



Ethnomedicinal Survey of Plants Used for the Management of Hypertension Sold in the Makola Market, Accra, Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Author EOB designed and supervised the study and also wrote the first draft of the study. Author IAK wrote the protocol and provided technical advice during the survey. Author JAS approved the final manuscript. Authors AO, CS, DA and MT performed the survey, performed the analysis and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Hypertension is a highly prevalent public health problem among Africans, including Ghanaians, and it is a major risk factor for cardiovascular diseases such as congestive heart failure, kidney disease, and coronary artery disease. Hypertension occurs at a rate of 19% to 48% across Ghana; and because about 70% of the patients are believed to be using herbs to manage this condition, it is important to know the kind of plants that are used in the management of this condition. The aim of this study was therefore to conduct an ethnomedicinal survey to document medicinal plant species which are sold on the open Ghanaian market; and are traditionally used in the treatment of

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hypertension. Validated questionnaires were administered to sellers of dried or semi-processed herbs at the Makola market, in the Accra Metropolitan Area. The survey identified the plant materials and the way and manner; by which these plant materials are prepared and administered. A total of 13 plant species belonging to 13 plant families were identified. The following medicinal plants were found to be commonly sold for the treatment of hypertension: *Bambusa vulgaris* (Graminaeae), *Bridellia ferruginea* (Euphorbiaceae), *Carica papaya* (Caricaceae), *Mangifera indica* (Anacardiaceae), *Moringa oleifera* (Moringaceae), *Nauclea latifolia* (Rubiaceae), *Ocimum gratissimum* (Lamiaceae), *Parkia biglobosa* (Leguminosae), *Persea americana* (Lauraceae), *Propolis africana* (Leguminosae – Mimosoideae), *Pseudoedreia kotschyii* (Maliaceae), *Theobroma cacao* (Sterculiaceae) and *Vitellaria paradoxa* (Sapotaceae). Leaves and roots of these plants predominated other plant parts. Most of these herbs were prepared as aqueous decoctions before administration. In conclusion, there are many medicinal plant species used to treat several conditions, including hypertension, within the Ghanaian community. This study therefore underscores the need to preserve, document and scientifically investigate traditional herbs used for the treatment of various diseases of public health importance, and to optimize their use since they serve as alternative treatment.

Keywords: Medicinal plants; hypertension; high blood pressure; on the market; alternative treatment.

ABBREVIATIONS

HTN: Hypertension; *HBP:* high blood pressure; *BP:* blood pressure.

1. INTRODUCTION

Hypertension (HTN) or high blood pressure (HBP) is defined as a chronic medical condition in which the blood pressure (BP) in the arteries is consistently elevated beyond normal, leading to cardiac complications such as left ventricular hypertrophy, fibrosis and an increased risk of heart failure and myocardial infarction [1]. Hypertension is a disease that is known to be highly prevalent among Africans. Currently hypertension prevalence in some sub-Saharan African countries is among the highest in the world. A few decades ago, several countries in sub-Saharan Africa were among the areas with the lowest blood pressure levels [2]. A number of studies indicate that hypertension in sub-Saharan Africa is as high as 38%. It is estimated that, out of approximately 650 million people in sub-Saharan Africa, between 10 to 20 million may have hypertension [3]. In Ghana the prevalence of hypertension ranges from 19% to 48% from several studies [4]. A study conducted in 2004 in 12 villages in the Ashanti region of Ghana showed that even with detection rates being suboptimal in both men and women, overall prevalence of hypertension was 28.7% [5]. Hypertension was reported to be the second leading cause of outpatient morbidity in adults older than 45 years in Ghana [6].

Hypertension is managed with both dietary and lifestyle modifications [7]. Despite the availability

of effective pharmacological treatments to aid the control of high blood pressure, the global rate of uncontrolled blood pressure remains high [8]. Adequate treatment of hypertension is still at a very low level [5]. About 70% of Ghanaians depend on traditional medicine for their health care [9] and about 19.5% of hypertensive patients use traditional medicine to manage their condition [10]. There is approximately one traditional medicine practitioner for every 400 people, compared with one allopathic doctor for every 12, 000 [9]. Apparently the majority of people patronize herbal medicines for the management of various disease conditions [9]. There is therefore an urgent need for preventive strategies and effective management of HTN in Ghana [5]. For the past three decades, a lot of efforts have been channeled into studying local plants with antihypertensive therapeutic values [7]. The aim of this study was therefore to document plants which are sold on the Ghanaian market; and are used in the treatment of HBP as well as rationalize their use in the light of published literature.

