Evaluation of Anti-hyperglycemic Potential of Methanolic Extract of *Tamarindus Indica* L. (Fabaceae) Fruits and Seeds in Glucose-induced Hyperglycemic Mice


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ABSTRACT

The present study was conducted to determine the anti-hyperglycemic potential of methanolic extracts of fruits and seeds of *Tamarindus indica* L. (Fabaceae) through glucose-tolerance tests using glucose-loaded Swiss albino mice. Significant anti-hyperglycemic activity of methanolic extract of fruits and seeds were observed at a dose of 200 mg extract/kg body weight. Methanolic extract of seeds demonstrated greater anti-hyperglycemic activity when compared to methanolic extract of fruits.

Key words: *Tamarindus indica*, anti-hyperglycemic, methanolic extract, fruits, seeds

Introduction

*Tamarindus indica* L. (Family: Fabaceae) is a medium growth bushy tree, which can attain a height of 12-18 meters. The leaves are evergreen, and the fruits (tamarind) are sweet and sour in taste and consumed in many countries of the world. The tree is endemic to tropical Africa, particularly in Sudan; it is also cultivated in Cameroon, Nigeria and Tanzania. It was introduced to India probably several thousand years ago. It is now widely distributed throughout the Tropical belt, from Africa to India, and throughout South East Asia, Taiwan and as far as China. In the 16th century, it was introduced to Mexico as well as South America by Spanish and Portuguese colonists.

The medicinal properties of the tree and particularly its fruits have been widely noted in the traditional medicinal systems of many countries. In the Indian sub-continent, traditional practitioners prescribe the fruits for constipation, indigestion and flatulence, while the seeds are prescribed for diabetes. In the Bangladesh folk medicinal system, both fruits and seeds are prescribed for diabetes. The fruits are used as laxative or febrifuge throughout the Sahel and Sudan. The bark and leaves are used in the treatment of wounds in central West Africa. In West Africa, the bark is used to treat diarrhea, while the leaves are used for this purpose in East Africa (Havinga, R.M., 2010). In Trinidad and Tobago, the plant is used to treat hypertension (Lans, C.A., 2006). In the traditional medicinal system of Burkina Faso, Africa the plant is used to treat kidney diseases (Lengani, A., 2010).
The anti-diabetic effect of aqueous extract of seeds in streptozotocin (STZ)-induced diabetic male rats has been reported (Maiti, R., 2004). The aqueous extract of seed also reportedly attenuated hyperglycemia and hyperlipidemia in STZ-induced diabetic rats (Maiti, R., 2005). Administration of MTEC – a formulated herbal drug containing aqueous-methanol extract of *Musa paradisiaca*, *Tamarindus indica*, *Eugenia jambolana*, and *Coccinia indica* has been shown to protect testicular dysfunctions in STZ-induced diabetic rat (Mallick, C., 2007). Considering the anti-diabetic potential of the plant, the objective of the present study was to evaluate the anti-hyperglycemic activity of methanol extracts of fruits and seeds in glucose-loaded Swiss albino mice.

**Material and Methods**

**Plant material and extraction**

The fruits and seeds of *Tamarindus indica* were collected from Dhaka in May 2009. The plant was taxonomically identified by the experts of Bangladesh National Herbarium, Mirpur, Dhaka (Accession no. 35,037) and a voucher specimen was also deposited there for future reference. The dried fruits and seeds were separately pulverized into a fine powder and 100g of powdered fruits or seeds were mixed with methanol at a ratio of 1:3. After 24 hrs, the mixture was filtered; filtrate was collected and the residue was again mixed with methanol at a ratio of 1:2 for 24 hrs. After filtration, filtrates were combined and evaporated to dryness using a rotary evaporator. The final weight of the fruit extract was 19g, while that of the seed extract was 20g. Prior to the experiment, extracts were suspended in 1% Tween-80 in water and used within 60 minutes of suspension.

**Drugs**

Glibenclamide and glucose were obtained from Square Pharmaceuticals Ltd., Bangladesh. All other chemicals were analytical grade.

**Animals**

Swiss albino mice (male), weighing 25-30g bred in the animal house of International Centre for Diarrheal Disease and Research, Bangladesh (ICDDR,B) were used for the present experiments. All the animals were acclimatized one week prior to the experiments. The study was approved by the Institutional Animal Ethical Committee of the University of Development Alternative, Dhaka, Bangladesh.

**Anti-hyperglycemic activity**

Glucose tolerance property of *Tamarindus indica* fruits and seeds was performed following the procedure as described previously by Joy and Kuttan (1999) with minor modifications. In brief, fasted mice were divided into five groups of five mice each (for evaluation of fruit extract) and five groups of four mice each (for evaluation of seed extract). Group 1 served as control and received vehicle (1% Tween 80 in water, 10 ml/kg body weight), group 2 received standard drug (glibenclamide, 10 mg/kg body weight) and the three other groups (groups 3-5) received the methanolic extract of *Tamarindus indica* fruits or seeds at three different doses of 50, 100, and 200 mg per kg body weight, respectively. Each mouse was weighed properly and the doses of the test samples, standard drug, and control materials were adjusted accordingly. Test samples, control, and glibenclamide were given orally by gavaging. After one hour all mice were orally treated with 2g/kg body weight of glucose. Blood samples were collected two hours after the glucose administration through puncturing heart. Serum was separated and blood glucose levels were measured immediately by glucose oxidase method (Venkatesh, S., 2004).

