Research article

Home-made *Hibiscus rosasinensis* tea on post-prandial blood glucose level and blood pressure: An interventional study

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Abstract

Most Hibiscus tea are made with *Hibiscus rosasinensis* and are expensive. Although these tea are marketed indicating hypoglycemic effects, scientific data are lacking on the effect of *H. rosasinensis* on humans.

The objective of the study was to determine the effect of home-made water extract of *H. rosasinensis* flower (HRWE) as a tea on post-prandial blood sugar level (PPBS) of healthy individuals compared to green tea (GT) and commercially available Hibiscus tea (CHT–H.rosasinensis+Rosehip).

Fasting and PPBS [after consuming a standard diet (StD=1045Kcal), StD+GT, StD+CHT and StD+HRWE on separate days] at 15, 30, 45, 60 and 120 minutes of healthy volunteers (n=14) were measured by glucose oxidase colourimetric assay kit method. Data were plotted on graphs as glucose concentration vs time. The mean of incremental area under the curves (IAUC) was estimated. Data were analyzed using SPSS.

IAUC for GT, CHT and HRWE (2763, 2580 and 2977) were significantly lower than IAUC for control (4758). No significant difference was observed between GT, CHT and HRWE. Although not significant, 2 hour-PPBS values of GT, CHT and HRWE were lower than that of control. Compared to control, a peak blood glucose reduction of 13.3%, 10.5% and 14.1% were observed for GT, CHT and HRWE respectively. Compared to control, significant PPBS reductions at 30, 45 and 60 minutes with GT and HCT were observed while significant reductions at 15, 30, 45 and 60 minutes were observed with HRWE ($p<0.05$).

It can be concluded that GT, CHT and HRWE significantly lower PPBS of the standard meal.The effect of HRWE on PPBS is comparable to GT and CHT.

Keywords: *Hibiscus rosasinensis*, *Hibiscus sabdariffa*, green tea, post-prandial blood glucose

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Background

In recent times the prevalence of non-communicable diseases (NCDs) like diabetes mellitus and hypertension has increased worldwide[1]. In Sri Lanka, one in five adults has either diabetes or pre-diabetes[2]. A report released by the Department of Census and Statistics in 2014 revealed that the prevalence of hypertension among men was 5.3% and among women was 8.4% in the total population of Sri Lanka[3]. The use of herbal remedies to control NCDs is a universal practice and research data reveal that more than 90% of Sri Lankan diabetic patients consume herbal remedies along with Western treatments to control hyperglycemia[4].

From ancient times, tea prepared with Hibiscus flower has been used worldwide as a remedy for many ailments including non-communicable diseases such as hyperglycemia and, especially, hypertension[5–8]. The common two Hibiscus varieties are *Hibiscus sabdariffa* and *Hibiscus rosasinensis*. *Hibiscus rosasinensis* is the most seen variety in Sri Lanka and is widely known as the Shoe flower (Sinhalase: Wada mal).

Scientific data are also available on hypoglycemic effects of Hibiscus, however, most of the studies have been carried out with the *Hibiscus sabdariffa* variety and many of the studies are animal studies[9,10]. Tea prepared with Hibiscus petals is a commercially available, reputed beverage[5,11]. Hibiscus tea products are available in the market stating the scientifically proven beneficial effects of *Hibiscus sabdariffa*; however, most tea products are made using the petals of *Hibiscus rosasinensis* not *Hibiscus sabdariffa*. Apart from a few animal studies carried out with *Hibiscus rosasinensis*, only one human study has been carried out so far to elicit the hypoglycemic effects of the flower extract on humans[12]. However, the validity of data of this human study is dubious due to inadequate sample size (n=6).

Further, commercially available Hibiscus tea is expensive although it could be prepared with flower petals easily, as a home remedy. Therefore, the scientific knowledge on the beneficial effects of homemade Hibiscus tea made from *Hibiscus rosasinensis* would be useful for patients with diabetes and hypertension, who are interested in herbal remedies. Control of postprandial blood glucose elevation is the main objective in reducing HbA1c levels, in most diabetic patients, [13] which is a key goal in the prevention of diabetes-related micro and macro vascular complications[14]. Therefore, as an initial step, the present study aims to observe the effect of *Hibiscus rosasinensis* tea on postprandial blood glucose level and postprandial blood pressure in healthy individuals.

