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Effects of *Hibiscus sabdariffa* on high blood pressure, lipid profile and C-reactive protein among adult hypertensive patients

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RESEARCH

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ABSTRACT

Background
Hypertension is a leading cause of mortality and morbidity worldwide. Hibiscus is a cheap readily available preparation.

Aims
We aimed to assess the effect of *Hibiscus sabdariffa* on blood pressure, lipid profile, plasma sugar, and h-sensitive C-reactive protein.

Methods
This is a prospective cohort study conducted among 19 College staff members at the University of Tabuk, Saudi Arabia during January 2020. The participants signed written informed consent, then responded to a questionnaire to report their demographic data. At baseline, the blood pressure was measured, anthropometric measures collected, and, and a blood sample was taken to measure fasting plasma sugar, serum cholesterol, triglycerides, high-density lipoproteins, and high-sensitive C-reactive protein. Participants thereafter took *Hibiscus sabdariffa* for four weeks, then the above measurements were repeated. The compliance of the participants was also assessed.

Results
No significant effects of *Hibiscus sabdariffa* consumption were observed on systolic and diastolic blood pressure, fasting plasma glucose, lipid profile, and high-sensitive C-reactive protein, P-value<0.05.

Conclusion
No significant effects were observed among *Hibiscus sabdariffa* users on blood pressure, plasma sugar, lipid profile, and C-reactive protein. Further larger multicenter studies are recommended.

Key Words
Hibiscus sabdariffa, blood pressure, plasma sugar, lipid profile, C-reactive protein

What this study adds:

1. What is known about this subject?
Hibiscus sabdariffa is a widely available drink, its effects on blood pressure, fasting plasma sugar, and lipid profile are largely unknown.

2. What new information is offered in this study?
Hibiscus sabdariffa had no significant effects on blood pressure, fasting plasma sugar, lipid profile, and high-sensitive C-reactive protein.

3. What are the implications for research, policy, or practice?

Hibiscus sabdariffa can be used among patients with diabetes, dyslipidaemias, and hypertension with no negative consequences on their health.

Background

Hypertension is a global health burden with mortality and morbidity. Globally one billion are diagnosed with high blood pressure with 7.1 million deaths annually. In Saudi Arabia, the urban population showed a significantly higher prevalence of 27.9%, compared to the rural 22.4%. High blood pressure is among the ten factors contributing to the global burden of the disease-causing 13% of death worldwide.[1,2] *Hibiscus sabdariffa* according to the Encyclopaedia Britannica is probably native to West Africa from where it got spread to many countries including African and Asian countries, it has a non-pharmacological treatment potential. The Anthocyanins and proanthocyanidins compounds in this plant cause the inhibition of angiotensin II converting enzyme and vasodilatation, control sodium and potassium levels.

One of the most common ingredients found in commercial herbal tea mixtures sold in western countries is *Hibiscus sabdariffa*. In other parts of the world, the *H. sabdariffa calyces*, and beverages derived from them, are called Hibiscus tea, bissap, roselle, red sorrel, Sudan tea, sour tea, or karkade where the term karakade is the most dominant in the western region. As a fact, the health benefits of plant foods is not only due to their macro or micronutrient content only but also linked with the presence of the phytochemicals.[3] In vitro studies showed that *H. sabdariffa* has anti-oxidant properties[4-7] whereas in vitro/animal models study presented the extracts of this flower to hold hypocholesterolemic[8,9] as well as anti-hypertensive properties.[10–13] Concentrated *H. sabdariffa* drink was found to lower blood pressure (BP)in hypertensive patients[14] and type 2 diabetes[15] compared with black tea (*C. Sinensis*) and have an effect similar to common hypotensive drugs.[16-18] Given the above, and the fact that no researchers have studied the effects of *H. sabdariffa* on blood pressure and lipid profile in Tabuk City, Saudi Arabia. We conducted this research to assess the relationship between consumption of Hibiscus drink/tea among adult hypertensive patients and their lipids profiles in Tabuk City, the Kingdom of Saudi Arabia.

Method

This is a prospective cohort study conducted among 19 participants in Tabuk City, Saudi Arabia during January 2020. All the participants signed written informed consent, then a face to face interview was undertaken to collect the following information: age, sex, occupation, and history of high blood pressure, diabetes, and dyslipidaemia, previous hibiscus use, and if used to control hypertension. For this research the following measurements were assessed:

- Weight and height were measured, and the Body Mass Index (BMI) was measured using the formula: Weight in Kg/height in (meters)^2.
- Neck circumference was measured below the laryngeal prominence and perpendicular to the long axis of the neck, and the minimal circumference is recorded to the nearest 0.1cm. The patients should look forward and the shoulders not elevated. Previous literature concluded that a neck circumference >37 in males and 34cm in females are probably the best cut-off to determine patients with central adiposity.[19,20]
- The blood pressure was measured with the arm rested on a table along with the standard methods, three readings were undertaken and the mean value was taken as the final recorded blood pressure.

