GAVIN PUBLISHERS

Archives of Natural and Medicinal Chemistry

Jannat K, et al. Arch Nat Med Chem: ANMC-113

Research Article

DOI: 10.29011/ANMC-113.000013

# Improved Oral Glucose Tolerance with Ripe Fruit Peels of *Musa seminifera* Lour

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**Citation:** Jannat K, Morshed Md Z, Akter S, Mohammed R (2018) Improved oral glucose tolerance with ripe fruit peels of *Musa seminifera* Lour. Arch Nat Med Chem: ANMC-113. DOI: 10.29011/ANMC-113.000013

**Received Date:** 22 December, 2017; **Accepted Date:** 15 January, 2018; **Published Date:** 22 January, 2018

## Abstract

Various parts of *Musa sapientum* plant varieties (banana) like leaf, pseudostem, root and fruit have been reported to demonstrate antihyperglycemic activity. The objective of the present study was to determine the antihyperglycemic effects of methanol extract of *Musa seminifera* (also considered as *Musa sapientum* var. *sylvestris*) ripe fruit peels in glucose-challenged mice. Antihyperglycemic activity was determined through oral glucose tolerance test (OGTT). Administration of Methanol Extract of *Musa seminifera* fruit peels (MEMS) at doses of 50, 100, 200, and 400 mg per kg body weight each to glucose-loaded mice reduced blood glucose levels by 16.5, 25.2, 29.8, and 35.1%, respectively compared to control (untreated) mice. By comparison, a standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, reduced blood glucose level by 41.6%. A combination of MEMS at 400 mg per kg and glibenclamide at 10 mg per kg reduced blood glucose level by 42.9% suggesting that the fruit peels can be an effective combination with glibenclamide.

**Keywords**: Antihyperglycemic; Glibenclamide; *Musa seminifera*; OGTT

## Introduction

Various varieties of different *Musa* species (Musaceae) are grown in Bangladesh because of their edible fruits. Both the plant and the fruit of various *Musa* species are known as 'banana' in English and as 'kola' in Bengali (however, one *Musa* species, namely *Musa paradisiaca* is known in English as 'plantain' and in Bengali as 'kanch kola'; unlike other *Musa* species, where fruits are consumed directly when ripe, the fruits of *Musa paradisiaca* are consumed in the unripe form following cooking). A number of reports exist on the anti-diabetic effects of various parts of *Musa sapientum* L. (like fruit, leaf, sucker and pseudostem), as well as other species and varieties of bananas, like *Musa balbisiana* [1-7]. There is also one report on suppression of Type-II Diabetes with dyslipidemia and nephropathy by peels of *Musa cavendish* fruit [8].

Diabetes and pre-diabetes are conditions characterized by glucose intolerance leading to disturbances in glucose metabolism and homeostasis, which in turn leads to elevated blood glucose levels. Although there are blood glucose lowering medications, diabetes itself cannot be cured. The two major types of diabetes are Insulin Dependent Diabetes Mellitus (IDDM) and Non-Insulin Dependent Diabetes Mellitus (NIDDM). Allopathic drugs like sulphonyl ureas and biguanides can lower blood glucose levels but have side effects and cannot cure the disease [9,10].

Diabetes can rapidly lead to other serious disorders involving fatalities like cardiovascular and kidney disorders. This disorder has been spreading in recent years, possibly caused by changes in food habit and a more sedentary life style, although other undetermined factors cannot be ruled out. It has been estimated that by 2030 the number of persons with impaired glucose tolerance will rise to 472 million, and a large section of these people will not be able to bear the high costs of diabetes treatment [11]. This is true for developing countries like Bangladesh, where modern clinics, doctors and treatment are not readily available or affordable to the rural and urban slum people.

We had been investigating various plants and plant parts for their ability to improve glucose tolerance for a number of years [12-20]. The fruits of *Musa sapientum* (different varieties) are affordable and available throughout the year in Bangladesh. The peels are discarded; at most, in rural areas they are fed to cattle.

*Musa seminifera* (Bengali name 'aitta kola') is distinguished from other varieties of *Musa sapientum* because the fruits contain a large number of seeds [21]. As such, it is not a preferred banana species or variety for consumption of ripe fruits, and is much cheaper than other varieties. This variety is basically grown for feeding to cattle.

We have previously reported on the antihyperglycemic effect of methanol extract of fruit peels of *Musa sapientum* "sagor' variety [22]. The objective of the present study was to examine the effect of methanol extract of peels of ripe fruits of *Musa seminifera* on oral glucose tolerance in mice through Oral Glucose Tolerance Test (OGTT).

