

The Effectiveness of *Hibiscus sabdariffa* for Improving Metabolic Syndrome: A Systematic Review

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Abstract

Metabolic syndrome (MetS) is characterized by abnormal clearance of postprandial triacylglycerol (TAG), an underlying condition for cardiometabolic diseases. Cardiometabolic risk factors increase the likelihood of developing cardiovascular disease by 2-fold. *Hibiscus sabdariffa* L. (*Hs*, *roselle*; *Malvaceae*) a potent and bioactive rich plant, may mediate oxidative stress, a mechanism that underpin metabolic syndrome (MetS) and its risk factors. The role of dietary bioactive compounds on this syndrome is not well characterized. The *Hs* plant is traditionally used as a food item, flavoring agent, herbal hot and cold beverages, and has medicinal properties shown to have remedial effects on MetS. The aim of this review of randomized control studies was to systematically assess the effectiveness of *Hibiscus sabdariffa* biomarkers and risk of MetS. A systematic review (SR) of relevant randomized control studies was undertaken to determine the effect of *Hs* on MetS. The initial search identified 23 potentially relevant articles, of which 9 articles met the selection criteria, representing 9 unique studies. The databases searched include PubMed, Cochrane, Medline, and OVID. The search criteria included peer reviewed articles and publications dated not more than 10 year. Case studies, systematic reviews, and meta-analysis were not included but were used for hand searches. A total of 782 subjects participated in all 9 studies. The findings clearly show that *Hs* lowered blood glucose, blood pressure, total cholesterol, LDL-C, serum TG and increase in HDL-C concentration. One study showed that participants with MetS who consumed *Hs* had significantly reduced glucose, and total cholesterol levels, increased HDL levels and improved TAG/HDL ratio a marker of insulin resistance. Additional research is needed to elucidate the mechanistic effects of *Hs* and to determine evidence-based recommendations concerning dose-duration effects of *Hs* and MetS risk reduction. In conclusion, evidence exist showing the health benefits of *Hs* and intake may be associated with favorable alterations to the components of MetS with no reported adverse effects. However, the clinical or *in vivo* studies demonstrating the mechanism of action, or the bioactive characteristics of *Hs* extracts are few and limited.

Keywords: *Hibiscus sabdariffa* Extract Powder; Metabolic Syndrome, Cholesterol; High-Density Lipoprotein-Cholesterol; Triglycerides

Abbreviations

MetS (MeSy): Metabolic Syndrome; *Hs*EP: *Hibiscus sabdariffa* Extract Powder; IR: Insulin Resistance; HSE: *Hibiscus sabdariffa* Extract; VLDL-C: Very Low-Density Lipoprotein-Cholesterol; NCEP ATP-III: National Cholesterol Education Program Adult Treatment Panel III; BP: Blood Pressure; TC: Total Cholesterol; HDL-C: High-Density Lipoprotein-Cholesterol; LDL-C: Low-Density Lipoprotein-Cholesterol; TG: Triglycerides; TG/HDL-C: Triglycerides/High Density Lipoprotein Cholesterol Ratio

Introduction

The metabolic syndrome (MetS), defined as a clustering of abdominal obesity, dyslipidemia, hyperglycemia and hypertension, is a major public health challenge [1]. Accordingly, the average prevalence of MetS is 31% and is associated with a two-fold increase in the risk of coronary heart disease, cerebrovascular disease, and a 1.5-fold increase in the risk of all-cause mortality. Metabolic syndrome

