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Original Article

Ethnobotanical survey of medicinal plants used to manage hypertension in the Republic of Guinea

[Estudio etnobotánico de las plantas medicinales utilizadas para tratar la hipertensión en la República de Guinea]

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Abstract

Context: Like many other African countries, medicinal plants are widely used in Guinea to manage hypertension, which is a highly prevalent health problem.

Aims: To identify the plants used in the traditional management of hypertension in Guinea.

Methods: From May to November 2018, three hundred and forty-nine Traditional Health Practitioners (THPs) respondents, including 244 traditional healers and 105 herbalists, were contacted. Through semi-structured interviews, ethnobotanical information on medicinal plants were collected. Voucher specimens were authenticated by the department of Botany of the IRDPMAG and deposited in the Herbarium of this Institute.

Results: Among the traditional anti-hypertensive recipes, a total of 97 plant species from 85 genera belonging to 43 families have been identified. *Combretum micranthum*, *Hymenocardia acida*, *Anacardium occidentale*, *Spondias mombin* and *Alchornea cordifolia* were the most frequently cited. The traditional recipes included one plant species (23 recipes), a combination of two species (18 recipes) or more (47 recipes).

Conclusions: A large number of medicinal plants are used for the management of arterial hypertension in Guinea. Further biological and phytochemical investigations are needed to validate the traditional uses of these plants.

Keywords: hypertension; Guinea; medicinal plants; traditional healers.

Resumen

Contexto: Al igual que muchos otros países africanos, las plantas medicinales se utilizan ampliamente en Guinea para controlar la hipertensión, que es un problema de salud muy frecuente.

Objetivos: Identificar las plantas utilizadas en el manejo tradicional de la hipertensión en Guinea.

Métodos: De mayo a noviembre de 2018, se contactó a trescientos cuarenta y nueve practicantes de salud tradicional (THP), incluidos 244 curanderos tradicionales y 105 herbolarios. A través de entrevistas semiestructuradas se recopiló información etnobotánica sobre plantas medicinales. Los ejemplares comprobantes fueron autenticados por el departamento de Botánica del IRDPMAG y depositados en el Herbario de este Instituto.

Resultados: Entre las recetas tradicionales antihipertensivas se han identificado un total de 97 especies vegetales de 85 géneros pertenecientes a 43 familias. *Combretum micranthum*, *Hymenocardia acida*, *Anacardium occidentale*, *Spondias mombin* y *Alchornea cordifolia* fueron las más citadas. Las recetas tradicionales incluían una especie de planta (23 recetas), una combinación de dos especies (18 recetas) o más (47 recetas).

Conclusiones: Un gran número de plantas medicinales se utilizan para el manejo de la hipertensión arterial en Guinea. Se necesitan más investigaciones biológicas y fitoquímicas para validar los usos tradicionales de estas plantas.

Palabras Clave: curanderos tradicionales; hipertensión; Guinea; plantas medicinales.

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INTRODUCTION

Hypertension is the leading cause of premature death and cardiovascular diseases worldwide, with higher prevalence, especially in low- and middle-income countries (LMIC) (Tannor et al., 2022). Unless adequately controlled, the cardiovascular, cerebrovascular and neurodegenerative complications of hypertension lead to significant morbidity and mortality (Oparil et al., 2018). About 16.5% of annual deaths worldwide are attributable to hypertension, which is the leading cause of morbidity and mortality associated with cardiovascular disease. By 2030, the annual deaths are expected to reach 23.5 million people. The current number of hypertensive patients in Africa is estimated at 74.7 million and is projected to increase by 68% (125.5 million) by 2025 (James et al., 2018). The economic impact of hypertension in sub-Saharan Africa is significant, as patients often cannot afford medical care, resulting in underdiagnosis and undertreatment (Twagirumukiza et al., 2011). Likewise, the effective management of hypertension in African countries is hampered by perceived ineffectiveness and safety concerns of anti-hypertensive medications and associated treatments, as well as cultural values and practices. These challenges have made traditional medicine a popular option as a complementary therapy among hypertensive patients (James et al., 2018). It is important to stress that the use of medicinal plants and their derivatives to control high blood pressure is well-recognized in several African countries, including Morocco (Amssayef and Eddouks, 2019; El-Ouady and Eddouks, 2020), Uganda (Nuwaha and Musinguzi, 2013), Ivory Coast (Yao et al., 2018), Ghana (Kretchy et al., 2014), Nigeria (Irondi et al., 2016; Ola-Davies et al., 2019), and South Africa (Aremu et al., 2019; Balogun and Ashafa, 2019; Keane et al., 2016; Tata et al., 2019).