Blood samples were taken to estimate plasma sugar, lipid profile, and highly-sensitive C-reactive protein as baseline as well as the blood pressure.

Total cholesterol and triglycerides were measured using a colorimetric enzyme test (NingBoRuiYuan Biotechnology Co., Ltd., Zhejiang, China). HDL-C was quantified by the GPO-PAP method (Beckman Coulter, Miami, FL, USA). Low density lipoprotein was calculated using the formula: LDL=Total cholesterol-TG/5-HDL.[21]

Participants were asked to consume two standard cups of *H. sabdariffa* (each with 1.25grams in 300ml of warm or cold drinking water) for four weeks[22] and report their compliance by responding to the following questions:
What percent of the time did you take all the hibiscus drink? And on average, how would you rate your ability to consume hibiscus? (excellent, very good, good, fair, poor, and very poor). The blood pressure, lipid profile, glucose measurement, and C-reactive protein measurements were repeated after four weeks.

The Statistical Package for Social Sciences (SPSS) was used for data analysis, the paired sample T-test was used to compare the blood pressure, lipid profile, and high –sensitive C –reactive proteins at baseline and after hibiscus use, a P-value of <0.05 was considered significant. The ethical committee of the Medical College, University of Tabuk, approved the current research.

Data analysis:

Data was described first then repeated measurement analysis was used to assess the impact of using Hibiscus at the baseline (before intervention), shortly after administration and its long-term effect. The effect of hibiscus use on the levels of blood sugar, cholesterol level, triglyceride (TG), high-density lipoprotein (HDL) and C-reactive protein were also assessed before and after hibiscus administration.

Results

Descriptive data analysis

There were 19 participants included in this study with 6 (31.58%) of them categorized as obese (BMI >30) and the average BMI was 28.10±5.45 and neck circumference of 38.84±3.01. Among the respondents, there were 6 (31.58%) known hypertensive and were all on antihypertensive medication. High blood pressure, hyperlipidaemia, and diabetes mellitus were reported in 33.3%, 26.3%, and 26.3% of participants respectively. It is interesting to note that 84.2% of respondents used Hibiscus before. However, only 15.8% of them linked their use to the purpose of blood pressure control. In the present study, stage 2 hypertension was the commonest (31.6%) followed by stage 1 (26.3%). The participant adherence to hibiscus use was 82.7%, with 31.6% of them stated their adherence as excellent, 15.8% as very good, 31.6% as good, and 21% reported fair adherence regarding Hibiscus use. Also, 60% of the respondents were taken hibiscus in warm water and the remaining 40% in cold water with few of them added sugar to their drink (Table 1).

Impact of hibiscus use

In the present study, although there was a gradual decline in blood pressure, no statistically significant differences were detected between pre and post hibiscus use regarding systolic blood pressure (130.63±16.82 *vs.* 125.06±20.15, P-value =0.373, 95% CI=6.97–14.12 and diastolic blood pressure (80.05±11.52 *vs.* 82.29±15.78, P-value =0.305, 95% CI=-4.53–14.04) (Table 2). General linear model using repeated measurement analysis confirmed the non-significant effect of hibiscus use in both short and long-term assessment for both systolic (129.80±15.38, 128.47±14.87 and 127.40±20.34, P-value =0.722) and diastolic blood pressure (87.27±12.30, 85.93±11.02, and 84.27±15.76, P-value =0.661) respectively (Table 3).

There was no effect of blood pressure even among those who excellently adherent to the hibiscus use during the study. Subgroup analysis for those who were known hypertensive, those who are on antihypertensive treatment, and those who are obese also showed no statistical difference in blood pressure before and after hibiscus use. The impact of hibiscus use on blood sugar (138.61±45.42mg/dl *vs.* 127.82±10.48mg/dl, P-value =0.447 and 95% CI=-19.74–41.32) and total blood cholesterol (185.84±39.05 *vs.* 197.59±11.40, P-value =0.419 and 95% CI=-40.91–17.42) was not significant as well. Other studied parameters such as triglyceride (TG), high-density lipoprotein (HDL), low density lipoprotein (LDL), and C-reactive protein were non-significantly associated with the use of hibiscus. The relevant findings were depicted in Table 4.

