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VARIATIONS IN ORAL GLUCOSE TOLERANCE IS PRESENT IN DIFFERENT SUB-CULTIVARS OF FRUIT SKINS OF *MUSA SAPIENTUM* L. (BANANA)

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ABSTRACT

Background: In previous studies we have observed that methanol extracts of fruit skins of various types of cultivated banana species (*Musa sapientum* and *Musa seminifera*) can improve glucose tolerance in glucose-loaded mice. The objective of this study was to evaluate the comparative oral glucose tolerance efficacy of methanol extract of fruit skins of three different sub-cultivars of *Musa sapientum* cultivar Champa. **Methods:** Oral glucose tolerance test (OGTT) was done to evaluate glucose tolerance. **Results:** In oral glucose tolerance tests, methanol extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Zin significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 16.6, 36.7, and 42.9%, respectively, at doses of 100, 200 and 400 mg each per kg body weight in mice. Methanol extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Kanthal Champa dose-dependently reduced blood glucose levels in glucose-loaded mice by 4.5, 19.0, and 34.6%, respectively, at doses of 100, 200 and 400 mg each per kg body weight. Methanol extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Bangla dose-dependently and significantly reduced blood glucose levels in glucose-loaded mice by 19.7, 27.3, and 35.3%, respectively, at doses of 100, 200 and 400 mg each per kg body weight. By comparison, a standard antihyperglycemic drug, glibenclamide

reduced blood glucose levels by 41.9% at a dose of 10 mg per kg. The results suggest that while various species, cultivars and sub-cultivars of banana may reduce blood glucose levels in glucose-loaded mice, the comparative ability to do so is different. **Conclusion:** To lower blood glucose levels with extract of banana skins, it is important to determine the comparative efficacy of different banana species, cultivars and even sub-cultivars.

KEY WORDS: Antihyperglycemic, *Musa sapientum*, OGTT, diabetes, sub-cultivar.

BACKGROUND

Diabetes is a debilitating disorder, which is currently affecting a substantial section of the population of Bangladesh.[1] The disorder is characterized by elevated blood glucose levels, and if left untreated can quickly progress to more life threatening conditions like diabetic nephropathy and increased risk of cardiovascular disorders.[2] Diabetes cannot be cured, but various allopathic and traditional medications exist to reduce elevated blood glucose to normal levels. A disadvantage with allopathic medication(s) is that they may be not available or affordable to people, particularly to the rural and remote area people of Bangladesh. Traditional medications (mostly plant-based) suffer from the disadvantage of not being available at the right time at the right place in sufficient quantities.

The situation calls for finding out plants, which can prove effective as sources of new blood glucose lowering drugs. We had been screening various plants of Bangladesh for their blood glucose lowering efficacies for a number of years.[3-18] The *Musa* genera (banana) have long been regarded by traditional medicinal practitioners to be able to control blood glucose.[19] We have previously observed effective improvement of glucose tolerance with methanol extracts of fruit peels of *Musa seminifera*, *Musa sapientum*, and *Musa textilis*.[20-22]

The multiple traditional uses of banana in various traditional medicinal systems of India[23] raises the question as to whether all species, cultivars and sub-cultivars can give same therapeutic effects or can these therapeutic effects vary widely? Towards answering this question, it is necessary to evaluate various *Musa* species, cultivars and sub-cultivars for any particular pharmacological effect relevant for treatment of a given disease. Towards that, the objective of the present study was to evaluate the comparative oral glucose tolerance efficacy of various sub-cultivars of *Musa sapientum* cultivar Champa.

Methods

Plant material collection

Ripe banana fruits of *Musa sapientum* Zin sub-cultivar were collected from Khulna district. Kanthal Champa and Bangla sub-cultivars were collected from Bandarban district in the Chittagong Hill Tracts region. Fruits of Zin sub-cultivar measured about 5.0 to 5.3 inches in length and 4.3 to 4.5 inches in girth at the fruits middle. The corresponding values in length for the fruits of Kanthal Champa and Bangla sub-cultivars were, respectively, 5.3 - 5.5 inches and 5.2 - 5.5 inches. The corresponding values in girth for the fruits of Kanthal Champa and Bangla sub-cultivars were, respectively, 4.3 – 4.5 inches and 3.2 – 3.5 inches. Local names of the sub-cultivars were obtained from the cultivators; fruits were further identified by a competent botanist at the University of Development Alternative.