**Statistical analysis**

Student’s t-test was used to determine a significant difference between the control group and experimental groups. *P* values < 0.05 was considered as significant compared to control.

**Results**

The effect of oral administration of varying doses of methanol extract of fruits of *Tamarindus indica* on glucose tolerance in mice is shown in Table 1. A dose-dependent hypoglycemic effect of the fruit extract was
observed; however, the results were significant only at the highest dose of 200 mg extract/kg body weight. Glibenclamide at a dose of 10 mg/kg body weight demonstrated greater potency on decreasing glucose levels in glucose-loaded mice. The effect of oral administration of varying doses of methanol extract of seeds of *Tamarindus indica* on glucose tolerance in mice is shown in Table 2. Once again, a dose-dependent hypoglycemic effect was observed. However, the seed extract showed more potency than the fruit extract when equivalent doses are compared. The results were significant only at the highest dose of 200 mg seed extract/kg body weight although hypoglycemic effects were noticeable even at the lowest dose of 50 mg seed extract/kg body weight.

**Discussion**

The experimental results validate the folk medicinal use in Bangladesh of fruits and seeds of *Tamarindus indica* for treatment of diabetes. Although the glucose lowering activity was not comparable to the standard drug glibenclamide even at the highest dose of extracts of fruits or seeds tested, nevertheless both extracts at the highest dose of 200 mg extract/kg body weight significantly lowered blood glucose levels in mice when compared to controls. Fruits of the plant are known to contain limonene (Duke, James A., 1992). The n-hexane extract of Diamante citron peel contains limonene as one of its major ingredients and has been shown to possess hypoglycemic activity (Conforti, F., 2010). Additionally, it possesses anti-oxidant properties, which could be beneficial during diabetes. The seed coat extract has also been shown to contain polyphenolic flavonoid with strong anti-oxidant properties (Komutarin, T., 2004). Taken together, the published literature shows that both fruits and seeds of *Tamarindus indica* contain phytochemicals with either hypoglycemic activity or having strong anti-oxidant activity, which can prove beneficial to diabetic patients.

The fruits of *Tamarindus indica* are widely consumed in Bangladesh both in the raw state as well as cooked with other items. The seeds are prescribed by folk medicinal practitioners to diabetic patients. Our study indicates that such consumption may be helpful for diabetic patients to keep their blood sugar under control if this is done on a regular basis. Also noteworthy in this regard is there has not been thus far any scientific or anecdotal evidence against consumption of fruits and seeds of this plant on a regular basis.

**Table 1:** Effect of oral administration of methanol extract of fruits of *Tamarindus indica* on oral glucose tolerance in mice.

<table>
<thead>
<tr>
<th>Group</th>
<th>Serum glucose level (mg/dL)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n = 5)</td>
<td>102.3 ± 6.1</td>
</tr>
<tr>
<td>2 (n = 5)</td>
<td>47.1 ± 3.1*</td>
</tr>
<tr>
<td>3 (n = 5)</td>
<td>122.3 ± 15.1</td>
</tr>
<tr>
<td>4 (n = 5)</td>
<td>92.9 ± 10.8</td>
</tr>
<tr>
<td>5 (n = 5)</td>
<td>84.7 ± 7.2**</td>
</tr>
</tbody>
</table>

Oral glucose tolerance tests were conducted with methanol extract of fruits of *Tamarindus indica* in mice. Mice were divided into five groups of five mice each; group 1 received distilled water containing 1% Tween-80 and served as control; group 2 received a standard drug glibenclamide; groups 3-5 received fruit methanol extract at doses of 50, 100 and 200 mg/kg body weight. After 60 min of extract or glibenclamide administration, glucose was orally administered to mice at a dose of 2g/kg body weight. Following another 120 min, animals were sacrificed and serum glucose levels measured. Further details on the experiment are given under Materials and Methods.

*Values are expressed as means ± S.E.M.; *P<0.005, **P<0.05 versus Group 1.

**Table 2:** Effect of oral administration of methanol extract of seeds of *Tamarindus indica* on oral glucose tolerance in mice.

<table>
<thead>
<tr>
<th>Group</th>
<th>Serum glucose level (mg/dL)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n = 4)</td>
<td>128.7 ± 17.0</td>
</tr>
<tr>
<td>2 (n = 4)</td>
<td>39.7 ± 2.1*</td>
</tr>
<tr>
<td>3 (n = 4)</td>
<td>108.1 ± 14.6</td>
</tr>
<tr>
<td>4 (n = 4)</td>
<td>81.6 ± 18.3</td>
</tr>
<tr>
<td>5 (n = 4)</td>
<td>77.9 ± 8.5**</td>
</tr>
</tbody>
</table>

Oral glucose tolerance tests were conducted with methanol extract of seeds of *Tamarindus indica* in mice. Mice were divided into five groups of four mice each; group 1 received distilled water containing 1% Tween-80 and served as control; group 2 received a standard drug glibenclamide; groups 3-5 received seed methanol extract at doses of 50, 100 and 200 mg/kg body weight. After 60 min of extract or glibenclamide administration, glucose was orally administered to mice at a dose of 2g/kg body weight. Following another 120 min, animals were sacrificed and serum glucose levels measured. Further details on the experiment are given under Materials and Methods.

*Values are expressed as means ± S.E.M.; *P<0.005, **P<0.05 versus Group 1.

**References**