In Guinea, hypertension is a major public health concern, and therapeutic management remains a challenge all over the country, especially in rural areas. A prevalence of 29.9% has previously been reported within the adult population aged 25 and older (Camara et al., 2016). In Lower Guinea, a high prevalence has been reported in both urban (32%) and rural (27% to 69%) areas (Baldé et al., 2006; N'Gouin-Claih et al., 2003).

As for other chronic diseases, the management of hypertension in Guinea is confronted with many difficulties, including the high cost of anti-hypertensive drugs, the absence of lifestyle and dietary measures, and inadequate medical care infrastructure, especially in rural areas. Such situation justifies the large use of pharmacopeia and traditional medicine (Baldé et al., 2006; Diallo et al., 2019). This present study was carried out in order to have a global overview of plant species traditionally used for the management of arterial hypertension in Guinea.

MATERIAL AND METHODS

Study location

Guinea is a coastal West African country lying between 7° 30′ and 12° 30′ of Northern latitude and 8° and 15° Western longitude. It sets out in four regions, which are quite distinct and heterogeneous from a geo-ecological point of view: Low Guinea, an area of littoral plains; Middle Guinea, with mountainous solid masses and lateritic high plateaus, Upper Guinea, a vast plateau and Forest Guinea, a true chain of mountains. The global population was estimated at 12,771,246 habitants in 2019, with an average density of 51.91 per km² (Baldé et al., 2020). The main ethnic groups are Soussous (Low Guinea), Peuhls (Middle Guinea), Malinkees (Upper Guinea), Kissis, Tomas and Guerzees (Forest Guinea).

In addition to the capital Conakry, two cities were randomly selected in each of the four geographic regions. A total of nine cities were surveyed (Fig. 1) viz Conakry, Coyah and Dubréka in Low Guinea; Labe and Lelouma in Middle Guinea; Kankan and Siguiri in Upper Guinea; N' Zerekore and Macenta in Forest Guinea.

Survey on the use of medicinal plants

Ethnobotanical and ethnomedicinal data were gathered following a series of surveys carried out from May to November 2018. The survey on Traditional Health Practitioners (THPs) were conducted in the preferred local language of the participants. All interviews were conducted based on a semi-structured questionnaire prepared by the "*Institut de Recherche et De Développement des Plantes Médicinales et alimentaires de Guinée, Dubréka* (IRDPMAG ex CRVPM-Dubréka).

The questionnaire for this survey was previously validated and standardized by this institution through a pre-survey of traditional health practitioners and has been used in many previous ethnobotanical and ethnomedical surveys (Diallo et al., 2012; 2019).

In each city, the traditional health practitioners were selected based on their recognition by the local community, their membership in the local association of traditional health practitioners, and their affiliation with the regional antenna of the IRDPMAG.

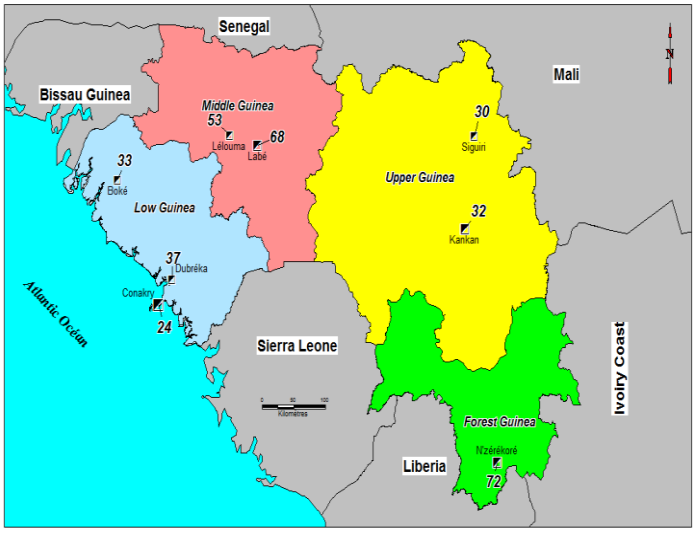

Figure 1. Map of Guinea showing investigated prefectures and number of interviewed traditional healers.