## Methods

### Plant Material Collection and Extraction

Fruit peels of ripe fruits of *Musa seminifera* were collected from Nilphamari district, Bangladesh during October 2017. Plant specimen was taxonomically identified by a trained botanist at the University of Development Alternative. Peels were sliced into thin strips and dried in the shade (typically 72 hours). The sliced air-dried fruit peels were grounded into a fine powder and 50g of the powder was extracted with methanol (1:5, w/v) for 48 hours. The extract (MEMS) was evaporated to dryness at 40°C and stored in small aliquots at -20°C till use. The final weight of MEMS was 1.9g. The extract (MEMS) was suspended in DMSO prior to administration by giving to mice in oral glucose tolerance test.

### Chemicals and Drugs

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

### Animals

Swiss albino mice, which weighed between 14-18g were used in the present study. The animals were purchased from International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) in Dhaka city, Bangladesh. The animals were acclimatized for three days prior to actual experiments. During this period, they were kept in a temperature controlled room (25°C) and given standard mice chow and water *ad libitum*. The study was conducted following approval by the Institutional Animal Ethical Committee of University of Development Alternative, Dhaka, Bangladesh and following European Union guidelines for experimenting with animals.

### Oral Glucose Tolerance Test (OGTT)

Oral glucose tolerance tests were carried out as per the procedure previously described by Joy and Kuttan (1999) [23] with minor modifications. Briefly, mice fasted for sixteen hours were grouped into seven groups of five mice each. The various groups received different treatments like Group 1 received vehicle and served as control, Group 2 received standard drug (glibenclamide, 10 mg/kg body weight). Groups 3-6 received MEMS at doses of 50, 100, 200, and 400 mg per kg body weight, respectively. Group 7 received (400 mg MEMS and 10 mg glibenclamide) per kg body weight. All substances were administered by gavaging. Following a period of one hour, all mice were orally administered 2g glucose/kg of body weight. Blood samples were collected 120 minutes after the glucose administration through puncturing heart. Blood glucose levels were measured with a glucometer [22]. The percent lowering of blood glucose levels were calculated according to the formula described below.

Percent lowering of blood glucose level = $(1 - W_e/W_c) \times 100$,

Where $W_e$ and $W_c$ represents the blood glucose concentration in glibenclamide or extract or extract plus glibenclamide administered mice (Groups 2-7), and control mice (Group 1), respectively [22].

### 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 [19].

## Results

### Oral Glucose Tolerance Test (OGTT) Results

Administration of Methanol Extract of *Musa seminifera* fruit peels (MEMS) at doses of 50, 100, 200, and 400 mg per kg body weight each to glucose-loaded mice reduced blood glucose levels by 16.5, 25.2, 29.8, and 35.1%, respectively, compared to control (untreated) mice. By comparison, a standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, reduced blood glucose level by 41.6%. Thus, at the highest dose tested, MEMS demonstrated good capacity to improve glucose tolerance. Co-administration of (400 mg MEMS and 10 mg glibenclamide) per kg body weight reduced blood glucose level by 42.9%, a marginal improvement than obtained with glibenclamide alone. The results are shown in (Table 1). All administrations were made orally.

| Treatment | Dose (mg/kg body weight) | Blood glucose level (mmol/l) | % lowering of blood glucose level |
|---|---|---|---|
| Control | 10 ml | 6.44 ± 0.07 | - |
| Glibenclamide | 10 mg | 3.76 ± 0.18 | 41.6* |
| (MEMS) | 50 mg | 5.38 ± 0.11 | 16.5* |
| (MEMS) | 100 mg | 4.82 ± 0.16 | 25.2* |
| (MEMS) | 200 mg | 4.52 ± 0.13 | 29.8* |
| (MEMS) | 400 mg | 4.18 ± 0.07 | 35.1* |
| (MEMS + glibenclamide) | (400 + 10) mg | 3.68 ± 0.16 | 42.9* |
| Values represented as mean ± SEM, (n=5); *$P < 0.05$; significant compared to hyperglycemic control animals. | | | |

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

## Discussion

The results suggest that similar to *Musa cavendish* [8], fruit peels of *Musa seminifera* can improve glucose tolerance and so lower blood glucose. Ethanol extract of fruit peels of *Musa sapientum* demonstrated the presence of glycosides, alkaloids, saponins, tannins, flavonoids, and volatile oils [24]. It would be a reasonable assumption that the fruit peels of *Musa seminifera* would contain similar nature of phytochemicals. Alkaloids, flavonoids, saponins, and tannins have variously been reported for their antihyperglycemic activities [25,26]. Thus, these groups of phytochemicals may be responsible for the observed improved glucose tolerance effect of MEMS, although the exact identification of the bioactive component(s) await further investigations. It is further intended to investigate fruit peels collected over a period of at least three years so as to determine any changes in oral glucose tolerance effect due to possible phytochemical constituent(s) variability because of season or any geographical factors.

## Conclusion

The results suggest that methanolic extract of of *Musa seminifera* fruit peels (MEMS) can improve glucose tolerance in glucose-challenged mice.

## Conflicts of interest

The author(s) declare that they have no competing interests.

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