Preparation of methanolic extract of various sub-cultivars

For preparation of methanol extract of fruit skins of the various sub-cultivars, skins were taken off ripe fruits, thoroughly sliced, dried in the shade, and pulverized into a fine powder. 50g of the powder of each sub-cultivar was extracted with 250 ml methanol over 48 hours. Methanol was evaporated at 40^{o}C and the extract was dissolved in Tween 20 prior to administration to mice by gavaging. The final weight of the extract was 6.0, 1.7, and 1.1g for Zin, Kanthal Champa and Bangla sub-cultivars, respectively. 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 eleven 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, methanolic extract of Zin sub-cultivar (MEZC) at doses of 100, 200 and 400 mg per kg body weight. Groups 6-8 received, respectively, methanolic extract of Kanthal Champa sub-cultivar (MEKC) at doses of 100, 200 and 400 mg per kg body weight. Groups 9-11 received, respectively, methanolic extract of Bangla sub-cultivar (MEBC) 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[23], 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.[23] 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 MEZC or MEKC or MEBC administered mice (Groups 2-11), 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.[12]

RESULTS

The results are shown in Table 1. In oral glucose tolerance tests, methanol extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Zin significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 16.6, 36.7, and 42.9%, respectively, at doses of 100, 200 and 400 mg each per kg body weight in mice. Methanol

extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Kanthal Champa dose-dependently reduced blood glucose levels in glucose-loaded mice by 4.5, 19.0, and 34.6%, respectively, at doses of 100, 200 and 400 mg each per kg body weight. Methanol extract of fruit skins of *Musa sapientum* cultivar Champa sub-cultivar Bangla dose-dependently and significantly reduced blood glucose levels in glucose-loaded mice by 19.7, 27.3, and 35.3%, respectively, at doses of 100, 200 and 400 mg each per kg body weight. By comparison, a standard antihyperglycemic drug, glibenclamide reduced blood glucose levels by 41.9% at a dose of 10 mg per kg. The results suggest that while various species, cultivars and sub-cultivars of banana may reduce blood glucose levels in glucose-loaded mice, the comparative ability to do so is different.

Table 1: Oral glucose tolerance tests with methanolic extracts of various *Musa sapientum* sub-cultivars 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	5.78 ± 0.10	-
Glibenclamide	10 mg	3.36 ± 0.11	41.9*
(MEZC)	100 mg	4.82 ± 0.10	16.6*
(MEZC)	200 mg	3.66 ± 0.19	36.7*
(MEZC)	400 mg	3.30 ± 0.04	42.9*
(MEKC)	100 mg	5.52 ± 0.13	4.5
(MEKC)	200 mg	4.68 ± 0.07	19.0*
(MEKC)	400 mg	3.78 ± 0.11	34.6*
(MEBC)	100 mg	4.64 ± 0.09	19.7*
(MEBC)	200 mg	4.20 ± 0.07	27.3*
(MEBC)	400 mg	3.74 ± 0.05	35.3*

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

DISCUSSION

Different species, cultivars and sub-cultivars belonging to the same genus may differ in their phytochemical content both qualitatively and quantitatively. Since the therapeutic efficacy of any given plant rests on its phytochemical content, when using plant or plant part directly as the medicine, it becomes imperative to find out the optimal plant species cultivar and sub-cultivar (if any) to use for therapeutic purposes. From that view point, the differences shown by the various sub-cultivars in the present study strongly support the view point that for proper therapeutic efficacy, bananas should be selected only after a proper scientific study as to the species, cultivar and sub-cultivar giving the optimal therapeutic effect.

CONCLUSION

The results suggest that methanolic extract of fruit skins of various sub-cultivars of *Musa sapientum*, although differing in their ability, can be used for lowering of blood glucose.

Conflicts of interest

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

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