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ORAL GLUCOSE TOLERANCE EFFICACY OF FRUIT SKINS OF *MUSA SAPIENTUM* FROM MUNSHIGANJ AND NARSINGDI DISTRICTS, BANGLADESH

Md. Zakaria Morshed and Mohammed Rahmatullah*

Department of Biotechnology and Genetic Engineering, University of Development Alternative, Lalmatia, Dhaka-1207, Bangladesh.

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***Corresponding Author**
Prof. Dr. Mohammed Rahmatullah
Department of Biotechnology and Genetic Engineering, University of Development Alternative, Lalmatia, Dhaka-1207, Bangladesh.

ABSTRACT

Background: Several previous studies from our laboratory have shown that fruit skins of a number of *Musa* species and their various cultivars were effective enhancers of oral glucose tolerance. Since phytochemicals present in plants are responsible for their pharmacological effects and such bio-active constituents can vary in the same species of plant but grown at different locations, it was of interest to determine oral glucose tolerance efficacy of *Musa sapientum* (banana) fruit skins grown in two different locations (Munshiganj and Narsingdi) of Bangladesh. **Methods:** Oral glucose tolerance test (OGTT) was done to evaluate glucose tolerance. **Results:** In oral glucose tolerance tests, methanol extract of fruit skins (Munshiganj) dose-dependently and significantly reduced blood glucose levels in glucose-loaded mice. At doses of 50, 100, 200 and 400 mg per kg body weight the extract (MEMSM) lowered blood glucose levels by 6.6, 18.2, 24.5, and 34.3%, respectively, compared to control animals. At doses of 50, 100, 200 and 400 mg per kg body weight the extract (MEMSN) obtained from Narsingdi grown fruit skins lowered blood glucose levels by 10.5, 20.6, 28.7, and 35.7%, respectively. By comparison, a standard antihyperglycemic drug, glibenclamide reduced blood glucose levels by 40.6% at a dose of 10 mg per kg. **Conclusion:** The fruit skins can be an effective means for lowering blood glucose in persons with elevated blood glucose levels.

KEYWORDS: Antihyperglycemic, *Musa sapientum*, OGTT, diabetes, Munshiganj, Narsingdi.

BACKGROUND

Type 2 diabetes mellitus, although not contagious, is spreading rapidly across all stratum of population throughout the world. The disease causes disorder in glucose homeostasis, leading to elevated levels of glucose in blood, which with time causes complicated disorders like cardiovascular disorders as well as diabetic neuropathy, nephropathy and retinopathy.[1] A significant inequality in diabetes management has been found in Bangladesh from poor to wealthy households, with low income groups getting less treatment.[2] To be noted is that in the South Asian region, Bangladesh has the highest number of adults with diabetes.[3]

The treatment costs for diabetes and associated disorder puts a serious financial burden on the patient and family members. Moreover, anti-diabetic medicines, which can alleviate high blood glucose levels, are costly and not readily available in rural areas, which are mostly bereft of modern medical doctors and hospitals. As a result, discovery of uncommon but readily available and affordable ways of lowering elevated blood glucose level are of prime importance. Oral glucose tolerance test (OGTT) can be a way of determining whether a substance can restore glucose homeostasis in glucose-loaded mice in an effective manner.

We had been screening various monoherbal and polyherbal formulations and plant extracts for their blood glucose lowering efficacies for a number of years.[4-19] The *Musa* genus (banana) is regarded by traditional medicinal practitioners to be able to control blood glucose [20]. We have previously observed effective improvement of glucose tolerance with methanol extracts of fruit peels of *Musa seminifera*, *Musa sapientum*, and *Musa textilis*.[21-23] However, since phytochemicals present in plants are responsible for their pharmacological effects and such bio-active constituents can vary in the same species of plant but grown at different locations, it was of interest to determine oral glucose tolerance efficacy of *Musa sapientum* (banana) fruit skins grown in two different locations (Munshiganj and Narsingdi) of Bangladesh.

METHODS

Plant material collection

Ripe banana fruits of *Musa sapientum* (‘sagor’ cultivar) were collected from two district towns within Dhaka division, namely Munshiganj and Narsingdi.

