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The effectiveness of *Hibiscus sabdariffa* in the treatment of hypertension: A systematic review

H.A. Wahabi [a,*], L.A. Alansary [a], A.H. Al-Sabban [a], P. Glasziou [a,b]

[a] *College of Medicine, King Saud University, Shaikh Bahamdan Research Chair for Evidence-Based Health Care and Knowledge Translation, P.O. Box 2925, Riyadh 11246, Kingdom of Saudi Arabia*
[b] *Oxford Centre for EBM, Oxford, UK*

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ABSTRACT

Introduction: Hypertension is a common global health problem with significant mortality and morbidity. *Hibiscus sabdariffa* is a plant known in many countries and is consumed as hot and cold drinks In addition to its use in folk medicine; it has been suggested as treatment for many conditions including hypertension.
Objectives: The objectives of this review were to examine the evidence of effectiveness and safety of hibiscus in the treatment of hypertension.
Methods: We searched several medical databases (MEDLINE, EMBASE, CINAHL, Cochrane Central Register of Controlled Trials, and the specialized register of the Cochrane Hypertension Group and the general engine Google) to January 2009.

We included randomized controlled trials that had examined Hibiscus's effectiveness and safety in the treatment of primary hypertension in adults. Two authors independently selected the trials for the review, extracted the data, and critically appraised the included studies.
Results: Four trials, with a total of 390 patients, met our inclusion criteria. Two studies compared *Hibiscus sabdariffa* to black tea; one study compared it to captopril and one to lisinopril. The studies found that Hibiscus had greater blood pressure reduction than tea but less than the ACE-inhibitors. However, all studies, except one, were short term and of poor quality with a Jadad scoring of < 3 and did not meet international standards.
Conclusion: The four randomized controlled studies identified in this review do not provide reliable evidence to support recommending *Hibiscus sabdariffa* for the treatment of primary hypertension in adults.

Introduction

High blood pressure is a global health problem with significant magnitude of morbidity and mortality, it has been estimated that 1 billion individuals all over the world suffer from hypertension causing up to 7.1 million deaths per year, which is about 13% of total death worldwide, and it is one of the ten factors contributing to the global burden of disease (Brown 1997).

Among the pharmacological agents used to treat hypertension are angiotensine converting enzyme (ACE) inhibitors, and diuretics (Neal et al. 2000; Gallagher et al. 2006). However, there are still needs for additional agents for resistant hypertension, and also for non-pharmacological measures that might be encouraged at population level.

Hibiscus sabdariffa is one potential non-pharmacological treatment. In folk medicine, the calyces' infusion is used for the treatment of several conditions including high BP.

Anthocyanins and proanthocyanidins compounds, detected in abundance in the aqueous infusion of the Hibiscus calyces, could be the bioactive compounds responsible for lowering the blood pressure based on earlier studies which proved the antihypertensive effects of anthocyanins through the inhibition of angiotensine II converting enzyme and hence a vasodilatation effect (Jonadet et al. 1990) in addition to its diuretic effect and the increased concentration of urinary sodium while maintaining normal potassium levels (Onyenekwe et al. 1999).

Objectives

The objectives of this review are to determine the effectiveness and safety of *Hibiscus sabdariffa* in the treatment of patients with pre-hypertension or hypertension ($\geq 140/90$), with the specific

* Corresponding author. Tel.: +966553294955; fax: +96614927987.
E-mail address: umlena@yahoo.com (H.A. Wahabi).

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outcome of reduction in systolic blood pressure (SBP), diastolic blood pressure (DBP) or both.

Methods

We included randomized controlled studies which compare Hibiscus to placebo, to other herbal or pharmacological preparation or to no other intervention in the treatment of adults (18-70 years), with the diagnosis of pre-hypertension 130-139/85-89 or primary hypertension of stage I or II according to the JCT classification (Chobanian et al. 2003), irrespective of patients' gender or co-morbidity.