Traditional healers were interviewed at home and herbalists in front of their stalls (roadsides or various marketplaces). The questions focused mainly on demographic data (age, sex), educational level, professional experience, knowledge about local names, causes and symptoms of hypertension, plants used in the preparation of anti-hypertensive remedies, plant parts employed, mode of preparation, and administration of recipes.

At the end of the survey, the plant species were collected in the presence of the Traditional healers for a first identification. The collected samples were then identified by botanists from the Botany Department of *IRDPMAG*-Dubreka, where voucher specimens were deposited.

Scientific names and botanical families were verified on http://www.theplantlist.org.

Ethical considerations

Approval of the internal Ethic Committee of IRDPMAG-Dubreka was obtained under the reference code 003/CRVPM/2017. The objective of the study was explained to all participants. Oral or written consent was obtained from each participant.

Literature review

Following botanical identification, a complete bibliographic review of the collected plants via scientific databases of international peer-reviewed journals was carried out (Scifinder, PubMed, Web of Science). Search terms were individual species names as well as the combination of species names with "hypertension" or "high blood pressure", "pharmacological activity", and "chemical composition".

Data analysis

A descriptive analysis of the sample was done, and data were presented in the form of numbers and percentage.

The percentage of respondents who have knowledge (PRK) regarding the use of a species in the treatment of hypertension was estimated using the formula [1] and the relative frequency of citation (RFC) was calculated using the standard method of Vitalini et al. (2013) according with the formula [2].

$$PRK = \frac{FC}{N} \times 100 \quad [1]$$

Where: FC: the total number of respondents using a given plant; N: the total number of respondents.

$$RFC = \frac{FC}{N} \quad [2]$$

Where: FC: number of people interviewed citing species; N: total number of interviewed people using plants.

RESULTS

Socio-demographic data

Traditional health practitioners

A total of 349 (Table 1) traditional health practitioners (206 males and 143 females) were interviewed, viz. 121 (34.7%) from Middle Guinea (68 in Labe, 53 in Lelouma), 94 (27%) from Low Guinea (24 in Conakry, 37 in Dubreka, 33 in Bôké), 62 (17.8%) from Upper Guinea (32 in Kankan, 30 in Siguri), 72 (20.6%) from Forest Guinea (in N'Zerekore) (Fig. 1). Among these, 244 (70%) traditional healers and 105 (30.1%) herbalists (Table 1). The age of the interviewed traditional health practitioners ranged from 25 to 84 years old. Of

these, 3.7% (13/349) were under 30 years of age, 38.7% (135/349) were between 30 and 50 years old, and 57.6% (201/349) were over 50 years.

Most informants (75.6%; 264/349) were illiterate, and their traditional knowledge had largely been passed on orally from their parents (57.3%; 200/349). More than half of the interviewees (66%; 230/349) had over 10 years of practice.

Knowledge about hypertension

Hypertension is locally known as "Nawnaarè landhan" in Pular, "tension fouré'' in Susu and "Djelikôtan" in Malinke. The notion of hypertension in Guinean traditional medicine seems relatively recent and is based generally on an established conventional diagnosis. For numerous traditional healers, the diagnosis of hypertension is based on the hospital report and patient self-report. However, some traditional healers claimed to be able to diagnose hypertension through symptoms such as dizziness (35.5%; 124/349), humming in the ears (3.4%; 12/349), headache (7.2%; 25/349), edema (11.2%; 39/349). They attribute the etiology of hypertension to progressive dietary changes in favor of Western food (30.1%; 105/349) and salt consumption (12.9%; 45/349).

