



## Anti-hyperglycemic activity of *Psidium guajava* bark extract

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### Abstract

**Objective:** To evaluate the anti-hyperglycemic activity of water extract of *Psidium guajava* stem bark. **Materials and methods:** The water extract of stem bark of *Psidium guajava* was tested for its hypoglycemic activity in normal glucose loaded and alloxan-induced hyperglycemic Wistar rats. Blood glucose levels were evaluated at intervals of 30 and 90 minutes in normal glucose loaded animals, at intervals of 0, 1 and 3 h in acute study and at days 1, 3, 7 and 10 during sub acute treatment after extract administration at an oral dose of 250 mg/kg. **Results:** During both acute and sub-acute tests, the water extract showed statistically significant and considerable anti-hyperglycemic activity and enhanced glucose tolerance in normal glucose loaded rats. **Conclusion:** *Psidium guajava* stem bark possessed statistically significant anti-hyperglycemic potential in alloxan induced diabetic rats and enhanced glucose tolerance in glucose loaded normal rats.

**Key words:** *Psidium guajava* Linn., hypoglycemic, hyperglycemic.

### 1. Introduction

Diabetes mellitus is a major disease affecting nearly 10% of the population. In spite of the introduction of hypoglycemic agents, diabetes and the related complications continue to be a major medical problem. Many indigenous Indian medicinal plants have been found to be successfully used to manage diabetes and some of them have been tested and the active principles isolated [1].

However, search for new anti-diabetic drug continues. *Psidium guajava* Linn. (Myrtaceae),

an arborescent shrub or small tree, up to 8 m high; often referred to as the apple of tropics; native of tropical America and has long been naturalized in India [2]. The following phytoconstituents have been isolated from the plant so far; catechol, tannins, wax, resins, sugars, carotene, vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, niacin [3], essential oil, vitamin C [4], calcium and manganese in combination with phosphoric, oxalic and maleic acids [5],  $\beta$ -sitosterol, quercetin, leucocyanidin, gallic acid [6], ellagitannin-guavin A, B, C, D [7]. The plant is used as astringent, anodyne,

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febrifuge, antispasmodic, tonic and in wounds, ulcers, cholera, diarrhoea, vomiting [8, 9], for swollen gums and ulceration of mouth [10].

The biological activities, viz. antidiarrhoeal [11], anticough and antimicrobial [12], analgesic, anti-inflammatory, CNS depressant [13-18], topical haemostatic [19], antiamoebic [20], antipyretic, antiarthritic [21], hypoglycemic [22, 23] of the various extracts of leaf and stem bark of the plant have been reported.

## 2. Materials and methods

### 2.1 Plant material

Fresh stem bark of *P. guajava* was collected from Bullandshehar district of Uttar Pradesh, India and authenticated at the Taxonomy Division, Department of Botany, Faculty of Science. A voucher specimen was deposited in the laboratory of Pharmacognosy and Phytochemistry, Jamia Hamdard, New Delhi.

### 2.2 Preparation of the extract

Shade dried bark (3 kg) was macerated in water. The water extract was dried under reduced pressure and obtained 125 g of the dry extract (yield 4.16%).

### 2.3 Animals

Male Wistar rats (180-200 g) were used in the experiment. They were procured from Central Animal House, Jamia Hamdard, (173/

CPCSEA), after approval under project number 135. They were maintained under standard environmental conditions and had free access to feed (Hindustan Lever, India) and tap water *ad libitum* during the quarantine period. The animals were fasted for 16 h before experiment but allowed free access to water.

## 3. Studies in normal glucose loaded animals

Effect of *P. guajava* water extract on glucose tolerance in normal rats

Fasted normal rats were divided into two groups of five animals each. Group I served as control and received distilled water. Group II received water extract at an oral dose of 250 mg/kg. After 30 min of extract administration, the rats of both the groups were orally treated with 2 g/kg of glucose. Blood samples were collected from the tip of the tail just prior to glucose administration and at 30 and 90 min after glucose loading. Serum was separated and blood glucose levels were measured immediately by glucose oxidase method [24].

## 4. Induction of experimental hyperglycemia

Hyperglycemia was induced by a single i. p. injection of 120 mg/kg of alloxan monohydrate (s. d. fine-chem. Ltd., Mumbai, India) in sterile saline [25]. After 5 days of alloxan injection,

Table 1.  
Effect of *P. guajava* water extract (250 mg/kg, p.o.), on oral glucose tolerance in normal rats<sup>a</sup>.

| Group | Treatment p.o.                     | Blood glucose level (mg/dl) |                 |                |
|-------|------------------------------------|-----------------------------|-----------------|----------------|
|       |                                    | Fasting                     | 30 min          | 90 min         |
| I     | Glucose (2 g/kg)                   | 72.00 ± 1.00                | 103.00 ± 2.302  | 81.80 ± 2.69   |
| II    | Water extract (250 mg/kg), glucose | 72.60 ± 1.030               | 82.60 ± 2.47 ** | 74.80 ± 0.86 * |

<sup>a</sup>Values are Mean ± S.E.; n = 5, \*\*p<0.001, \*p<0.05, NS: not significant vs. group I.



