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IMPROVED GLUCOSE TOLERANCE WITH A POLYHERBAL FORMULATION OF *COLOCASIA ESCULENTA* TUBERS AND *ALLIUM SATIVUM* CLOVES

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ABSTRACT

Background: *Colocasia esculenta* and *Allium sativum* are cultivated in Bangladesh, respectively, for consumption of tubers as vegetable and use of cloves as spice. Both plant parts have previously been reported to have antihyperglycemic properties. It was therefore of interest to determine the antihyperglycemic potential of a polyherbal formulation containing the tubers of the first and cloves of the second plant. **Methods:** Oral glucose tolerance test (OGTT) was done to evaluate antihyperglycemic potential. **Results:** In oral glucose tolerance tests, methanol extract of tubers of *Colocasia esculenta* (MECE), administered at a dose of 400 mg per kg body weight reduced blood glucose by 31.5%. Methanol extract of cloves of *Allium sativum* (MEAS), administered at the same dose reduced blood glucose by 31.8%. Administration of a combination of MECE and MEAS (1:1, w/w), tentatively termed MECEAS, significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 32.2, 36.6, 40.1, and 45.5%, respectively, at doses of 50, 100, 200 and 400 mg each per kg body weight in mice. Thus even at the lowest dose, MECEAS exhibited better antihyperglycemic properties than MECE or MEAS at their highest doses, when administered singly. By comparison, a standard antihyperglycemic drug, glibenclamide, reduced blood glucose levels by 46.9% at a dose of 10 mg per kg. **Conclusion:** MECEAS can be used as a blood glucose lowering agent in diabetic patients.

KEYWORDS: Antihyperglycemic, *Colocasia esculenta*, OGTT, *Allium sativum.*

BACKGROUND

Colocasia esculenta (L.) Schott (Araceae), known in English as taro and in Bangladesh as pani kochu (one of the local names) is a fast growing herbaceous plant, which can be found growing in the wild as well as cultivated for its large edible tuber. *Allium sativum* L. (Liliaceae), known in English as garlic and in Bangladesh as roshun is cultivated for its clove, which is used in many culinary dishes as a spice. Both plants are considered medicinal with a number of therapeutic properties attributed to them.

Diabetes mellitus is a disorder characterized primarily by elevated blood glucose levels. The disorder, which happens due to insulin deficiency, is one of the fastest growing disorders in the world. There are no known medications to cure, whether be it traditional or allopathic (modern). Existing medications are costly and can at the most be useful in lowering blood glucose, when elevated. Survey results have found that already 10% of the Bangladesh population may be suffering from diabetes.[1] Most of these diabetic patients reside in rural or remote areas, which areas lack modern doctors, clinics and other medical facilities. On top of it, the patients are mostly poor and illiterate, which makes it difficult for them to self-measure their blood glucose and take medications at appropriate times and in appropriate doses.

Antidiabetic plants, if they are safe and can be found easily, may be an answer to solving the diabetic blood sugar lowering problem. Towards that, we had been experimenting with various local plants and formulations for their blood glucose lowering effects.[2,14] *Colocasia esculenta* and its various sub-species and cultivars, alone and in combination with other plants or plant parts have previously been shown by us to possess antihyperglycemic properties.[15,16] The same applies to cloves of *Allium sativum.*[17] The objective of the present study was to evaluate the antihyperglycemic potential of a combination of *Colocasia esculenta* and *Allium sativum*.

Methods

Plant material collection

Tubers of *Colocasia esculenta* and cloves of *Allium sativum* were collected from a vegetable market in Dhaka city, Bangladesh.

Preparation of methanolic extract of Colocasia esculenta tubers and Allium sativum cloves

For preparation of methanol extract of tubers of *Colocasia esculenta* (MECE), tubers were at first thoroughly sliced, dried in the shade, and pulverized into a fine powder. 100g of the powder was extracted with 500 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 3.668g. For cloves of *Allium sativum*, the cloves were sliced and thoroughly dried in the shade prior to pulverizing into a fine powder. 100g of the powder was extracted with 500 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 (MEAS) was 4.184g.

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 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 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[18] with minor modifications. Briefly, fasted mice were grouped into eight 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 and 4 received MECE and MEAS, respectively, at a dose of 400 mg per kg body weight. Groups 5-8 received, respectively, (MECE + MEAS, otherwise denoted as MECEAS) at doses of 50, 100, 200 and 400 mg each extract 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[4,10], all

mice were orally administered 2g glucose/kg of body weight. Blood samples were collected 120 minutes after the glucose administration through puncturing heart following previously published procedures.[4,10] 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 MECE, MEAS or (MECE + MEAS) administered mice (Groups 2-8), 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.[10]

RESULTS

In oral glucose tolerance tests, methanol extract of tubers of *Colocasia esculenta* (MECE), administered at a dose of 400 mg per kg body weight reduced blood glucose by 31.5%. Methanol extract of cloves of *Allium sativum* (MEAS), administered at the same dose reduced blood glucose by 31.8%. Administration of a combination of MECE and MEAS (1:1, w/w), tentatively termed MECEAS, significantly and dose-dependently reduced blood glucose levels in glucose-loaded mice by 32.2, 36.6, 40.1, and 45.5%, respectively, at doses of 50, 100, 200 and 400 mg each per kg body weight in mice. By comparison, a standard antihyperglycemic drug, glibenclamide, reduced blood glucose levels by 46.9% at a dose of 10 mg per kg. Thus the highest dose of MECEAS was nearly equivalent in lowering blood glucose compared to glibenclamide and as such can act as a herbal substitute for the drug.

Table 1: Effect of MECE, MEAS and (MECE + MEAS) 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	5.84 ± 0.12	-
Glibenclamide	10 mg	3.10 ± 0.15	46.9*
(MECE)	400 mg	4.00 ± 0.13	31.5*
(MEAS)	400 mg	3.98 ± 0.10	31.8*
(MECE + MEAS)	(50 + 50) mg	3.96 ± 0.20	32.2*
(MECE + MEAS)	(100 + 100) mg	3.70 ± 0.15	36.6*
(MECE + MEAS)	(200 + 200) mg	3.50 ± 0.10	40.1*
(MECE + MEAS)	(400 + 400) mg	3.18 ± 0.11	45.5*

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

DISCUSSION

Tubers of *Colocasia esculenta*, when incorporated in feed of streptozotocin-induced diabetic rats reportedly gave ameliorative effects, particularly for diabetic nephropathy.[19] Aqueous extract of *Allium sativum* cloves reportedly reduced blood glucose levels in alloxan-induced albino diabetic rats.[20] Thus the results obtained in the present study are in agreement with antidiabetic results on the two plant parts obtained in previous studies. The polyherbal combination may also have the beneficial effect of ameliorating diabetic nephropathy.

CONCLUSION

The results suggest that a combination of methanolic extract of *Colocasia esculenta* tubers and *Allium sativum* cloves can be used for lowering of blood glucose. Since the plants are cultivated (*Colocasia esculenta* also grows in the wild and can be collected without any cost), the plant parts are readily available and affordable. Since both plant parts are edible, the crude extract can serve as a substitute for allopathic glucose-lowering drugs.

Conflicts of interest

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

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