Plant species used to treat hypertension

A total of 97 plant species belonging to 85 genera distributed in 43 botanical families were reportedly used in herbal preparations for the traditional treatment of hypertension (Table 2). The most represented families were *Fabaceae* (11 species), *Rubiaceae* (8 species), *Combretaceae* (6 species) and *Apocynaceae* (6 species), followed by *Annonaceae* and *Phyllanthaceae* (4 species each). The most frequently mentioned plant species were *Combretum micranthum* (75 citations, 21.49%), *Hymenocardia acida* (63 citations, 18.05%), *Anacardium occidentale* (12 citations, 3.44%), *Spondias mombin and Mitragyna stipulosa* (11 citations, each), *Citrus medica* and *Alchornea cordifolia* (9, each). Other

Table 1. Sociodemographic data of traditional healers (n = 349).

Variable	Category	Number (%)
Gender	Male	206 (59)
	Female	143 (41)
Age group	<30	13 (3.7)
	30-40	49 (14.0)
	41-50	86 (24.6)
	51-60	96 (27.5)
	61-70	68 (19.5)
	>70	37 (10.6)
Education level	Illiterate	264 (75.6)
	Primary level	48 (13.8)
	Secondary level	30 (8.6)
	Post-secondary	7 (2.0)
Status	Herbalist	105 (30.1)
	Traditional healers	244 (70.0)
Mode of acquisition of knowledge	Inheritance	200 (57.3)
	Learning	94 (27.0)
	Old patient	22 (6.3)
	Personal experience	20 (5.7)
	Dream	13 (3.7)
Experience	Less than 5 years	8 (2.3)
	5–10 years	111(32.0)
	11–20 years	144 (41.3)
	More than 20 years	86 (24.6)

Table 2: List of plant species cited by traditional healers.

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Anacardiaceae (3)	*Anacardium occidentale* L.	D3HK1	Yalaghè (Pular)	Le/Sb	Dc, powder	7/5	12	0.034	3.44
	Mangifera indica L.	D3HK2	Mango (pular)	Le/Sb	Dc	2/3	5	0.014	1.43
	Spondias mombin L.	D3HK3	Ninkön (Malinké) Lukhuré (Soussou) Tyalé (Pular)	Le	Dc	11	11	0.032	3.20
Annonaceae (4)	*Annona muricata* L.	D5HK1	Sop sop (Sousou), Lilaa bagha (Kpélé)	Le	Dc	5	5	0.014	1.43
	Annona senegalensis Pers.	D5HK2	Doukoummé (Pular) Sounsou (Malinké)	Le	Dc	3	3	0.009	0.90
	Xylopia aethiopica (Dunal) A. Rich.	D5HK3	Guilè (Pular)	Le/ Fruit	Dc	2/6	8	0.023	2.30
	Uvaria chamae P. Beauv.	D5HK4	Boylé (Pular), Moronda (Sousou)	Le/Sb	Dc	2/3	5	0.014	1.43
Apocynaceae(6)	*Funtumia elastia* (Preuss) Stapf	D7HK2	Hëghëlë (Kpélè)	Le	Dc	2	2	0.006	0.60
	Landolphia heudelotii A.DC.	D7HK1	Yalan porè (Pular)	Le	Dc	2	2	0.006	0.60
	Landolphia owariensis P. Beauv.	D7HK3	Kwélan kpömö (Kpélè)	Sb	Dc	1	1	0.003	0.30
	Picralima nitida (Stapf) T. Durand & H. Durand	D7HK5	Wolokpagö (Kpélè)	Seed	inf	3	3	0.009	0.90
	Rauvolfia vomitaria Afzel.	D7HK4	Kwèni gnaguélé (Kpélè)	Le/Sb	Dc	1/1	2	0.006	0.60
	Saba senegalensis (A.DC.) Pichon.	D7HK6	Sagba(Malinké)	Rb	Dc	5	5	0.014	1.43
Asteraceae (1)	*Acanthospermum hispidum* DC.	D13HK1	Taagnalé ou Teekokokwana (Kpélè)	WP	Dc	1	1	0.003	0.30
Balsaminaceae (1)	*Impatiens irvingii* Hook.f.ex Oliv. Var irvingii	D15HK1	Kpolokoï (Kpélè)	Le	Dc	2	2	0.006	0.30
Bignoniaceae (3)	*Kigelia africana* (Lam.) Benth.	D18HK3	Zikizikiyakpo (Kpélè)	Sb	Dc	1	1	0.003	0.30
	Markhamia tomentosa (Benth.) K.Schum. ex Engl.	D18HK1	Kaafa wadu (Pular) Kwun wohé wulu (Kpélè)	Le	Dc	6	6	0.017	1.72
	Spathodea campanulata P. Beauv.	D18HK2	Kpoyoro ou powalo wulu (Kpélè)	Sb	pw	2	2	0.006	0.60

Table 2: List of plant species cited by traditional healers (continued...)

