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ORAL GLUCOSE TOLERANCE TESTS WITH NON-BOILED AND BOILED *MOMORDICA CHARANTIA* FRUITS

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ABSTRACT

Background: The fruits of *Momordica charantia* L. are considered to lower blood glucose levels and as such are consumed in the raw state in Bangladesh. The fruits are also consumed in the cooked form as a vegetable. Since cooking involves boiling or steaming, it was of interest to evaluate antihyperglycemic activity of boiled versus non-boiled fruits. **Methods:** Antihyperglycemic activity was determined through oral glucose tolerance test (OGTT) in mice. **Results:** Administration of methanol extract of non-boiled *Momordica charantia* fruits (MEMC-NB) at doses of 100 and 200 mg per kg body weight to glucose-loaded mice reduced blood glucose levels by 17.4 and 26.2%, respectively. Methanol extract of boiled fruits (MEMC-B) at the same two doses reduced blood glucose levels by 23.2 and 30.2%, respectively. By comparison, a standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, reduced blood glucose level by 51.0%. **Conclusion:** Methanolic extract of fruits of *Momordica charantia* (MEMC) can be antihyperglycemic in both non-boiled and boiled form. However, boiling induced a higher lowering of blood glucose suggesting that the fruits possibly will be better for diabetic patients when consumed in the cooked form for lowering blood glucose.

KEYWORDS: Antihyperglycemic, *Momordica charantia*, glibenclamide, OGTT, mice.

BACKGROUND

Momordica charantia L. (Cucurbitaceae family, bitter gourd in English and 'korolla' in Bengali) is a vinous plant grown widely in Bangladesh for its edible fruits. The fruits are available more or less throughout the year. There appears to be two varieties of fruits; the smaller sized fruits are known as 'deshi korolla' or local variety, and the larger sized fruits being called 'bideshi korolla' or foreign variety. The fruits are bitter in taste, hence the name bitter gourd.

Diabetes is a disorder, which is spreading rapidly throughout the world to a point where it may be said to be reaching epidemic proportions. The disorder is characterized by high blood glucose levels, cannot be cured except for some symptomatic cures, and can lead rapidly to other complications with accompanying fatalities.[1] Since diabetic patients have high blood glucose levels and their urine tastes sweet, various traditional forms of medicinal systems in Bangladesh consider bitter substances (particularly plants or plant parts) to be effective antihyperglycemic agents. On the basis of this supposition, fruits and leaves of *Momordica charantia*,[2-4] leaves of *Azadirachta indica*,[5] aerial parts of *Andrographis paniculata*,[6] and seeds of *Swietenia macrophylla*[7] to name only a few, are taken orally for blood glucose control, all of these plant parts being bitter in taste.

Since antihyperglycemic drugs are not readily affordable or available to the rural population of Bangladesh, we had been experimenting with various indigenous plants and polyherbal formulations for their antihyperhyperglycemic effects.[8-35] The blood glucose-lowering capability of fruits of *Momordica charantia* have been extensively reported and scientifically validated.[36, 37] Thus, it appears to be a useful fruit to be used by diabetic patients. The fruit would gain in usefulness if its blood glucose-lowering properties are retained following cooking, for in our experiences, most diabetic patients prefer to consume cooked fruits as a vegetable rather than drinking fruit juice or chewing and orally consuming raw fruits. The objective of the present study was to evaluate the antihyperglycemic potential through oral glucose tolerance test (OGTT) of methanol extract of non-boiled and boiled (steamed) fruits of *Momordica charantia* (MEMCNB and MEMCB).

METHODS

Plant material collection and extraction

Fruits (unripe) of *Momordica charantia* were collected from a local market in Dhaka city, Bangladesh during December, 2016. Plant specimen was taxonomically identified by a

trained botanist at the University of Development Alternative. The sliced air-dried fruits were grounded into a fine powder and 100g of the powder was extracted with methanol (1:5, w/v) for 48 hours. The extract (MEMCNB) was evaporated to dryness and stored at -20^{o}C till use. The final weight of MEMCNB was 8.308g.

For preparation of methanol extract of boiled fruits (MEMCB), sliced fruits were steamed over a steamer for 20 minutes followed by air-drying. The air-dried fruits were grounded into a fine powder and 100g of the powder was extracted with methanol (1:5, w/v) for 48 hours. The extract (MEMCB) was evaporated to dryness and stored at -20^{o}C till use. The final weight of MEMCB was 12.625g.

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 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 period, they were kept in a temperature controlled room (25^{o}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.

Oral glucose tolerance tests (OGTT) for evaluation of antihyperglycemic activity

Oral glucose tolerance tests were carried out as per the procedure previously described by Joy and Kuttan (1999)[38] with minor modifications. Briefly, fasted mice were grouped into six 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 and 4 received MEMCNB at doses of 100 and 200 mg per kg body weight, respectively. Groups 5 and 6 received, respectively, 100 and 200 mg per kg MEMCB. All substances were orally administered. 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. 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 various extracts administered mice (Groups 2-6), 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.[39]

RESULTS

Oral glucose tolerance test (OGTT) results

Administration of MEMCNB at doses of 100 and 200 mg per kg to glucose-loaded mice reduced blood glucose level significantly by 17.4 and 26.2%, respectively. A standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight, reduced blood glucose level by 51.0%. Administration of MEMCB at doses of 100 and 200 mg per kg to glucose-loaded mice reduced blood glucose level significantly by 23.2 and 30.2%, respectively. The results are shown in Table 1 and suggest that methanol extract of fruits of *Momordica charantia* demonstrate better antihyperglycemic activity when boiled versus when non-boiled.

Table 1: Effect of MEMCNB and MEMCB 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	5.96 ± 0.49	-
Glibenclamide	10 mg	2.92 ± 0.29	51.0*
(MEMCNB)	100 mg	4.92 ± 0.22	17.4*
(MEMCNB)	200 mg	4.40 ± 0.34	26.2*
(MEMCB)	100 mg	4.58 ± 0.21	23.2*
(MEMCB)	200 mg	4.16 ± 0.29	30.2*

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

DISCUSSION

It may be noted that while the weight of final extract of non-boiled fruits was 8.308g, the weight of the final extract of boiled fruits was 12.625g. This suggests that boiling leads either to release of greater amounts of antihyperglycemic component(s) or possibly breakdown or changes of an inactive component or components to active antihyperglycemic component(s). Consumption of boiled fruits also have another advantage; while no adverse effects have been reported from consumption of cooked (and so boiled) fruits at any time period (to be noted that cooked fruits are consumed as a vegetable by possibly millions of people in Bangladesh alone on a daily basis), non-boiled fruit consumption may lead to mild diarrhea and abdominal pain.[40]

CONCLUSION

The results suggest that methanolic extract of fruits of *Momordica charantia* can give antihyperglycemic effects in both boiled and non-boiled form and that methanolic extract of boiled fruits demonstrate better antihyperglycemic activity than non-boiled fruits.

Conflicts of interest

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

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