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Glucose lowering effect of wild banana cultivar of *Musa acuminata* L. fruit peels from Bandarban, Bangladesh in Swiss albino mice

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Abstract

Diabetes is a debilitating disease, which has become a serious concern in Bangladesh. Earlier studies have shown that extracts of fruit skins of various cultivars of banana species can improve glucose tolerance in glucose-loaded mice. The objective of this study was to evaluate through oral glucose tolerance test (OGTT) of methanol extract of fruit peels of a wild cultivar of *Musa acuminata*, which can be found in southeast Bangladesh forests. In OGTT, ripe fruit skin methanolic extract of *Musa acuminata* (MEMA) showed a reduction by 0.04, 19.65, 19.80 and 26.84%, when administered per kg body weight in mice at doses of 50, 100, 200 and 400 mg, respectively. A standard glucose lowering drug, glibenclamide decreased blood glucose levels by 21.08 and 37.38% at doses of 2 and 10 mg. Overall, the findings indicate that MEMA can improve glucose tolerance and may be of potential use to diabetic patients.

Keywords: Glucose lowering, *Musa acuminata* L, fruit peels, Swiss albino mice, Bangladesh

Introduction

Diabetes mellitus (DM) is a disorder that cause disturbances in glucose homeostasis (characterized by high blood glucose) and is becoming of serious concern in Bangladesh. A recent study comprising of 7,535 individuals in Bangladesh found that among the 50-54 years age group, the prevalence of DM was 33.3% [1]. This report suggests that because of increasing age, there is an increased risk of DM, raising both age and financial concerns because people at that age are near retirement, have less capability to work, and with reduced income levels are more vulnerable in meeting increased health costs. DM increases oxidative stress, which can increase DM-associated cardio-, reno-, and retino-vascular complications [2-4]. DM-induced comorbidities like retinopathy, nephropathy, and neuropathy can substantially increase health costs beyond the ability of low-income population in developing countries. A cross-sectional study carried out with 1,253 diabetic patients in Bangladesh in 2017 found that the average health cost for treatment of diabetes only was US\$ 864.7 per year (gross domestic product per capita was US\$ 1,564) [5]. Type 2 is the common form of DM in Bangladesh. Because of the high costs of treatment of diabetes and diabetes-induced complications, lack of affordability and accessibility to diabetes-treatment centers, and general illiteracy regarding diabetes and adverse effects of glucose-lowering drugs, scientists are searching for better glucose-lowering drugs, the main source of the searches being the plant kingdom [6-8]. For the last decade and more, we had been evaluating antihyperglycemic activity of medicinal flora of Bangladesh [9-24]. Among medicinal plants, various parts of the banana plant (which has many species as well as both cultivated and wild cultivars) have been reported to possess antihyperglycemic properties [25-28]. The previous effects on hypoglycemic activity as demonstrated in OGTT of peels or fruits of *Musa seminifera*, *M. sapientum* and *M. textilis* have been reported [28-31]. It was the aim of the present study to evaluate the antihyperglycemic potential, as measured by OGTT, of peels of ripe fruits of *M. acuminata* (MEMA), which can be found growing in the wild. These bananas are otherwise known as Jongli kola or 'banana that grows in the wild'. This type of banana can be found in the wild hilly regions of Chittagong Hill Tracts (CHT) and is not to be confused with another wild banana cultivar *Musa textilis* Nee found in CHT [30, 31], also referred to by the indigenous people and the Bangla-speaking settlers of CHT as Jongli kola. A major problem in the banana names is that fruits of both banana species wild cultivars (*Musa acuminata* and *Musa textilis*) as well the

plants look similar and can be mistaken even by a trained person. However, the fruits of *Musa acuminata* are slightly larger in size than the fruits of *Musa textilis* and are in some opinion sweeter in taste, though the latter opinion differs in various regions of CHT.

Methods



Fig 1: Fruits and plants of wild *Musa acuminata* in Bandarban district, Bangladesh.

Plant material collection

M. acuminata ripe fruits (Figure 1) were collected from Bandarban in the Chittagong Hill Tracts region and identified by trained botanists.