Preparation of methanolic extract of fruit skins

For preparation of methanol extract of fruit skins, skins were taken off ripe fruits, thoroughly sliced, dried in the shade, and pulverized into a fine powder. Powder obtained from the fruit skins of two districts were kept and extracted separately. 50g of the powder of each district fruit skins was extracted with 250 ml methanol over 48 hours. Methanol was evaporated at 50^{o}C and the extract was dissolved in Tween 20 prior to administration to mice by gavaging. Henceforth extract of the fruit skins of fruits obtained from Munshiganj district will be referred to as (MEMSM), and extract of the fruit skins of fruits obtained from Narsingdi district will be referred to as (MEMSN). All extracts were maintained at -20^{o}C prior to use.

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 14-17g 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[24] with minor modifications. Briefly, fasted mice were grouped into ten 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 3-6 received, respectively, (MEMSM) at doses of 50, 100, 200 and 400 mg per kg body weight. Groups 7-10 received, respectively, (MEMSN) at doses of 50, 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[19], 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 [25]. Blood glucose levels were measured with a glucometer. The percent lowering of blood glucose levels were calculated according to the formula described below.

$$\text{Percent lowering of blood glucose level} = (1 - W_e/W_c) \text{ X } 100,$$

Where W_e and W_c represents the blood glucose concentration in glibenclamide or (MEMSM) or (MEMSN) administered mice (Groups 2-10), and control mice (Group 1), respectively. Gavaging was done carefully such that injuries do not happen, and no mice fatalities occurred during gavaging. Mice were handled carefully throughout the experiment so that they did not get subjected to any unnecessary pain.

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.[25]

RESULTS

In oral glucose tolerance tests, methanol extract of fruit skins (Munshiganj) dose-dependently and significantly reduced blood glucose levels in glucose-loaded mice. At doses of 50, 100, 200 and 400 mg per kg body weight the extract (MEMSM) lowered blood glucose levels by 6.6, 18.2, 24.5, and 34.3%, respectively, compared to control animals. At doses of 50, 100, 200 and 400 mg per kg body weight the extract (MEMSN) obtained from Narsingdi grown fruit skins lowered blood glucose levels by 10.5, 20.6, 28.7, and 35.7%, respectively. By comparison, a standard antihyperglycemic drug, glibenclamide reduced blood glucose levels by 40.6% at a dose of 10 mg per kg. The results are shown in Table 1.

Table 1: Oral glucose tolerance tests with methanolic extracts of *Musa sapientum* 'sagor' cultivar 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	5.72 ± 0.07	-
Glibenclamide	10 mg	3.40 ± 0.09	40.6*
(MEMSM)	50 mg	5.34 ± 0.06	6.6*
(MEMSM)	100 mg	4.68 ± 0.06	18.2*
(MEMSM)	200 mg	4.32 ± 0.07	24.5*
(MEMSM)	400 mg	3.76 ± 0.13	34.3*
(MEMSN)	50 mg	5.12 ± 0.11	10.5*
(MEMSN)	100 mg	4.54 ± 0.14	20.6*
(MEMSN)	200 mg	4.08 ± 0.07	28.7*
(MEMSN)	400 mg	3.68 ± 0.07	35.7*

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

DISCUSSION

There were no significant differences between the results obtained from fruit skins obtained from Munshiganj (MEMSM) and fruit skins obtained from Narsingdi (MEMSN). This could be due to two reasons. One possible reason is that since the same cultivar 'sagor' of *Musa sapientum* was used, there were no significant differences in the results despites the banana plants growing in two different areas. A more plausible reason could be that the fruits were collected from plants growing in two areas not much distant from each other. Munshiganj district is 19 km south of Dhaka city, while Narsingdi district is 50 km northeast of Dhaka city. The distance between Munshiganj and Narsingdi, as the crow flies, is only 54.76 km. Thus the two areas possibly have practically similar conditions in terms of weather and soil conditions, and as such, no significant phytochemical variations exist between bananas grown in the two areas. Nevertheless, our results indicate that the 'sagor' variety of *Musa sapientum* fruit skins can be a readily available and affordable agent for lowering elevated blood glucose. It is to be noted that a previous experiment done with *Musa sapientum* 'sagor' cultivar fruit skins obtained from Dhaka city also showed improved oral glucose tolerance in OGTT in glucose-loaded mice.[26]

CONCLUSION

The results suggest that methanolic extract of fruit skins of 'sagor' cultivar of *Musa sapientum* can be used for lowering of elevated blood glucose.

Conflicts of interest

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

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