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Bombacaceae (2)	*Adansonia digitata* L.	D20HK1	Bhoyai (pular)	Fr	Mc	1	1	0.003	0.30
	Ceiba pentandra (L.) Gaertn.	D20HK2	Bandan (Malinké) Kondé (soussou) Lukun (pular) Bana-fola (Kpélè)	Sb	Dc	3	3	0.009	0.90
Bromeliaceae (1)	*Ananas comosus* (L.) Merr.	M146HK1	Fougnè (Pular) Kwi too (Kpélè)	Fr/Le	Dc, Jus	3/5	8	0.023	2.30
Caesalpiniaceae (Leguminosae) (2)	*Bussea occidentalis* Hutch.	D25HK3	Kpayélé (Kpélè)	Sb	Dc	1	1	0.003	0.30
	Cassia sieberiana DC.	D25HK4	Gbangba (Sousou) Singha (Pular)	Le/Rb	Dc	2/4	6	0.017	1.72
Caricaceae (1)	*Carica papaya* L.	D29HK1	Yiridjè (Malinké) Yélé tigha (Kpélè)	Le/Rb	Dc, Mc	3/5	8	0.023	2.30
Chrysobalanaceae (2)	*Parinari excelsa* Sabine	D30HK2	Kura (Pular), Sougué (Sousou) Köra (Malinké)	Le/Sb	Dc/Mc	1/2	3	0.009	0.90
	Parinari curatellifolia Planch.	D30HK1	Kurawongola (Pular)	Sb	Dc	1	1	0.003	0.29
Combretaceae (6)	*Anogeissus leiocarpus* (DC.) Guill. & Perr	D36HK6	Gödjoli (Pular)	Rb	Dc	2	2	0.006	0,57
	Combretum glutinosum Perr. ex DC.	D36HK2	Dhoki Sattaga (Pular) Yambakata (Sousous)	Le	Dc	5	5	0.014	1.43
	Combretum micranthum G.Don	D36HK1	Kankaliba (Pular), Kankalibanyi (Sousou)	Le	Dc	75	75	0.215	21.50
	Guiera senegalensis J.F.Gmel.	D36HK3	Koumgbénin (Malinké)	Le	Dc	6	6	0.017	1.72
	Terminalia albida Sc.Elliot	D36HK4	Koberafikhé (Sousou) Böri billel (Pular)	Sb	Mc, Dc	6	6	0.017	1.72
	Terminalia macroptera Guill. & Perr.	D36HK5	Woli (Sousou) Warsa, Wöro (Malinké) Boorigoré (Pular)	Sb	Dc	3	3	0.009	0.86
Convolvulaceae (1)	*Ipomoea batatas* (L.) Lam.	D38HK1	Gbölöhwèè (Kpélè)	Le	Mc	2	2	0.006	0.57
Cucurbitaceae (1)	*Cucumis sativus* L.	D40HK1	Cacumbossi (Sousou)	Fruit	Cru	1	1	0.003	0.29

Table 2: List of plant species cited by traditional healers (continued...)