Search Strategy

We searched the several databases (MEDLINE, EMBASE, CINAHL, Cochrane Central Register of Controlled Trials, Cochrane library for systematic reviews, the specialized register of the Cochrane Hypertension Group, ClinicalTrials.gov and the general search engine Google) from commencement until January 2009. Using the search words (Hibiscus, *Hibiscus sabdariffa*, Sour tea, Roselle, Red sorrel, Karkade, Jamaica, Flor de Jamaica, herbal tea, herbal medicine) and in combination with (high blood pressure, elevated blood pressure, hypertension, pre-hypertension, mild hypertension), there was no limitation to language. We reviewed the reference list for any potential study and we contacted authors when further information was enquired, we did not conduct hand search.

Identification of included studies

All titles and abstracts retrieved by electronic searching were screened independently by two reviewers and the studies which clearly did not meet the inclusion criteria were excluded. Copies of the full text of potentially relevant references were obtained and their eligibility was assessed independently by two reviewers. Differences between reviewers were resolved by discussion.

Data extraction and studies evaluation

The data were extracted and categorized by two authors including number of patients, type of comparison to hibiscus (placebo or other herbal or pharmacological agent), duration of treatment and the primary outcome which was the reduction in the SBP, DBP or both, expressed as Means ± SD. The trials were assessed for methodological quality using Jadad Score (Jadad et al. 1996) in addition evidence of allocation concealment and adequacy of addressing incomplete data were assessed.

Results

The literature search retrieved 523 titles of which we reviewed ten potential abstracts and the full text was retrieved for six studies (Haji Faraji and Haji Tarkhani 1999; Herrera-Arellano et al. 2004, 2007; Mozaffari-Khosravi et al. 2008; Diane et al. 2008; Wright et al. 2007), four of which met the inclusion criteria. The description of the selected studies is included in (Table 1) and the results of the studies are included in (Table 2).

One study was excluded because only the abstract was published and the authors did not provide us with information about the methodology of the study (Diane et al. 2008) and the other study was a review of studies mostly done on animals (Wright et al. 2007).

The results of the 2 studies of hibiscus against black tea suggest a modest reduction of systolic and diastolic blood pressure; the two studies that compared hibiscus to ACE-inhibitors showed similar declines in blood pressure, but less than that of ACE-inhibitors. However, Meta-analysis was not done due to the poor methodology of the studies and the low Jadad score (Table 2). Table 3 shows the methods for hibiscus preparation and use.

Discussion

Our systematic review of the effectiveness and safety of *Hibiscus sabdariffa* in the treatment of hypertension found insufficient high quality research. Three of the four studies we included in this review were of poor methodological quality. One of the included studies did not mention how the randomization was done (Haji Faraji and Haji

Table 1
Results of the identified studies.

First Author (Year of publication)	Participants		Stage of HT according to the JCPTTH-7th Report	Experimental treatment	Control treatment	Duration	ResultsDSBP (Means ± SD)DDBP (Means ± SD)		A/E
	E	C					E	C	
Haji Faraji. M et al. (1999)	31	23	Stage II	ST	BT	2 WEEKS	DSBP (17.6 ± 11.3)DDBP (10.9 ± 7.6)	(6.3 ± 6.6)(3.5 ± 5.2)	NR
Herrera-Arellano. A et al. (2004)	53	37	Pre-HT & stage I	HS extract	Captopril	4 WEEKS	DSBP (14.2 ± 11.8)DDBP (11.2 ± 6.9)	(16.4 ± 9.6)(13.1 ± 7.2)	NR
Herrera-Arellano. A et al. (2007)	100	93	Stage I & Stage II	HS standardized extract	Lisinopril	4 WEEKS	DSBP (17.1 ± 10.0)DDBP (12.0 ± 7.0)	(23.3 ± 70)(15.4 ± 60)	NR
Mozaffari-Khosravi. H et al. (2008)	27	26	Pre-HT & stage I	ST	BT	4 WEEKS	DSBP (15.0 ± 7.5)DDBP (4.3 ± 12.3)	(8.4 ± 11.0)(4.6 ± 11.8)	NR

Key: E=Experimental; C=Control; HT=Hypertension; Pre-HT=Prehypertention; ST=Sour tea; HS=*Hibiscus sabdariffa*; BT=Black tea; A/E=Adverse event; NR=Not recorded; JCPTTH=Joint national committee of prevention detection and treatment of hypertension 7th report; DSBP/DDBP=difference in systolic/diastolic blood pressure.