(MetS), also known as Insulin Resistance Syndrome (IRS), is characterized by abnormal clearance of postprandial TG and a decline in HDL [1]. Although MetS is a common underlying condition for cardiovascular diseases, which is one of the leading causes of death in the industrialized world, biological markers of this syndrome are not fully established. The *Hibiscus sabdariffa* L. (*Hs*, *roselle*; *Malvaceae*) plant is traditionally used as a food item, a flavoring agent, herbal hot and cold beverages, in addition to medicinal properties shown to affect MetS in many developing countries. *Hibiscus sabdariffa* L. has been reported to modulate negatively on obesity. Water extract of this plant inhibits differentiation of adipocytes through a modulation of the P13-K and MAPK pathways that are critical for adipogenesis [2]. Hibiscus extracts were also shown to inhibit porcine pancreatic amylase, effective in decreasing levels of cholesterol, lipids, and triglycerides in rats and inhibitory effect on adipogenesis in 3T3-L1 preadipocytes [3]. Traditional knowledge combined with recent scientific findings suggests that extracts of hibiscus can be used as a functional food or alternative medicinal beverages in the management of obesity and/or obesity related diseases. The main bioactive constituents of *H. sabdariffa* associated to its nutrition and cardiometabolic effects include organic acids, anthocyanins, flavonoids and polysaccharides [4,5]. Some clinical trials, including *in vitro* and *in vivo* studies have been reported, although there is limited evidence for the mechanism of action and phytochemical characteristics of *Hs* extracts. Other therapeutic claims include; lowering of high blood pressure [6-8], antioxidant activities, antibacterial and antifungal effects, anti-parasitic and hepatoprotective effects, nephroprotective, and diuretic effect [9], cancer preventive activities, anti-cholesterol effects, anti-obesity activity, anti-hypertensive activities [10] and anti-anemic activity. The objective of this systematic review is to determine the effectiveness of *H. sabdariffa* in the prevention and or improvement in the health of participants at risk, or with MetS.

Methods

The systematic review methodology used to support the 2010 and 2015 Dietary Guidelines Advisory Committee was used for this study [11]. A comprehensive search of the following databases was conducted: PubMed, Cochrane, Medline, and OVID. Additional studies from the lists of eligible articles and relevant systematic reviews were identified and recorded as hand searches. The literature review covered the period between 2009 and 2018. The search terms used were inserted simultaneously into the databases using the MeSH terms and sub-headings: intervention randomized controlled trial, and the search terms: Hibiscus sabdariffa, sour tea, metabolic syndrome, hypertension, Type 2 diabetes and hyperlipidemia. The following inclusion criteria were used for this study: human studies, males and female with hypertension, visceral obesity, insulin sensitivity, and hyperlipidemia, research findings were published in peer-review journals, and the article was written in English. The exclusion criteria were animal and Case studies. Full-text versions of the nine articles were retrieved and screened for inclusion as shown in the Prisma flow diagram (Figure 1).

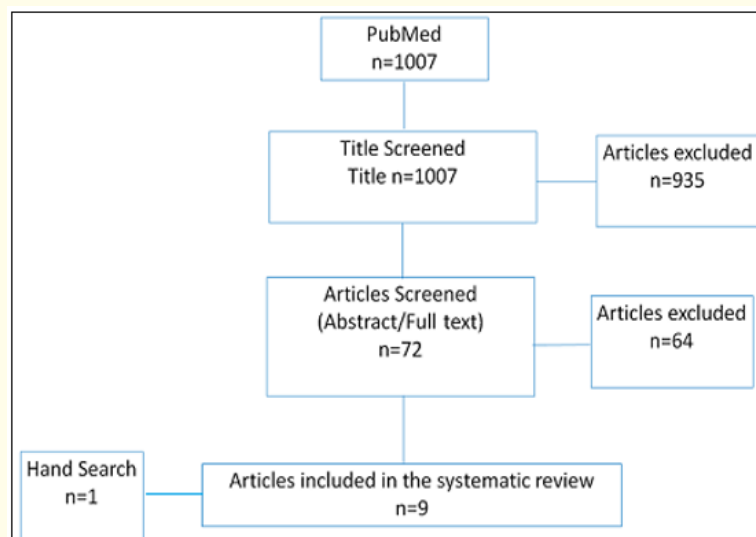


Figure 1: PRISMA Flow Diagram depicting the flow of information through the different phases of screening articles for this systematic review.

