable doses of *P. guajava* fruit peel extract. The maximum rise of 26.51 per cent was observed in BGL from a dose of 400 mg/kg bw exactly after 8 h of administration in normal rats whereas the maximum rise of 90.7 per cent was observed with the same dose of 400 mg/kg bw after 2 h of glucose administration in sub-diabetic rats.

Interpretation & conclusion: The hyperglycaemic effect of *P. guajava* fruit peel suggests that the diabetic patients should peel off the guava fruits before consuming. However, it can also be useful in controlling hypoglycaemia occasionally caused due to excess of insulin and other hypoglycaemic drugs.

Key words Fasting blood glucose - fruit peel - glucose tolerance test - hyperglycaemic - *Psidium guajava*

Type 2 diabetes accounts for about 95 per cent of the disease and its characteristic feature is insulin resistance¹. Several drugs to increase the insulin sensitivity are currently being used. Protein tyrosine phosphatase 1B (PTP1B) has recently emerged as a promising therapeutic target in effective treatment of type 2 diabetes². In traditional system of medicine many plants have been claimed to be useful in the treatment

of diabetes mellitus³⁻⁶. *Psidium guajava* Linn. (family: Myrtaceae) is a semi-deciduous tropical tree and is widely grown throughout India for its fruit called Guava (*amrud* in Hindi). The fruit a berry, when unripe is considered indigestible, while the ripe one is a good aperient. The fruit contains a high percentage of vitamin C, carotene, vitamin B1, B2, B6, free sugars (glucose, fructose and sucrose), pectin and water soluble araban⁷.

The guava industry provides a variety of processed products⁸. Root bark is an astringent and given to children in diarrhoea and root preparation with fruit is considered to be useful in jaundice⁹.

The extract of the whole plant of *P. guajava* excluding roots was reported to be devoid of any antibacterial, antifungal, antiviral, antifertility, hypoglycaemic, diuretic and antiinflammatory activities¹⁰. The leaves of *P. guajava* inhibit the increase of plasma sugar level in alloxan induced diabetic rats, during glucose tolerance test¹¹. In addition, the butanol and water-soluble fractions were found to suppress adrenalin induced lipolysis in fat cells from rats epididymal adipose tissues¹².

Several flavonoids, glycosides, terpenoids, *etc.* have been shown to possess antidiabetic properties¹³⁻¹⁵. It is interesting to note that many plant polysaccharides have also been reported to exhibit hypoglycaemic effect¹⁶⁻¹⁸. Although the fruit of *P. guajava* is known to contain free sugars⁷, yet the fruit extract showed hypoglycaemic effect in alloxan treated mice and patients with diabetes¹⁹. *P. guajava* fruit has also been shown as a source of antioxidant due to the presence of polyphenols, ascorbic acids and carotenoids²⁰.

We undertook this study to evaluate the effect of *P. guajava* fruit peel extract on blood glucose level (BGL) of normal and streptozotocin induced sub-diabetic rats during fasting blood glucose (FBG) studies and glucose tolerance test (GTT).

Material & Methods

The study was conducted in the Medicinal Research Laboratory, Department of Chemistry, University of Allahabad, Allahabad.

Plant material: Semi ripe fruits of *P. guajava* collected from the guavas' garden Khushrobagh, Allahabad, India, and authenticated by Prof. Satya Narayan, Taxonomist, Department of Botany, University of Allahabad, India were peeled off. The redish yellow peel of the fruit was cut into small pieces. The pieces were mechanically crushed and continuously extracted for 48 h with boiling water. The extract was filtered, concentrated in rotatory evaporator at $35 \pm 5^\circ\text{C}$ under reduced pressure to obtain semisolid material and lyophilized to get a powder. Lyophilized fruit peel extract powder, suspended in distilled water, was fed orally in different doses to rats.

Experimental animals: Female adult albino Wistar rats (210-250 g) of approximately same age group, obtained from National Institute of Communicable Diseases

(NICD), Delhi. Animals were kept in our animal house at an ambient temperature of $27 \pm 3^\circ\text{C}$ and 50 ± 5 per cent relative humidity with a 12 h each of dark and light cycle. Animals were fed pellet diet (Golden Feed, New Delhi) and distilled water. The study was approved by the Institutional Ethical Committee.

Diabetes was induced by a single intraperitoneal (ip) injection of freshly prepared streptozotocin (STZ, 45 mg/kg bw) in 0.1 M citrate buffer (pH 4.5) to a group of overnight fasted rats. After 3 days of STZ administration²¹, sub diabetic animals with normal FBG 80-110 mg/dl and abnormal post-prandial glucose (PPG) >210 mg/dl levels were selected for the study²².

Blood glucose level (BGL) was estimated by glucose oxidase method²³, using standard kit of Ranbaxy Laboratories Limited, New Delhi, India.

The animals were randomly divided into seven groups of six rats each depending upon their BGLs. Each group was treated only once either with single dose of vehicle (distilled water only) or with single dose of variable doses (100, 200 or 400 mg/kg bw) of extract powder dissolved in distilled water.

Group 1 normal (control) treated with vehicle.

Group 2 normal treated with fruit peel extract of 100 mg/kg bw.

Group 3 normal treated with fruit peel extract of 200 mg/kg bw.

Group 4 normal treated with fruit peel extract of 400 mg/kg bw.

Group 5 sub-diabetic (control) treated with vehicle.

Group 6 sub-diabetic treated with fruit peel extract of 200 mg/kg bw.

Group 7 sub-diabetic treated with fruit peel extract of 400 mg/kg bw.