The present study aimed to determine the effect of homemade *Hibiscus rosasinensis* flower petal extract (Hibiscus tea) on post-prandial blood glucose level and blood pressure of healthy individuals compared to green tea and commercially available Hibiscus tea.

Methodology

Identification and authentication of the flower

The flower used for the study was authenticated as *Hibiscus rosasinensis* (Rose mallow – Wada mal) by the National Herbarium, Royal Botanical Gardens, Peradeniya, Sri Lanka [Ref No. 6/01/H/03].

Preparation of the herbal tea

Home-made *Hibiscus rosasinensis* tea (HRWE)

Sample collection: *Hibiscus rosasinensis* flowers were collected from the Anuradhapura area, North Central province of Sri Lanka. The petals were separated and homogenized. Petals were air-dried and stored in an air-tight container.

Preparation of Hibiscus tea (HRWE)

Dried petals (2 g) were brewed in 180 mL of boiled hot water for 5 minutes and filtered. The filtrate was used as the herbal tea with a few drops of lime juice (to increase palatability).

Commercially available *Hibiscus rosasinensis* tea (HRC)

Commercially available hibiscus tea made up of *Hibiscus rosasinensis*, Rosehip and black tea (labeled as made up of *Hibiscus sabdariffa*, Rosehip and black tea) was purchased from a reputed tea shop in Colombo (2 g/bag) and brewed in 180 mL of boiled hot water for 5 minutes and filtered and few drops of lime juice was added.

Commercially available Green tea (GT)

Commercially available green tea was purchased from a tea shop in Colombo (2 g/bag) and brewed in 180 mL of boiled hot water for 5 minutes and filtered and few drops of lime juice were added.

Interventional study

Randomly selected healthy individuals (n=14, fasting blood glucose < 110mg/dL, BMI 18 – 23 kg/m^2) from a group of volunteers were recruited for the study[5]. There were 4 test days as follows.

Test day 1 – StD + 180 mL hot water
Test day 2 – StD + GT 180 mL
Test day 3 – StD + CHT 180 mL
Test day 4 – StD + HRWE 180 mL
Gaps of 3-5 days were kept between the test days.

Participants were advised to fast for 8-10 hours on the night before the designated day of the test and to refrain from heavy exercises, alcohol consumption and smoking and advised to consume a normal routine meal on the previous day. They were kept at rest in the laboratory for 10 minutes on the designated day before starting the experiment. Fasting blood samples and after meal blood samples at 15, 30, 45, 60, 120 minutes were obtained from the participants by the finger-prick method. Blood samples were centrifuged at 3500 rpm for 10 minutes and serum was separated. Fasting blood glucose, post-prandial blood sugar (PPBS) at 15, 30, 45, 60 and 120 minutes were estimated by glucose oxidase colorimetric assay (BIOLABO, France) method, after consumption of a standard high calorie diet (StD) (Enriched White bread-4 slices, Strawberry jam 20g, 4 Raisin cookies = 1045 kcal). Blood pressure was measured at 30, 60 and 120 minutes.

Consumers' perception

Consumer's perception on taste, odour, appearance and feeling of hunger after consumption of the tea was obtained through a Likert scale questionnaire for the three tested teas.

Ethical approval

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka (ERC No: ERC/2018/44).

Data Analysis

Data was plotted on a graph, glucose concentration vs time, for each individual for each meal separately. Incremental area under the curve (IAUC) was estimated for all individuals separately for control (hot water), GT, HRWE and HRC samples. Data were analyzed by Excel 2007 and presence of any significant difference in IAUC was analyzed by SPSS through ANOVATukey's post hoc test.