Results

Population

The results from all nine studies included for this systematic review on the effects of *Hibiscus sabdariffa* on metabolic syndrome are summarized in table 1. The baseline health status included subjects with hypercholesterolemia [12,13], obesity [14], metabolic syndrome [15,16] and hypertension [17-19] and diabetes and hypertension [20]. The mean age of participants ranged between 14 and 55 years. Female participation in the seven studies was between 45.6 and 78%. Race or ethnicity was not reported in these studies.

Table 1: Effect of *Hibiscus sabdariffa* L. on metabolic syndrome.

Study and Location (Rating)	Sample Size/ Age Gender and Population	Length of Study	Hs Preparation	Dosage (Hs)	Health Outcomes
Asgary, et al. (2016) Iran (Positive)	N = 35 Ave age = 47.5 Female = 45% Adults with MetS	4 wks	<i>H. sabdariffa</i> calyx powder	500 mg	<i>Hs</i> significantly: ↓serum TAG (p = 0.044), ↓SBP (P = 0.049) ↓BMI (P = 0.027) ↑HDL (P = 0.048)
Gurrola-Diaz, et al. (2010) Mexico (Neutral)	N = 72 (21 drop out) Gurrola-Diaz, et al. (2010) Mexico	30 days	HsEP - Powdered aqueous extract (calyx)	100 mg daily (capsule)	Patients with MetS: ↓glucose and TC. ↑ HDL-c levels, Improved TAG/HDL-c ratio (P < 0.05). <i>HsEP</i> plus diet: significant differences in TC, HDL-C, and TAG/HDL-C ratio (P < 0.02).
Herrera-Arellano, et al. (2007) Mexico (Neutral)	N = 168; Ave age = 43	4 wks	<i>H. sabdariffa</i> extract	Standardized in 250 mg of total anthocyanins	↓ BP in experimental group (p < 0.05) ↓ BP in Control group (p < 0.05). BP - Therapeutic effectiveness higher than experimental group.
Herrera-Arellano, et al. (2016) Mexico (Neutral)	N = 115 Age = 51 Female = 64% Hypertensive patients	16 wks	<i>H. sabdariffa</i> extract	Standardized in 100 mg of total anthocyanins) Control 5 mg lisinopril	↓ in Control vs experimental group (P = 0.0001). Experimental group significant ↓BP at the end of 16 weeks of treatment (P = 0.0001).
Kuriyan, et al. (2010) India (Positive)	N = 57 Age = 46 Female = 45.6% Hyperlipidemic patients	90 days	Hibiscus powdered extract	Two -500mg daily (capsules)	↓ Serum TAG: Hs vs Control (P<0.01) No changes in TC, HDL, fasting and post prandial blood glucose.
Mckay, et al. (2009) USA (Positive)	N = 65 Ave age = 54.3 Female = 44% Pre-hypertensive adults	6 wks	Brewed Hibiscus Tea	Three 240- mL servings/d of brewed hibiscus tea	↓ mean SBP and DBP. Participants with higher SBP at baseline showed a greater response to <i>Hs</i> intake (r = 20.421 for SBP change; P = 0.010).

Mozaffari-Khosravi, <i>et al.</i> (2009a) Iran (Positive)	N = 94 Ave age = 52 Female = 78% Diabetes with mild hypertension	4 wks	Hibiscus Tea (calyx)	2 g 2x daily (infusion)	↓SBP and DBP (P < 0.001) on type II diabetic patient with mild hypertension.
Mohagheghi, <i>et al.</i> (2011) Iran (Neutral)	N = 84 Ave age = 51 Female = 45% Essential hypertension	30 days	Hibiscus Tea (calyx)	15 mg 2x daily (tea)	↑in TC, HDL, and LDL cholesterol was evident in both groups. ↑in total and HDL cholesterol in both groups relative to their initial values was observed.
Sabzghabae, <i>et al.</i> (2013) Iran (Neutral)	N = 72 Ave age = 14.2 Female = 51.4% Obese adolescents	4 wks	Hibiscus Powder (calyx)	6g daily doses (powder)	↓ in LDL, TC and TG with P values <0.01, 0.032, and 0.005 respectively. No significant ↓ in HDL (P = 0.782).