2. MATERIALS AND METHODS

2.1 Data Collection

Sellers of medicinal plant materials at the Makola market above the age of 18 years who were willing to participate in this study were purposely

selected and interviewed. Semi-structured questionnaires were administered to twenty five participants. The questionnaire sought information on which plant drug materials they commonly sold for the management of hypertension. The Makola market is located in the centre of the city of Accra within the Accra Metropolis, 5.55602° N, -0.1969° W. The Accra Metropolis has a population of 1,848,614 which consists of 887,673 males and 960,941 females (Ghana Statistical Service, 2010). This site was chosen because it is one of the markets that is known to trade in substantial amounts of medicinal plant materials [11] and therefore holds many of the herbal medicinal sellers within the metropolis. This study was carried out as part of a wider ethnopharmacological survey of commonly sold herbal plant materials at two major markets in the Accra Metropolis and preliminary *in vitro* investigations into their mutagenic activities.

2.2 Ethical Approval

Ethical clearance was sought from the Institutional Review Board of the Noguchi Memorial Institute for Medical Research, NMIMR-IRB (00001276).

2.3 Identification of Plant Samples

The plant materials mentioned in the survey were bought from the sellers to serve as specimen to aid in identification. Information on the plant materials (vernacular or common names, plant part and preparation methods) were recorded. Similar to the method used by van Andel et al. [11], medicinal plant materials were identified by confirming their local names in documented literature. Further confirmation of the plant samples was done by studying their organoleptic properties. Voucher specimen have been made and kept at the Department of Pharmacognosy and Herbal Medicine, School of Pharmacy, University of Ghana.

3. RESULTS

The survey identified 13 plant species being sold at the Makola market for the treatment of hypertension (Table 1). These were sold as dried plant materials that were to be boiled in water to form a decoction before being drunk. Leaves were found to be the most dominant plant part (Fig. 1). The plants were distributed across several families (13) (Table 1).

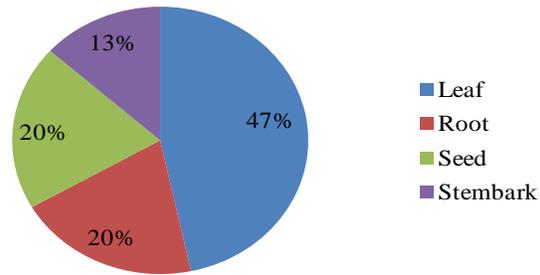


Fig. 1. Plant parts

4. DISCUSSION

The Makola market is one of the five major markets in Accra, the capital of Ghana, where substantial amounts of medicinal plants are sold [11], and hence this study site can give a wide range of plants species that are widely used for the management of hypertension among Ghanaians.

Hypertension remains a significant health challenge for many [4]. It is the second leading cause of outpatient morbidity in adults older than 45 years in Ghana [6], hence the herbal medicines used in the management of this condition remain very important. Within the Ghanaian community, an estimated majority of patients might be using herbal medicines [9]. However, only a small fraction of the plants may have been investigated. This study therefore documents plants used by Ghanaians in the Accra metropolis for the treatment of hypertension and creates an array of plants for future in-depth studies. These plants can be developed into alternative medicines for the management of hypertension. The literature search revealed that a number of these plant species are multipurpose plants that are used simultaneously for the treatment of several other diseases [18,28,33,34,38,40,43,45]. Similar to the New World findings [11], these herbs (47%) were mostly sold in the form of leaves, followed by roots (20%), seed (20%) and stem bark (13%). Leaves are more easily available and in larger quantities for harvesting than other parts of the plants such as the bark and roots. All the plants mentioned in this survey were reported to be administered orally as water-based decoctions. This finding is also in agreement with several other ethnobotanical studies [46]. A brief literary review of the antihypertensive activity of the mentioned plants also showed that the majority of the plants are already documented in literature to be used for this condition.