Methanol extract of *M. acuminata* ripe fruit peels (MEMA)

Methanol extract of ripe fruit peels of *M. acuminata* (MEMA) was prepared as described before [30]. Extraction with 250 ml methanol of 50g of dried fruit peel powder was done over 48 hours. Evaporation of methanol was done at 40°C, yielding 6.5g extract.

Chemicals and Drugs

Square Pharmaceuticals Ltd., Bangladesh was the source for glibenclamide and glucose. The rest of the chemicals were of analytical grade. Glucometer and strips were purchased from a local chemist shop in Dhaka, Bangladesh.

Animals

Oral glucose tolerance test (OGTT) experiments were conducted with Swiss albino mice of both sexes. The mice weights were in the range of 12-15g. Mice were procured from International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). The animals were kept in the animal house of the University for 3 days prior to actual experiments for adaptation to their new housing. During this period, the animals were fed with mice chow and water *ad libitum*. The Institutional Animal Ethical Committee of the University approved the present study with mice as the experimental animal.

Oral glucose tolerance tests for evaluation of antihyperglycemic activity

Oral glucose tolerance tests (OGTTs) were carried out as previously described [32] with a few changes. Mice, which were fasted, were divided into seven groups, each group consisting of five mice each. Group 1 received vehicle (1% Tween 20 in water, 10 ml/kg body weight) and served as

control, Groups 2 and 3 received glibenclamide at 2 mg and 10 mg/kg body weight, respectively. The other four groups, that is Groups 4-7 received, respectively, MEMA at doses of 50, 100, 200 and 400 mg per kg. Administration was through gavage. The amount of Tween 20 administered was kept the same in all groups. After a 60 min period [14, 15], all mice were given 2g glucose per kg. The collection of blood samples was performed two hours following glucose administration as previously described [30, 31]. Glucometric measurement and percent lowering of blood glucose levels were as described before [30, 31].

Statistical analysis

The results are expressed as mean \pm SD (standard deviation). For statistical analysis, Independent Sample t-test was carried out. A p value < 0.05 in all cases was considered to be statistically significant [10].

Results and Discussion

In OGTTs, MEMA was found to significantly reduce blood glucose levels in glucose-challenged mice by 19.65, 19.80, and 26.84%, respectively, when orally administered at doses of 100, 200 and 400 mg each per kg in mice. A standard antihyperglycemic drug, glibenclamide, at a dose of 10 mg per kg was found to reduce blood glucose levels by 37.38%. The results are shown in Table 1. Table 1 further shows that MEMA at 400 mg per kg was better in lowering blood glucose levels than glibenclamide at 2 mg per kg.

To our knowledge this is the first description of the ability of methanol extract of *M. acuminata* fruit peels to reduce blood glucose. The hypoglycemic activity of ethanolic extract of *M. acuminata* fruit peels have been reported for glucose-induced diabetic rats [33]. The antioxidant and antihyperglycemic (alpha-amylase and alpha-glucosidase inhibitory properties) of *M. sapientum* (Latundan banana), *M. acuminata* (Cavendish banana) and *M. acuminata* (Red Dacca banana) have also been reported [34]. The polyphenolic constituents of bananas can contribute to reduced oxidative stress and consequent alleviation of diabetes and diabetes-induced complications [35]. If this holds up in further studies for different types of banana fruits and/or peels and their active component(s), this can prove to be a highly effective means to reduce high blood glucose levels in diabetic patients, because bananas are affordable and can be readily available substitutes for antidiabetic drugs.

Table 1: Effect of MEMA 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	6.26 \pm 0.75	-
Glibenclamide	2 mg	4.94 \pm 0.86	21.08*
Glibenclamide	10 mg	3.92 \pm 0.80	37.38*
(MEMA)	50 mg	6.04 \pm 0.72	0.04
(MEMA)	100 mg	5.30 \pm 0.75	19.65*
(MEMA)	200 mg	5.02 \pm 0.78	19.80*
(MEMA)	400 mg	4.58 \pm 0.81	26.84*

All administrations were made orally. Values represented as mean \pm SD, (n=5); *P < 0.05 ; significant compared to hyperglycemic control animals.

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