Table 2
Evaluation of validity of selected studies.

Trial Author (year)	Participants' Sequence Generation	Allocation Conceal-ment	Blinding	Incomplete Data Addressed?	Other Biases	Jadad Score
Haji Faraji and Haji Tarkhani (1999)	Unclear	Unclear	No, (Only participants were blinded)	No, (unbalanced dropout from the experimental and control groups, dropout is due to high blood pressure, no intention to treat analysis)	No report of adverse outcome. No baseline characteristics for study and control groups to verify adequacy of randomization.	Zero
Herrera-Arellano. A et al. (2004)	Yes, (Random number table)	Not done	No, (two different preparation was used for experimental and control groups.	No, (unbalanced dropout from the experimental and control groups, dropout, is mostly, due to bitter taste of hibiscus, no intention to treat analysis)	There is significant baseline imbalance between the two groups in SBP, PP, stage of hypertension and BMI which directly influence the outcome.	2
Herrera-Arellano. A et al. (2007)	Yes, (Random number table)	Not done	Yes. Double blinding. (author confirmation)	No, (12% of participants were excluded from the analysis due to non-adherence to treatment. No intention to teat analysis.)	No other obvious biases. Tolerability was addressed	>3
Mozaffari-Khosravi. H et al. (2008)	Yes, (Random number table)	Not done	Unclear (participants were blinded but no information about assessors blinding)	Yes, (10% of participants from each group were excluded from the analysis, however this did not affect the balance between the two groups	There is significant baseline imbalance between the two groups in SBP, DBP, and PP, which directly influence the outcome. Some participants in control have got normal BP	1

Table 3
Methods of preparation and use of hibiscus.

Study (Year Publication)	Methods and conditions of preparation of Hibiscus	Methods of use of hibiscus by the trial participants
Haji Faraji and Haji Tarkhani (1999)	Method of preparation of Hibiscus was not mentioned in the trial.	two spoonfuls of blended tea in one glass of boiled water boiled for 20–30 min, to take once a day for 15 days
Herrera-Arellano et al. (2004)	The collected material was dried under dark conditions at room temperature and then ground in an electric mill to obtain particles of <2 mm. This material was packed in paper envelopes (10 g each),	Preparation of an infusion is by add the contents of the envelope to 0.5 l of boiling water and let stand for 10 min, and drink daily before breakfast for 4 weeks
Herrera-Arellano et al. (2007)	The collected material was dried under dark conditions at room temperature and then ground in an electric mill to obtain particles of <2 mm. The plant material was macerated in water at 60 °C for 8 hours. The extracted was reduced and freeze- dried to form a powder which was packed in envelopes to total 250 mg of anthocyanines.	The contents of the envelope were dissolved in 250 ml of water to drink daily for 4 weeks
Mozaffari-Khosravi et al. (2008)	Preparation methods was not mentioned	to pour the contents of one sachet, weighing 2 g, in a tea pot, add 240 ml of boiling water and drink it after a steeping time of 20–30 min with one cube of sugar (5 g)

Tarkhani 1999) the other three studies used the random number table to generate participants' sequence (Herrera-Arellano et al. 2004, 2007; Mozaffari-Khosravi et al. 2008) , however there were obvious baseline characteristics imbalance between the experimental and the control groups on the level of SBP and DBP in two of these studies (Herrera-Arellano et al. 2004; Mozaffari-Khosravi et al. 2008) None of the included studies had allocation concealment in their methodology (Table 2).