The body of evidence consisted of four double blind randomized controlled trials [12,15-17], four randomized controlled trials [13,18-20] and one Triple masked RCT [14]. The studies were carried out between 2009 and 2016. Two studies were conducted in the Mexico; four in Iran and one each in the United States and India. In terms of study quality, four of the nine studies received a positive rating [12,15,17,20], and five received a neutral rating [13,14,16,18,19]. The sample sizes ranged from 40 to 168 participants per study (total studies were conducted in adults except one which was conducted in adolescent. The study duration ranged from 30 to 120 days.

Overall, the findings clearly showed that *Hs* lowers blood pressure, total cholesterol LDL, serum TG and an increase in HDL-C concentration. One study showed that participants with MetS who consumed *Hs* had significantly reduced glucose, total cholesterol levels, increased HDL-C levels and improved TAG/HDL ratio, a marker for insulin resistance. The findings from five studies [14,16,17,18,21] clearly shows that *Hibiscus sabdariffa* lowers Systolic, Dystolic blood pressure, post prandial blood glucose, cholesterol and triacylglycerol. Findings from Mohagheghi, *et al.* 2011 [19] showed no significance difference, while findings from Hernández- Pérez and Herrera-Arellano, 2011 [13] showed that pravastatin is significantly superior to *Hs* in promoting the reduction of blood lipids.

Discussion

Background information suggest that *H. sabdariffa* (*Hs*, *roselle*; *Malvaceae*) has a wide range of traditional and potential new health food uses, based on evidence largely obtained from 9 randomized controlled studies of varying quality. *Hibiscus sabdariffa* L. is used traditionally as a food, in herbal drinks, in hot and cold beverages, as a flavoring agent in the food industry. It is also used as herbal medicine [22], as a remedy to cardiometabolic diseases. This study had some limitations. First, the numbers of clinical trials available were limited and insufficient to undertake subgroup analysis by dosage, duration of trials, and baseline cholesterol levels. Secondly, only two studies targeted populations with metabolic syndrome, and the included trials were not only small, the methodology used was unclear in some studies. However, it is proposed that future studies should investigate the mechanism of action, and phytochemical characteristics of *Hs* components and extracts. This will allow the linking of the phytochemical profiling of *Hs* extract and the part of plant with its therapeutic uses. In addition, such studies should further investigate the mechanistic effect of the bioactive compounds in *Hs* on hyperglycemia, hyperlipidemia, dyslipidemia and heart disease. Lastly, futures studies will determine the effect of both the leaves and calyces of *Hs* on cardiometabolic diseases.

Conclusion

In conclusion, the result from this systematic review suggest that intake of *Hs* on a regular basis may have a great potential to reduce the risk factors associated with MetS, with no reported adverse effects, although further studies are warranted. The number of clinical, *in vitro* and *in vivo* studies to understand the mechanism of action, or the bioactive characteristics of *Hs* extracts are few.