Discussion

Cardiovascular disease is the leading cause of mortality and morbidity worldwide, measures to reduce its burden by controlling its major risk factors are major Health concerns. Hibiscus use effects on blood pressure, lipid profile, and inflammation are largely unknown.

In the current study, Hibiscus consumption had no effects on blood pressure in contradiction to previous studies in which Hibiscus is beneficial in blood pressure but the effects are inversely associated with baseline blood pressure.[23] Further studies found hibiscus consumption was comparable to captopril,[24] the discrepancies in the results may be explained by race and gender as most of the participants in the current studies were black (Sudanese, data not shown) who are salt conservers by nature and the majority were males. Anthocyanin, the main flavonoid of sour tea was shown to decreases the angiotensin-converting enzyme (ACE) activity.[23,24] However, the effects were lower among blacks. In the present study, no significant statistical differences were observed between baseline lipid levels and the levels after hibiscus use in line with Kafeshani et al.[25] who observed no significant effects of hibiscus use on lipid profile. Our findings of the effects of Hibiscus on low density lipoproteins were in line with a randomized controlled trial[26] that find no significant differences among the interventional and control groups after 12 weeks of hibiscus use, it is interesting to note that a study[27] found that hibiscus use is associated with an upward trend in LDL and HDL among hypertensive patients who consumed hibiscus and black tea, however the trial was limited by the short follow-up period.

A review and meta-analysis including six randomized controlled trials and 474 participants showed no effect of hibiscus use and improvement in lipid profile in line with the current data.[28] It is interesting to note that sour tea (Hibiscus) significantly reduced systolic blood pressure among males, but failed to show significant effects on

diastolic blood pressure, the current data showed no significant effects on diastolic blood pressure and a numerical reduction in systolic blood pressure that not amounting to statistical significance. A double-blind placebo-controlled trial[29] showed no effect of hibiscus use on fasting blood glucose, high-sensitive C-reactive protein, lipoproteins, and diastolic blood pressure supporting the current findings.

The study limitations: A major limitation of the current study is the small sample size, also, the short period of follow-up and the study was conducted at a single College, so generalization to the whole Saudi population cannot be insured.

Conclusion

No significant effects of hibiscus use were observed on blood pressure, lipid profile, high-sensitive C-reactive protein, and fasting blood glucose. Further larger multi-center studies with longer follow-up are recommended.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

The survey was ethically approved by the Medical College ethical committee

Table 1: Basic characters of the study participants

Character	Mean±SD
BMI	28.10±5.45
Neck circumference	38.84±3.01
Hypertension	6 (33.3%)
Hyperlipidemia	5 (26.3%)
Hibiscus use before	16 (84.2%)
Diabetes mellitus	5 (26.3%)
Hibiscus use for high blood pressure	3 (15.8%)
Hypertension stage:	
Stage 1	5 (26.3%)
Stage 2	6 (31.6%)
Stage 3	4 (21.1%)
Stage 4	2 (10.5%)
Stage 5	2 (10.5%)
Adherence level:	
Excellent	6 (31.6%)
Very good	3 (15.8%)
Good	6 (31.6%)
Fair	4 (21.0)
Hibiscus use (no=15)	
Warm water	9 (60%)
Cold water	6 (40%)
Sugar added to hibiscus (no=15)	2 (13.3%)

Table 2: Effect of Hibiscus use on blood pressure (before and after)

Character	At baseline	After Hibiscus	P-value*	95%CI (difference)
Diastolic BP	80.05±11.52	82.29±15.78	0.305	-4.53 - 14.04
Systolic BP	130.63±16.82	125.06±20.15	0.373	-6.97 - 14.12

* Paired sample T-Test

Table 3: Effect of Hibiscus use on blood pressure (short and long-term effect)

Character	At baseline	After Hibiscus 1	After Hibiscus 2	P-value*
Systolic BP	129.80±15.38	128.47±14.87	127.40±20.34	0.722
Diastolic BP	87.27±12.30	85.93±11.02	84.27±15.76	0.661

* GLM: Repeated measurement analysis

Table 4: Effect of Hibiscus use on blood pressure, lipid profile, and blood glucose

Character	At baseline	After Hibiscus	P-value*	95%CI (difference)
Blood sugar	138.61±45.42	127.82±10.48	0.477	-19.74 - 41.32
Cholesterol	185.84±39.05	197.59±11.40	0.419	-40.91 - 17.42
TG	142.11±67.33	160.00±54.10	0.389	-59.59 - 23.80
HDL	65.42±13.07	62.76±10.71	0.513	-5.50 - 10.81
LDL	91.75±37.95	102.72±43.06	0.437	-22.41—0.48

* Paired Sample T-Test