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Oral glucose tolerance tests with methanolic extract of fruits of *Musa textilis* Nee

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Abstract
In previous studies we have observed that methanol extracts of fruit skins of various types of cultivated banana species (*Musa sapientum*, *Musa seminifera* and *Musa textilis*) can improve glucose tolerance in glucose-loaded mice. The objective of this study was to evaluate the oral glucose tolerance efficacy of methanol extract of fruits of *Musa textilis*. Oral glucose tolerance test (OGTT) was done to evaluate glucose tolerance. In oral glucose tolerance tests, methanol extract of fruits of *Musa textilis* (MEMTF) significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 10.3, 15.9, and 19.7%, respectively, at doses of 100, 200 and 400 mg each per kg body weight in mice. By comparison, a standard antihyperglycemic drug, glibenclamide reduced blood glucose levels by 39.3% at a dose of 10 mg per kg. The results suggest that MEMTF, although not as effective as glibenclamide, can still improve glucose tolerance and serve as an effective means for reducing blood glucose levels in persons with elevated blood glucose.

Keywords: antihyperglycemic, *Musa textilis*, OGTT, diabetes, glucose

Introduction
Diabetes is a serious disorder caused by lack of sufficient insulin production or inability for insulin to function properly. The disorder is characterized by elevated blood glucose levels and if left untreated can quickly lead to complications like heart, kidney, eye and brain disorders. Diabetes cannot be cured; treatment, however, exists to bring down elevated blood glucose levels. On the other hand, recent years are showing more and more the adverse reactions of many allopathic drugs. To properly control and cure diseases, it is possibly time to reverse back to the old Hippocratic adage of "let food be thy medicine and medicine be thy food". In that aspect, bananas can play a part in the control of diabetic glucose levels.

Daily consumption of banana has been demonstrated to marginally improve blood glucose profile and increase serum adiponectin in type 2 diabetic patients; adiponectin is known to possess anti-diabetic properties [1]. Since Bangladesh has a high number of diabetic patients [2], we had been screening various local plants and plant-based formulations for their blood glucose lowering effect [3-18]. We have previously observed effective improvement of glucose tolerance with methanol extracts of fruit skins of *Musa seminifera*, *Musa sapientum* and *Musa textilis* [19- 21]. The objective of the present study was to evaluate the oral glucose tolerance efficacy of methanol extract of fruits of wild banana (MEMTF), otherwise known as *Musa textilis* Nee (Musaceae family), known in Bengali as Pahari kola or Jongli kola, that is banana that grows in hilly regions or wild banana.

Methods
Plant material collection
Ripe fruits of *Musa textilis* were collected from Bandarban district in the Chittagong Hill Tracts region and identified at the University of Development Alternative.

Preparation of methanolic extract of Musa textilis fruits (MEMTF)
Methanol extract of fruits of *Musa textilis* (MEMTF) was prepared as described before [21] for skins. 50g of dried fruit powder was extracted with 250 ml methanol over 48 hours. Methanol was evaporated at 40ºC. The final weight of the extract was 7g.

Chemicals and Drugs

Glibenclamide and glucose were obtained from Square Pharmaceuticals Ltd., Bangladesh. All other chemicals were of analytical grade. Glucometer and strips were purchased from Lazz Pharma, Bangladesh.

Animals

Swiss albino mice, which weighed between 12-15g were used in the present study. The animals were obtained from International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B). The animals were acclimatized for three days prior to actual experiments. During this time, the animals were fed with mice chow (supplied by ICDDR, B) and water *ad libitum*. The study was conducted following approval by the Institutional Animal Ethical Committee of University of Development Alternative, Dhaka, Bangladesh.

Oral glucose tolerance tests for evaluation of antihyperglycemic activity

Oral glucose tolerance tests (OGTT) were carried out as per the procedure previously described by Joy and Kuttan [22] with minor modifications. Briefly, fasted mice were grouped into five groups of five mice each. The various groups received different treatments like Group 1 received vehicle (1% Tween 20 in water, 10 ml/kg body weight) and served as control, Group 2 received standard drug (glibenclamide, 10 mg/kg body weight). Groups 3-5 received, respectively, MEMTF at doses of 100, 200 and 400 mg per kg body weight. All substances were orally administered by gavaging. The amount of Tween 20 administered was same in both control and experimental mice. Following a period of one hour as described earlier [15, 16], all mice were orally administered 2g glucose per kg of body weight. Blood samples were collected 120 minutes after the glucose administration through puncturing heart following previously published procedures [15, 16]. Blood glucose levels were measured with a glucometer. The percent lowering of blood glucose levels were calculated according to the formula described below.

Percent lowering of blood glucose level = $(1 – W_e/W_c) X 100$, where W_e and W_c represents the blood glucose concentration in glibenclamide or MEMTF administered mice (Groups 2-5), and control mice (Group 1), respectively.

Statistical analysis

Experimental values are expressed as mean ± SEM. Independent Sample t-test was carried out for statistical comparison. Statistical significance was considered to be indicated by a p value < 0.05 in all cases [10].

Table 1: Effect of MEMTF on blood glucose level in hyperglycemic mice following 120 minutes of glucose loading.

Treatment	Dose (mg/kg body weight)	Blood glucose level (mmol/l)	% lowering of blood glucose level
Control	10 ml	5.80 ± 0.14	-
Glibenclamide	10 mg	3.52 ± 0.09	39.3*
(MEMTF)	100 mg	5.20 ± 0.07	10.3*
(MEMTF)	200 mg	4.88 ± 0.11	15.9*
(MEMTF)	400 mg	4.66 ± 0.14	19.7*

All administrations were made orally. Values represented as mean ± SEM, (n=5); $^*P < 0.05$; significant compared to hyperglycemic control animals.

Results and Discussion

In oral glucose tolerance tests, methanol extract of fruits of *Musa textilis* (MEMTF) significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 10.3, 15.9, and 19.7%, respectively, at doses of 100, 200 and 400 mg each per kg body weight in mice. By comparison, a standard antihyperglycemic drug, glibenclamide reduced blood glucose levels by 39.3% at a dose of 10 mg per kg. Although MEMTF was not effective as glibenclamide in reducing blood glucose, it is to be noted that since the extract yield was 14%, 400 mg extract is equivalent to only 2.86g whole fruit. As such, more fruit can be easily consumed for possible greater reduction of blood glucose.

Another important aspect of this study is that to our knowledge this is the first description of the ability of *Musa textilis* fruits to reduce blood glucose. If this holds up for other types of bananas and the active component(s) along with their mechanism of action is identified and elucidated, this can be a highly promising means towards alleviation of high blood glucose levels in diabetic patients or people with impaired glucose metabolism.

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