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Dilleniaceae (1)	*Tetracera alnifolia* Willd.	D37HK1	Nintè (Sousou)	Le	Dc	3	3	0.009	0.90
Euphorbiaceae (2)	*Alchornea cordifolia* (Schumach.& Thonn.) Müll. Arg.	D50HK1	Pélènnaa (Kpélè) Bölönta (Sousou) Garkassaki (Pular)	Le/Sb	Dc	3/6	9	0.026	2.60
	Jatropha curcas L.	D50HK3	Baani(Malinké)	Le/Sb	Dc	3/4	7	0.020	2.01
Fabaceae (11)	*Afzelia africana* Sm. ex. Pers	D51HK 1	Lengué (Pular) Lenkè (Malinké)	Sb	Dc	8	8	0.023	2.30
	Albizia zygia J. F. Macbr.	D51HK2	Gbanha laakpea kpea (Kpélè) Marônaïe (Kpélè)	Sb	Dc	6	6	0.017	1.72
	Anthonotha macrophylla P.Beauv.	D51HK3	Telilo zié wulu (Kpélè)	Sb	Dc	1	1	0.003	0.30
	Dialium guineense Willd.	D51HK4	Köfina (Malinké) Mèko (Pular)	Le	Dc	5	5	0.014	1.43
	Dichrostachys cinerea (L.) Wight & Arn.	D51HK5	Bullé beté (Pular) Lanan (Kpélè)	Le	Dc	7	7	0.020	2.00
	Erythrina senegalensis DC.	D51HK6	Mbötyöla (Pular) Tilimingni (Sousou)	Rb	Mc or Dc	2	2	0.006	0.60
	Erythrina sigmoidea Hua	D51HK7	Papatara (Pular)	Sb	Dc	1	1	0.003	0.30
	Pericopsis laxiflora (Benth. ex Bak.) van Meeuwen	D51HK8	Kolokolo (Malinké), Kulo-kulo (pular)	Le	Dc	2	2	0.006	0.60
	Piliostigma thonningii (Schumach.) Milne-Redhead	D51HK 9	Barkè (Pular) Yorokoye (Sousou)	Le/Rb	Dc	2/4	6	0.017	1.72
	Pterocarpus erinaceus Poir.	D51HK10	Gbénin (Malinké) Bani (Pular) Khaï karengni (Sousou)	Le/Sb	Dc	4/3	7	0.020	2.00
	Tamarindus indica L.	D51HK11	Djabhè (Pular)	Le	Dc	5	5	0.014	1.43
Hypericaceae (2)	*Harungana madagascariensis* Lam. ex Poir.	D62HK2	Sungbala (Malinké) Wobé (Sousou) Lolo (Kpélè)	Le, Sb	Dc	3	3	0.009	0.90
	Vismia guineensis (L.) Choisy	D62HK1	Wobè siné (Sousou)	Le	Dc	1	1	0.003	0.30
Lamiaceae (1)	*Ocimum gratissimum* L.	D66HK1	Kwunkul (Kpélè)	Le	Dc, Mc	2	2	0.006	0.60
Lauraceae (1)	*Persea Americana* Mill.	D67HK1	Piya (Pular)	Le, walnut	Dc, powder	5	5	0.014	1.43

Table 2: List of plant species cited by traditional healers (continued...)