Results

Mean blood glucose values for the 4 test days are shown in Table 1 and Figure 1. IAUC for GT (2763), CHT (2580) and HRWE (2977) were significantly lower than IAUC of control (4758). No significant difference was observed between GT, CHT and HRWE (Table 2). Significant PPBS reductions at 30, 45 and 60 minutes of GT and HCT and at 15, 30, 45 and 60 minutes of HRWE ($p<0.05$) were observed compared to control. Compared to control, a peak blood glucose reduction of 13.3%, 10.5% and 14.1% was observed for GT, CHT and HRWE respectively (Table 2). Although not significant, 2 hour-PPBS for GT, CHT and HRWE were lower than that of control.

Table 1: Mean±SD blood glucose values for StD, GT, CHT and HRWE in mg/dL

	Fasting	15 min	30 min	45 min	60 min	120 min
StD	93±10	125±27	137±18	152±22	142±33	121±28
StD + GT	99±13	116±19	130±22	132±16	124±15	113±14
StD + CHT	106±19	125±22	124±18	136±15	131±16	120±22
StD + HRWE	93±11	110±12	131±19	128±17	122±17	111±13

SD – Standard deviation; StD – standard meal; GT – green tea; CHT – commercially available Hibiscus tea; HRWE – Home-made Hibiscus tea (water extract)

Table 2: Mean IAUC, peak blood glucose reduction percentage, blood glucose gap between fasting and 120 minutes

	IAUC	Peak blood glucose value	Peak blood glucose reduction %	Gap between fasting and 120 min values (mg/dL)
StD	4758	152	-	28
StD + GT	2763*	132*	13.3	14
StD + CHT	2580*	136*	10.5	14
StD + HRWE	2977*	131*	14.1	18

*significantly lower than StD ($p<0.05$)

IUAC: incremental area under the curve

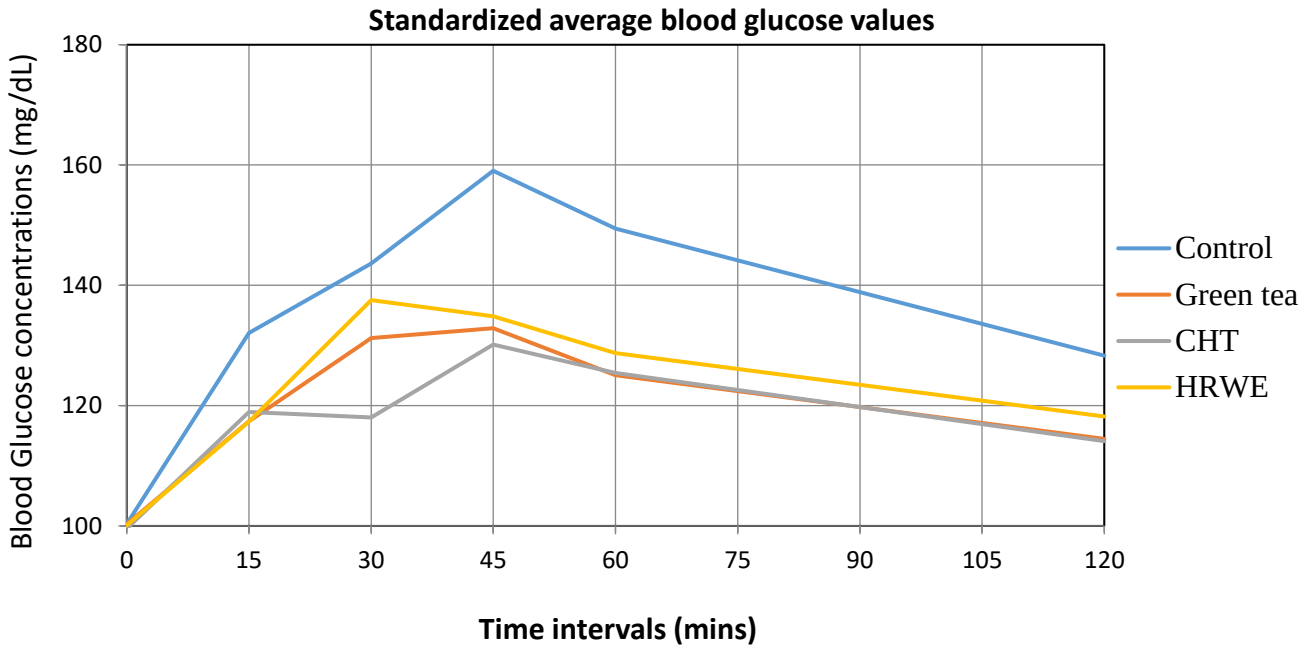

Figure 1: Blood glucose curves for Control (StD), GT, CHT and HRWE

No significant change in the blood pressure was observed throughout the study at any of the time intervals.