Antihypertensive activity of crude extracts of *Theobroma cacao*, *Carica papaya*, *Persea americana*, *Bambusa vulgaris*, *Parkia biglobosa* and *Moringa oleifera* have been reported in literature to be antihypertensives (Table 2). However, *Pseudocedrela kotschyii*, *Prosopis africana*, and *Vitellaria paradoxa* are mentioned for the treatment of hypertension for the first time. Published phytochemical investigations of these plants also showed that majority of the plants were predominated by the presence of flavonoids, tannins and alkaloids [22,23,27,29, 33,35-38,43]. Phytochemicals such as flavonoids have been widely proven to exert beneficial effects in cardiovascular disease, including hypertension. Flavones and isoflavones, flavanones, and flavanols are able to modulate blood pressure by restoring endothelial function either directly, by affecting nitric oxide levels, or indirectly, through other pathways [47, 48]. Alkaloids and tannins have however been less investigated with regards to their

Table 1. Medicinal plant species often used for hypertension management

Plant species	Family	Local name	Voucher specimen number	Plant part	Preparation	Uses
<i>Bambusa vulgaris</i>	Poaceae	pampuro ahaban (Akan) [12]	PSM4/5/16	leaves	decoction	hypertension, malaria
<i>Bridellia ferruginea</i>	Euphorbiaceae	Flatsho (Ga) [13]	PSM13/5/16	leaves	decoction	stomach ulcers, diarrhoea, wounds, hypertension
<i>Carica papaya</i>	Caricaceae	Pawpaw ahaban (Akan) [12]	PSM2/5/16	leaves	decoction	hypertension, worm infestation, jaundice
<i>Mangifera indica</i>	Anacardiaceae	Mango dua (Akan) [12,14]	PSM7/5/16	stembark	decoction	hypertension, diabetes
<i>Moringa oleifera</i>	Moringiaceae	Moringa	PSM11/5/16	leaves	decoction	stomach ulcer, hypertension
<i>Nauclea latifolia</i>	Rubiaceae	Tafashia (Hausa) [13]	PSM16/5/16	roots	decoction	malaria fever, typhoid, jaundice, hypertension
<i>Ocimum gratissimum</i>	Lamiaceae	Nunum (Akan) [12, 15,16]	PSM12/5/51 6	leaves	decoction	diarrhoea, typhoid fever, hypertension
<i>Parkia biglobosa</i>	Leguminosae	Dawadawa (Hausa) [12]	PSM10/5/16	Root	decoction	stomach ulcer, diabetes, typhoid, malaria fever, hypertension
<i>Persea americana</i>	Lauraceae	Paya ahaban (Akan) [12]	PSM6/5/16	Root	decoction	hypertension
<i>Prosopis africana</i>	Mimosaceae	prekese (Akan) [12]	PSM9/5/16	seed, leaves	decoction	hypertension, skin diseases
<i>Pseudocedrela kotschyii</i>	Meliaceae	Tuna (Hausa) [17]	PSM6/5/16	root	decoction	impotence, piles, hypertension
<i>Theobroma cacao</i>	Malvaceae	Cocoa ahaban (Akan) [12]	PSM1/5/16	leaves	decoction	hypertension
<i>Vitellaria paradoxa</i>	Sapotaceae	Nkuto dua [12]	PSM8/5/16	stembark	decoction	stomach ulcer, hypertension

antihypertensive activities. However, alkaloids from the *Rauwolfia* species for example are used in the treatment of hypertension in various parts of the world. Several clinical studies have also shown the beneficial effects of *Rauwolfia* in the treatment of high blood pressure [49].

Table 2. Literature reports on phytochemical constituents and antihypertensive properties of plants