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Liliaceae (1)	*Alium sativum* L.	M156HK1	Laye (Pular)	Bulb	Cru	6	6	0.017	1.72
Loganiaceae (1)	*Anthocleista nobilis* G.Don.	D73HK1	Bomon(Kpélè)	Sb	Dc	4	4	0.011	1.15
Malvaceae (2)	*Sida rhombifolia* L.	D77HK2	Fazagha wulu ou kèghèkè tein tein (Kpélè)	Le	Dc	1	1	0.003	0.30
	Gossypium barbadense L.	D77HK1	Hottollo (Pular), Yee (Kpélè)	Le, seed	Dc	2/3	5	0.014	1.43
Meliaceae (2)	*Carapa procera* DC.	D80HK1	Göbi (Pular) Kobhé (Kpélè)	Sb	Dc	2	2	0.006	0.60
	Khaya senegalensis (Desr.) A. Juss.	D80HK2	Dyala (Malinké) Gbitili (Kpélè)	Sb	Dc	5	5	0.014	1.43
Mimosaceae (2)	*Mimosa pudica* L.	D84HK4	Kolou woumèn (Kpélè)	Wp	Dc	1	1	0.003	0.30
	Parkia biglobosa Benth.	D84HK3	`Netee (Pular)	Fruit, Sb	Dc/Mc	7	7	0.020	2.01
Moraceae (2)	*Ficus capensis* Thunb.	D85HK1	Djibè (Pular)	Le/Sb	Dc	3/4	7	0.020	2.01
	Ficus ovata Vahl	D85HK2	Nonkhö (Pular)	Sb	Dc, powder	4	4	0.011	1.15
Musaceae (1)	*Musa paradisiaca* L.	M158HK1	Banana (Pular)	Le	Dc	2	2	0.006	0.30
Myrsinaceae (1)	*Maesea lanceolata* Forssk.	D89HK1	Boullè Sarkhanna (Pular)	Rb	Dc	2	2	0.006	0.30
Myrtaceae (2)	*Syzygium guineense* (Willd.) DC.	D90HK2	Kissa, Kökisa (Malinké) Khayo (Soussou) Kaadjo Tyangol (pular)	Le, Sb	Dc	7	7	0.020	2.01
	Psidium guajava L.	D90HK1	Kôbkè (Sousou)	Le	Dc	1	1	0.003	0.30
Ochnaceae (1)	*Lophira alata* Banks ex C.F. Gaertn.	D93HK1	Malanga (Pular) Mana (Malinké)	Sb	Dc	2	2	0.006	0.30
Piperaceae (1)	*Piper umbellatum* L.	D104HK1	Pkèmènèna(Kpélè)	Le	Mc	1	1	0.003	0.30
Phyllanthaceae (4)	*Bridelia micrantha* (Hochst.) Baill.	D172HK1	Daafi (Pular)	Sb	Dc	1	1	0.003	0.30
	Hymenocardia acida Tul.	D172HK2	Djèbé,Toumani (Malinké) Mèrèmèrègny (Sousou) Pellitoro (Pular)	Le/Sb	Dc	58/5	63	0.181	18.10
	Margaritaria discoidea (Baill.) G.L. Webster	D172HK3	Métè (Sousou) Keeri (Pular) Tiho (Kpélè)	Le	Dc	5	5	0.014	1.43
	Uapaca togoensis Pax	D172HK4	Sömö (Malinké)	Le/Sb	Dc	1/3	4	0.011	1.15

Table 2: List of plant species cited by traditional healers (continued...)

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Poaceae(2)	*Bambusa vulgaris* Schrad. ex J.C. Wendl.	D162HK1	Bhöi(Kpélè)	Le	Dc	2	2	0.006	0.60
	Saccharum officinarum L.	D162HK2	Hémoyi (Sousou), Kpoulö (Kpélè)	Le	Dc	2	2	0.006	0.60
Rubiaceae (8)	*Canthium vulgare* (K.Schum.) Bullock	D117HK8	Djambawiribali,doko-fida (Malinké)	Le	Dc	3	3	0.009	0.90
	Crossopteryx febrifuga (Afzel. ex G. Don) Benth.	D117HK7	Mekia (Sousou), Belendé (Pular)	Le	Dc	5	5	0.014	1.43
	Mitragyna inermis (Willd.) Kuntze	D117HK2	Djiou (Malinké)	Le	Dc	8	8	0.023	2.30
	Morinda morindoïdes (Bak.) Milne-Redh	D117HK4	Hiowamen (Kpélè)	Le	Dc	2	2	0.006	0.60
	Mitragyna stipulosa Kuntze.	D117HK5	Böön (Kélè) pôpô (Pular)	Rb	Dc	11	11	0.032	3.20
	Nauclea latifolia Sm.	D117HK3	Dundakhè (Sousou)	Le/Sb	Dc	1/4	5	0.014	1.43
	Nauclea pobeguinii (Pobég. &.Pellegr) Merr. ex E.M.A. Petit	D117HK6	Dundunkè thiaghöl (Pular)	Sb	Mc	1	1	0.003	0.30
	Pavetta crassipes K. Schum.	D117HK1	Pémperemani (Malinké)	Le	Dc	8	8	0.023	2.30
Rutaceae (3)	*Citrus aurantium* L.	D118HK3	Lèmounnè(Pular)	Le	Dc	4	4	0.011	1.15
	Citrus medica L.	D118HK2	Cathiou (Pular)	Fruit	Jus	9	9	0.026	2.60
	Citrus reticulata Blanco	D118HK4	Mandereni (Pular)	Le	Dc	1	1	0.003	0.30
	Zanthoxylum zanthoxyloides (Lam.) Zepernick & Timler	D118HK1	Kéghénen (Kpélè), Bulèbarkelé (Pular)	Sb	dc	2	2	0.006	0.60
Sapindaceae (1)	*Paullinia pinnata* L.	D121HK	Guinè biri kha houri (Sousou), Kollydyowi (Pular) Bolokoinèn lolu (Malinké)	Le	Dc	7	7	0.020	2.00
Simaroubaceae (1)	*Harrisonia abyssinica* Oliv.	D124HK1	Nyalekpagpou (Kpélè) Ghabbou (Pular)	Sb	Dc	3	3	0.009	0.90