Bibliography

1. Engin A. "The Definition and Prevalence of Obesity and Metabolic Syndrome". *Advances in Experimental Medicine and Biology* 960 (2017): 1-17.
2. Kim JK, et al. "Hibiscus sabdariffa L. water extract inhibits the adipocyte differentiation through the P13-k and MAPK pathway". *Journal of Ethnopharmacology* 114.2 (2007): 260-267.
3. Kim MS, et al. "Hibiscus extracts inhibits the lipid droplet accumulation and adipogenic transcription factors expression of 3T3-L1 preadipocytes". *Journal of Alternative and Complementary Medicine* 9.4 (2003): 499-504.
4. Eggensperger H and Wilker M. "Hibiscus-Extrakt-Ein hautverträglicher Wirkstoffkomplex aus AHA'a und polysacchariden". *Parfumerie und Kosmetik* 9 (1996): 540-543.
5. Müller VBM and Franz G. "Hibiscusblüten-eine Schleimdroge?" *Deutsche Apotheker Zeitung* 130.7 (1990): 299-333.
6. Ngamjarus C., et al. "Roselle for hypertension in adults". *Cochrane Database of Systematic Reviews* 1 (2010): CD007894.
7. Wahabi HA, et al. "The effectiveness of Hibiscus sabdariffa in the treatment of hypertension: A systematic review". *Phytomedicine* 17.2 (2010): 83-86.
8. Hopkins AL, et al. "Hibiscus sabdariffa L. in the treatment of hypertension and hyperlipidemia: A comprehensive review of animal and human studies". *Fitoterapia* 85 (2013): 84-94.
9. Morton JF. "Roselle, Hibiscus sabdariffa L". In: Morton JF (Ed.). *Fruits of Warm Climates*. Miami, FL, USA (1987): 281-286.
10. Burnham T, et al. "The Review of Natural Products". 3rd edition. St. Louis, MO: Facts and Comparisons (2002).
11. Spahn JM, et al. "The Systematic Review Methodology Used to Support the 2010 Dietary Guidelines Advisory Committee". *American Journal of Clinical Nutrition* 99.3 (2014): 692S-696S.
12. Kuriyan R, et al. "An evaluation of the hypolipidemic effect of an extract of Hibiscus Sabdariffa leaves in hyperlipidemic Indians: a double blind, placebo-controlled trial". *BMC Complementary and Alternative Medicine* 10 (2010): 27.
13. Hernández-Pérez F and Herrera-Arellano A. "Therapeutic use Hibiscus sabadariffa extract in the treatment of hypercholesterolemia. A randomized clinical trial". *Revista médica del Instituto Mexicano del Seguro Social* 49.5 (2011): 469-480.
14. Sabzghabae AM, et al. "Effect of Hibiscus sabdariffa Calices on Dyslipidemia in Obese Adolescents: A Triple-masked Randomized Controlled Trial". *Materia Socio-Medica* 25.2 (2013): 76-79.
15. Asgary S, et al. "Evaluation of the effects of roselle (Hibiscus sabdariffa L.) on oxidative stress and serum levels of lipids, insulin and hs-CRP in adult patients with metabolic syndrome: a double-blind placebo-controlled clinical trial". *Journal of Complementary and Integrative Medicine* 113.2 (2016): 175-180.

16. Gurrola-Díaz CM., *et al.* "Effects of Hibiscus sabdariffa extract powder and preventive treatment (diet) on the lipid profiles of patients with metabolic syndrome (MeSy)". *Phytomedicine* 17.7 (2010): 500-505.
17. McKay DL., *et al.* "Hibiscus sabdariffa L. tea (tisane) lowers blood pressure in prehypertensive and mildly hypertensive adults". *Journal of Nutrition* 140.2 (2010): 298-303.
18. Mohagheghi A., *et al.* "The effect of Hibiscus sabdariffa on lipid profile, creatinine, and serum electrolytes: a randomized clinical trial". *ISRN Gastroenterology* (2011): 976019.
19. Herrera-Arellano A., *et al.* "Therapeutic Effectiveness of an Herbal Medicinal Product of Hibiscus sabdariffa in Hypertensive Patients: A 16 Week Controlled and Randomized Clinical Study". *Medicinal and Aromatic Plants* 5 (2016): 265.
20. Mozaffari-Khosravi H., *et al.* "Effects of Sour Tea (Hibiscus sabdariffa) on lipid profile and lipoproteins in patients with Type II diabetes". *Journal of Alternative and Complementary Medicine* 15.8 (2009): 899-903.
21. Da-Costa-Rocha I., *et al.* "Hibiscus sabdariffa L. – A phytochemical and pharmacological". *Food Chemistry* 165 (2014): 424-443.
22. Ismail A., *et al.* "Roselle (Hibiscus sabdariffa L.) seeds nutritional composition. protein quality and health benefits". *Food* 2.1 (2008): 1-16.

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