According to the consumer's perception, 68%, 76% and 85% indicated the taste, odour and appearance of HRWE were better than GT and CHT.

Discussion

The present study elicited that homemade *Hibiscus rosasinensis* tea possesses effects on lowering PPBS which is comparable to green tea and commercially available Hibiscus tea. A study revealed the presence of tannins (7.5%±0.20), phenols (0.678%±0.14) and alkaloids (0.51%±0.16) in Red Hibiscus flower extract while the total phenol content in flowers was 735±46 mg gallic acid equivalent /100g. The four main types of flavonoids in petals are rutin, quercetin, kaempferol and myricetin[15]. Other flavones in petals are quercetin-3-di-0-beta-D-glucoside, quercetin-3-7-di-0-beta-D-glucoside, quercetin- 3-0-beta-D-sophorotrioside, kaempferol-3-0-beta-D-xylosyl-glucoside, cholesterol, campesterol, ß-sitosterol, catalase. Red and magenta colour flower petals contain dark-purplish dye, anthocyanin pigment, cyanidin diglucoside[16,17] and proanthocyanidins[18]. Another study revealed the presence of terpenoids in flower petals[19]. As all these compounds possess antioxidant properties, Hibiscus petal extracts might also possess high antioxidant capacity.

Many previous studies have revealed the effect of polyphenols on blood glucose-lowering. The key enzymes in carbohydrate digestion, α-amylase and α-glucosidase are inhibited by the phenolic compounds present in tea [20]. Furthermore, polyphenolics in tea inhibit glucose uptake by intestinal Caco-2 cells [21]. Circulatory glucose clearance is exerted mainly by tannic acid which stimulates the translocation of glucose transporters (GLUT 4) and activates insulin receptors by phosphorylation [22]. Thus, most of the blood glucose controlling effects of hibiscus could be attributed to the presence of polyphenols and antioxidants. The whole plant of *Hibiscus rosasinensis* increases insulin secretion from the pancreatic beta cells, probably by the actions exerted by polyphenolic compounds, alkaloids, flavonoids and terpenoids[23].

Among the Hibiscus varieties, *Hibiscus sabdariffa* is the commonly used variety to manufacture Hibiscus tea. Arabic people consume *Karkadeh* tea

made from *Hibiscus sabdariffa*, mainly after meals. In a previous study, this tea was prepared by boiling 10 g of dried petals in 500 mL of water for 60 minutes. The final volume was 250 mL which was refrigerated at 4^0C until consumption. After a high glycemic meal, this tea elicited a slow rise in blood glucose level compared to an English breakfast tea. Conversely, the meal with Karkadeh tea showed a 20% higher area under the curve (AUC) compared to the meal with English breakfast tea [5] indicating the slow glucose absorption. However, the present study elucidated a significantly lower AUC for *Hibiscus rosasinensis* tea revealing the efficacy in postprandial blood glucose control.

In a few previous studies, antifertility effects and acute toxic effects were observed with *Hibiscus rosasinensis*, however with very high doses (35 – 250 times high doses) compared to the doses used for a tea. Therefore, *H.rosasinensis* tea could be used as a home remedy in controlling postprandial hyperglycemia without toxic effects. However, the effects of long-term consumption should be further investigated to establish the safety of the regular use of Hibiscus tea.

Conclusion

GT, CHT and HRWE significantly lower PPBS of the high-calorie standard meal. The effect possessed by HRWE on PPBS is comparable to GT and CHT.

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