FBG was checked in all groups of overnight fasted animals. Group 1 and 5 were served as controls for normal and sub-diabetic groups and received vehicle (distilled water) only. The blood samples were collected from the tail vein and blood glucose levels were estimated at 2, 4, 6 and 8 h after the treatment, of groups 1, 2, 3 and 4 of normal healthy rats to assess the effect of extract on FBG in normal models.

In groups 5, 6 and 7 of sub-diabetic rats, blood glucose levels were first checked after 2 h of treatment, considered as '0' h value and then 2 g/kg bw glucose

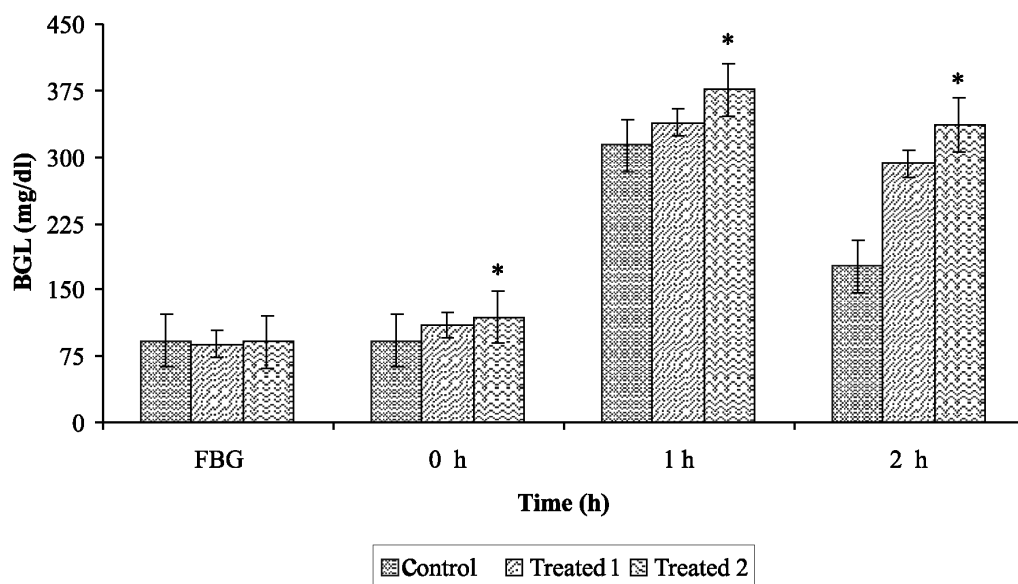


Fig. Effect of graded doses of *P. guajava* fruit peel aqueous extract on BGL of sub-diabetic rats during (GTT).

* $P < 0.05$ as compared with control value. Control- group 5 (distilled water); Treated 1- group 6 (200 mg/kg); Treated 2- group 7 (400 mg/kg).

was given. Blood glucose levels were further checked up to 2 h at one h intervals, considered as 1 and 2 h values, to assess the effect of extract on GTT on sub-diabetic rats.

Statistical analysis: Data were statistically evaluated using one-way ANOVA, followed by a post hoc Scheffe's test using the SPSS computer software, version 7.5. The values were considered significant with $P < 0.05$.

Results & Discussion

Rats in groups 2 and 3 showed a continuous increase in BGL up to 8 h which reached up to 7.76 and 15.36 per cent respectively after 8 h. A rise of 26.51 per cent was observed in BGL from a dose of 400 mg/kg bw after 8 h of oral administration in group 4 rats (Table).

Significant hyperglycaemic effect with doses of 200 and 400 mg/kg bw of *P. guajava* fruit peel extract on glucose tolerance was seen in sub-diabetic rats in groups 6 and 7. The rise of 65.98 and 90.7 per cent was observed at doses 200 and 400 mg/kg bw respectively after 2 h of glucose administration (Fig.).

Various parts of *P. guajava* have been used for the treatment of diabetes mellitus¹⁰. Methanolic extract (51%) of *P. guajava* leaves showed hypoglycaemic effect in type 2 diabetes²⁴. *P. guajava* fruits are considered a good source of antioxidants¹⁹.

The absence of anti-hyperglycaemic effect of *P. guajava* fruit peel extract in our experimental models do not rule out its potential effect in patients with diabetes mellitus, because any mechanism not related to direct hypoglycaemic effect may still work in those patients. This was the case with effective antidiabetic plant drug metformin²⁴.

Table. Effect of graded doses of *P. guajava* fruit peel aqueous extract on blood glucose levels of normoglycaemic rats

Experimental groups (Normal)	Treatment aqueous extract (mg/kg)	FB (mg/dl)	Blood glucose levels (mg/dl)			
			2	4	6	8
Control	Distilled water	74.3 ± 3.9	74.2 ± 3.2	74.2 ± 4.6	73.6 ± 3.8	73.9 ± 4.2
Treated -1	100	77.3 ± 3.2	77.8 ± 3.9	79.9 ± 3.4	82.2 ± 4.1*	83.3 ± 4.6*
Treated -2	200	78.1 ± 4.6	80.2 ± 4.2	82.6 ± 4.8	84.8 ± 3.7*	90.1 ± 4.5*
Treated -3	400	72.8 ± 3.2	78.5 ± 4.4	83.6 ± 4.6	87.4 ± 5.1	92.1 ± 3.8*

* $P < 0.01$ as compared with base value. Control- group 1 (distilled water); Treated 1- group 2 (100 mg/kg); Treated 2- group 3 (200 mg/kg); Treated 3- group 4 (400 mg/kg).

Values are mean ± SD of 6 rats

In conclusion, the presence of hyperglycaemic effect of the extract of *P. guajava* fruit peel suggests that it can be useful in controlling hypoglycaemia occasionally caused due to excess of insulin and other hypoglycaemic drugs. However, it could be used in patients with diabetes also but it has not been studied in severe cases due to high risk of mortality.

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