Table. 2

Effect of acute treatment of *P. guajava*, water extract (250 mg/kg, p.o.), on blood glucose level in alloxan induced hyperglycemic rats<sup>a</sup>.

| Group | Treatment                          | Blood Glucose (mg/dl) |                             |                             |
|-------|------------------------------------|-----------------------|-----------------------------|-----------------------------|
|       |                                    | Basal value           | 1 h                         | 3 h                         |
| I     | Control<br>(Distilled water only)  | 75.60 ± 1.24          | 77.00 ± 1.87                | 74.80 ± 2.08                |
| II    | Diabetic Control<br>(Alloxan only) | 353.80 ± 5.85         | 352.60 ± 2.78               | 352.00 ± 1.59               |
| III   | Standard<br>(Alloxan+Std. Drug)    | 329.00 ± 4.49         | 315.60 ± 5.68 <sup>NS</sup> | 308.20 ± 5.07 <sup>NS</sup> |
| IV    | Test<br>(Alloxan+extract)          | 376.20 ± 4.95         | 290.20 ± 3.43 <sup>**</sup> | 240.00 ± 3.89 <sup>**</sup> |

<sup>a</sup>Values are means ± S. E. ; n = 5, <sup>\*\*</sup>p<0.001, NS, not significant vs. group II.

Table 3.

Effect of sub acute treatment of *Psidium guajava*, water extract (250 mg/kg, p.o., once daily), on blood glucose level in alloxan induced hyperglycemic rats<sup>a</sup>

| Group | Treatment<br>(p.o)                 | Blood Glucose (mg/dl) |                             |                             |                             |                             |
|-------|------------------------------------|-----------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|       |                                    | Basal value           | Day 1                       | Day 3                       | Day 7                       | Day 10                      |
| I     | Control<br>(Distilled water only)  | 75.60 ± 1.24          | 93.80 ± 6.08                | 93.20 ± 5.45                | 91.80 ± 3.48                | 92.20 ± 1.77                |
| II    | Diabetic Control<br>(Alloxan only) | 353.80 ± 5.85         | 353.40 ± 8.91               | 354.60 ± 7.12               | 355.00 ± 6.05               | 354.80 ± 4.64               |
| III   | Standard<br>(Alloxan+Std. Drug)    | 329.00 ± 4.49         | 303.80 ± 3.65 <sup>NS</sup> | 306.40 ± 3.20 <sup>NS</sup> | 304.40 ± 3.16 <sup>NS</sup> | 304.60 ± 3.36 <sup>NS</sup> |
| IV    | Test<br>(Alloxan+extract)          | 376.20 ± 4.95         | 220.20 ± 3.40 <sup>**</sup> | 191.20 ± 3.81 <sup>**</sup> | 169.60 ± 4.01 <sup>**</sup> | 160.00 ± 3.01 <sup>**</sup> |

<sup>a</sup>Values are means ± S.E.; n = 5, <sup>\*\*</sup>p<0.001, NS, not significant vs. group II.

the hyperglycemic rats (glucose level>300 mg/dl) were separated and used for the study.

## 5. Effect of *P. guajava* water extract on alloxan-induced hyperglycemic rats

### 5.1 Acute treatment

The hyperglycemic rats were divided into three groups of five diabetic animals each. Group I was previously selected from normal rats and served as normal control and was given distilled water and no alloxan. Group II served as diabetic control and was given distilled water. Group III

received standard anti-diabetic drug gliclazide at an oral dose of 25 mg/ kg (Panacea Biotech Ltd., Batch No. 01030513). Group IV was treated orally with water extract at a dose of 250 mg/kg; the dose was selected after preliminary behavioural and acute toxicity tests.

The extract of the drug was found to be safe for further biological studies as no lethality was observed at 1000 mg/kg, i.p. in mice. Blood samples were collected from the tip of tail just prior to and at 1 and 3 h after the extract/drug administration.



### 5.2. Sub-acute treatment

In sub-acute treatment, the administration of extract/drug was continued for 10 days, once daily. Blood samples were collected from the tip of the tail just prior to and on days 1, 3, 7 and 10 of the extract/drug administration. The blood glucose levels were determined for all the samples by glucose-oxidase method. Data were expressed as Mean  $\pm$  SE, n=5. Statistical significance was determined by using one-way analysis of variance (ANOVA) followed by Dunnet's *t* test.

## 6. Results and discussion

The effect of water extract of *P. guajava* on glucose tolerance is shown in table 1. By 30 min after starting the glucose tolerance test, the blood concentration increased rapidly from its initial value as was evident from control but the extract fed group showed marginal rise in glucose concentration at 30<sup>th</sup> min and remained upto 90<sup>th</sup> min.

The water extract of *P. guajava* has shown statistically significant ( $P < 0.001$ ) and considerable fall in blood glucose levels during acute treatment in alloxan-induced hyperglycemic rats (table 2). In the untreated

animals, blood glucose level did not change significantly. During sub-acute treatment with *P. guajava* extract in alloxan-induced hyperglycemic rats a consistent reduction in the blood glucose level as compared to diabetic control was observed (table 3).

The results indicate that *P. guajava* bark water extract possessed significant anti-hyperglycemic activity in both acute and sub-acute treatments. It is generally accepted that alloxan treatment causes permanent destruction of  $\beta$ -cells [26].

It is, therefore, conceivable that the hypoglycemic principles in the water extract of *P. guajava* stem bark may exert their effect by an extra pancreatic mechanism in diabetic rats. Since the blood glucose lowering effect of the extract of the bark of *P. guajava* was observed in alloxan-induced hyperglycemic rats as well as in fasted normal glucose loaded rats, this effect could, possibly be due to increased peripheral glucose utilization.

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