Blinding of participants was not feasible in the studies which compared hibiscus to black tea (Haji Faraji and Haji Tarkhani 1999; Mozaffari-Khosravi et al. 2008) because of their distinct tastes. However, blinding of observers would have been possible but was not done.

Withdrawals were also a problem. Two studies had dropouts but did not state the number of participants withdrawn and without employing intention to treat analysis (Haji Faraji and Haji

Tarkhani 1999; Herrera-Arellano et al. 2007). In another study 28% (15/53) of the experimental group withdrew from the trial due to the bitter taste of the hibiscus extract and were not considered at the analysis of the data (Herrera-Arellano et al. 2004). Only one study had a balanced withdrawal of participants from the experimental and the control groups (Mozaffari-Khosravi et al. 2008).

Another reporting problem was the lack of attention in the included studies to adverse events associated with the use of hibiscus. Only one study mentioned tolerability to hibiscus (Herrera-Arellano et al. 2004) but it did not describe the methods used to monitor participants for events; the other studies did not mention adverse events. Considering the fact that some experiments reported adverse effect of hibiscus on the reproductive function of laboratory animals (Nivsarkar et al. 2005) and other studies in humans has reported its interference with the bioavailability of some medications (Fakeye et al. 2007), it is important that studies include methods to assess participants for adverse events; that samples are large enough to assess that effect and follow up of participants over a sufficient period of time to detect infrequent events.

Another important drawback of the investigated studies is the lack of standardization of the amount and the conditions of preparation of Hibiscus (Infusion, decoctions, extraction) together with obvious variation in the amount of water and temperature used for preparation (Table 3), and hence the amount and the bioactivity of anthocyanins given to the experimental group (Haji Faraji and Haji Tarkhani 1999; Mozaffari-Khosravi et al. 2008). The other two studies used different doses of anthocyanins (Herrera-Arellano et al. 2004, 2007) (Table 3) which might have resulted in variable response to the biologically active ingredients of Hibiscus and hence inconclusive results about its effectiveness.

The effectiveness and safety of regularly consumed dietary items, such as teas, for the treatment of common condition such as hypertension is appealing for communities with low socio-economic conditions. Such traditionally used items, if proven effective, will have some advantages over the pharmaceutical preparations including low cost, easy availability and more compliance with the treatment. The calyces of *Hibiscus sabdariffa* are used in many countries not only for preparation of nice beverages but also in traditional medicine for the treatment of many conditions, a fact that motivated many scientists to investigate its biological effects and its chemically active constituents on living animals and in humans (Ali et al. 2005). In addition to the possible antihypertensive effect of *Hibiscus sabdariffa*, the plant has many suggested beneficial effects including, strong antioxidant activity, anti-hypercholesterolemic effect (Hirunpanich et al. 2006) and antipyretic action (Ali et al. 2005). Hence, proper evaluation of these properties would be important for the burden of cardiovascular disease.

Conclusion

Current trials of *Hibiscus sabdariffa* effects in reducing high blood pressure were poor expect for one trial with Jadad score of >3 (Herrera-Arellano et al. 2007). That trial compared Hibiscus to ACE and not to placebo hence, there is sufficient preliminary evidence to warrant further evaluation of this widely used herbal remedy. We recommend that more robust high quality RCTs should be conducted with a standardized dose of the active ingredient of *Hibiscus sabdariffa*, to be used on pre-hypertension and stage 1 hypertension to avoid withdrawal of participants due to uncontrollable blood pressure and to design such studies with long duration of follow up to detect any adverse effects.

Authors' contributions

PG conceived of the study; LA, AA and HW searched and retrieved studies. HW and LA screened papers for inclusion; HW extracted, categorized and interpreted data; HW drafted the manuscript. PG, LA helped revise the manuscript, and all authors read an approved the final version.

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