Plant species	Documented phytochemical properties	Documented antihypertensive activity
<i>Bambusa vulgaris</i>	The aqueous extract of <i>B. vulgaris</i> leaves is reported to contain alkaloids, tannins, phenolics, glycosides, saponins, flavonoids, and anthraquinones [18,19].	Asian medicine, especially in China and Japan have recorded Bamboo to be protective against cardiovascular diseases [18].
<i>Bridellia ferruginea</i>	The phytochemical analysis carried out on <i>B. ferruginea</i> leaves and bark detected the presence of alkaloids, flavonoids, tannin, cardiac glycosides, anthraquinone, phlobatinnin, and saponins, and was negative for anthocyanin [20].	Studies by Tettey-Larbi et al. [21] recorded high activity and concentration of Potassium-40 in <i>B. ferruginea</i> and stated that this medicinal plant can significantly aid the therapeutic purposes for the treatment of hypertension.
<i>Carica papaya</i>	The leaves of <i>C. papaya</i> are rich in flavonoids (kaempferol and myricetin), alkaloids (carpaine, pseudocarpaine, dehydrocarpaine I and II), phenolic compounds (ferulic acid, caffeic acid, chlorogenic acid), cynogenetic compounds (benzylglucosinolate), carotenoids and anthraquinones glycoside [22-24].	<i>C. papaya</i> plant (leaves and unripe fruits) have been used in treating numerous diseases including high blood pressure [22].
<i>Nauclea latifolia</i>	Phytochemical screening of different parts of the plant confirmed the presence of saponins, alkaloids, glycosides, tannins, flavonoids and anthraquinones [25].	Roots of <i>N. latifolia</i> are used in Nigeria for the treatment of hypertension. The extract reduced systolic, diastolic, and mean arterial pressure in normotensive and in one kidney one clip hypertensive rats in a dose dependant manner [26].
<i>Mangifera indica</i>	Phytochemical screening of the leaves revealed the presence of saponin, steroids, tannin, flavonoid, reducing sugars, cardiac glycosides and anthraquinone [27].	Various biological effects including its hypolipidemic activity have been studied [28]. Anecdotal reports have however stated its use in the management of hypertension.
<i>Moringa oleifera</i>	The foliage of <i>M. oleifera</i> has been established as a rich source of phenolic acids, flavonoids, alkaloids, phytosterols, natural sugars, vitamins (ascorbic acid, tocopherol, folate) minerals, organic acids and polyunsaturated fatty acids [29].	Oral administration of <i>M. oleifera</i> seed powder in spontaneous hypertensive rats resulted in a beneficial effect on the cardiac structure and function. This study thus provided scientific rationale for the empirical use of moringa in traditional Malagasy medicine against cardiac diseases associated with blood pressure overload [30].
<i>Ocimum gratissimum</i>	Phytochemical screening revealed the presence of alkaloids, tannins, saponin, steroids, cardiac glycoside, flavonoids, terpenoids and phenols. The proximate analysis confirmed that the leaves contain appreciable amount of ash, crude protein, lipids, fibre and carbohydrates [31].	Treatment of deoxycorticosterone acetate-hypertensive rats with the essential oil of <i>Ocimum gratissimum</i> caused a dose-dependently decreased in blood pressure [32].
<i>Parkia biglobosa</i>	Phytochemical screening showed that sterols and triterpenes, saponosides,	<i>P. biglobosa</i> seeds and bark are used in Burkina Faso in West Africa for the

Plant species	Documented phytochemical properties	Documented antihypertensive activity
	tannins, coumarins, anthocyanosides and flavonosides are present in both bark and leaf but in different concentrations [33].	treatment of hypertension [33,34].
<i>Persea americana</i>	Peptone, b-galactoside, glycosylated abscisic acid, alkaloids, cellulose, polygalacto urease, polyuronoids, cytochrome P-450 and volatile oils are reported to be present in this plant [35].	This plant is reported to be used in the treatment of hypertension [13,35,36].
<i>Prosopis africana</i>	The phytochemical analysis of the seed and pod extract revealed that saponin, alkaloids, steroids, flavonoids, phlabotanin and tannin were present. Potassium, magnesium, sodium, calcium, phosphorus, manganese, copper, zinc and iron are minerals found to be present [37].	No reference found.
<i>Pseudocedrela kotschyii</i>	The ethyl acetate partition portion of the ethanolic extract of this plant revealed the presence of flavonoids, glycosides and tannins as major chemical constituents [38].	No reference found.
<i>Theobroma cacao</i>	The three main groups of cocoa polyphenols are catechins, anthocyanins and proanthocyanidins [39]. The polyphenolic compounds identified were simple phenols, benzoquinones, phenolic acids, acetophenones, phenylacetic acids, hydroxycinnamic acids, phenylpro-penes, coumarines, chromones, naphtoquinones, xanthones, stilbenes, anthraquinones, lignins, lignans and flavonoids [40]. Cocoa also contains theobromine and minerals [40].	A meta-analysis of randomized controlled trials showed that cocoa products may have blood pressure–lowering properties due to their high content of plant-derived flavonoids [41]. Flavonoids, contained in chocolate, stimulate the formation of nitric oxide, increase vasodilatation, and reduce endothelial dysfunction [42].
<i>Vitellaria paradoxa</i>	<i>Vitellaria paradoxa</i> contains a wide range of flavonoids including quercetin and catechin based proanthocyanidins [43].	No reference found. This plant is however known to reduce blood cholesterol [44].

5. CONCLUSION

This ethnopharmacological survey which attempted to identify medicinal plants sold on the Ghanaian market used in the management of hypertension revealed 13 plants belonging to 13 families. Almost all of these plants (10 out of the 13) are documented in literature to be used for managing hypertension. Three plants are being reported for the first time to be used in the management of hypertension namely, *Prosopis africana*, *Pseudocedrela kotschyii* and *Vitellaria paradoxa*.

These plants may need further investigations to identify active principles that can be used to enhance the management of hypertension in Ghana.

CONSENT

As per international standards, participants' written consent have been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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