Table 2: List of plant species cited by traditional healers (continued...)

Family (total species)	Botanical name	Voucher Specimen number	Local name (ethnic)	Plant part	Preparation form	Citations per plant part	FC per sp.	RFC	PRK (%)
Solanaceae (3)	*Solanum melongena* L.	D125HK1	Kwi koné (Kpélè)	Fruit	Mc	2	2	0.006	0.60
	Solanum aethiopicum L.	D125HK2	Diakatou (Pular)	Fruit	Cru	1	1	0.003	0.30
	Solanum nigrum L.	D125HK3	Kiya (Kpélè)			1	1	0.003	0.30
Sterculiaceae (3)	*Cola cordifolia* R.Br.	D127HK1	Goumbanbhè (Pular)	Le	Dc	1	1	0.003	0.30
	Cola laurifolia Mast.	D127HK2	Lee (Kpélè)	Le	Dc	2	2	0.006	0.60
	Sterculia tragacantha Lindl.	D127HK3	Gowa (Kpélè)	Sb	Dc	2	2	0.006	0.60
Verbenaceae (1)	*Lantana camara* L.	D135HK1	Tagania (Sousou) Bombomtia (Pular)	Le	Dc	1	2	0.006	0.60
Vitaceae (1)	*Cissus aralioides* (Welw.Ex Bak) Planch.	D137 HK1	Fafarou (Pular); Semendji (Sousou)	R	Dc or Mc	3	3	0.009	0.90
Zingiberaceae (1)	*Aframomum melegueta* K.Schum.	M171HK1	Kpoguiyèn (Kpélè), gögö (Pular)	R	Mc	2/4	6	0.017	1.72

Le: leaves; Sb: stem bark; R: root; Rb: root bark; Wp: whole plant; TH: traditional healer; Mc: maceration; Dc: decoction.

medicinal plants that were mentioned by at least seven respondents were *Saba senegalensis, Carica papaya, Pavetta crassipes, Xylopia aethiopica, Ananas comosus, Afzelia africana, Jatropha curcas, Pterocarpus erinaceus, Khaya senegalensis, Dichrostachys cinerea, Parkia biglobosa, Ficus capensis, Syzygium guineense* and *Paullinia pinnata*.

The plant parts used for the preparation of the herbal medicinal drugs consisted of leaves, stem bark, root, fruit, and seeds. The leaves were the most frequently used part (57 species), followed by stem bark (37 species), root bark (8 species), fruit (7 species), and seed (3 species).

Preparation and administration

The major mode of preparation is decoction followed by maceration. The traditional recipes consisted of one plant species (23 recipes), a combination of two plant species (18 recipes), and three or more plant species (47 recipes). The amounts used are not standardized and depend on the individual traditional healer's experience. The preparations were administered orally one to three times a day for 10 to 30 days or until the symptoms disappeared. The average cost of an anti-hypertensive traditional treatment ranged from 0.5 to 1 USD.

DISCUSSION

Hypertension remains a major public health problem in many countries because of its high prevalence and concomitant increase in disease risk. To face non-communicable diseases such as hypertension, Guinean traditional medicine remains still popular, mainly in rural areas.

A total of 349 traditional practitioners were interviewed from which 244 (70%) were healers, and 105 (30.1%) were herbalists. People over 50 years of age (57.6%) were predominant, indicating a low representation of youth in traditional medicine practices. The advanced age of respondents found in our study is similar to that previously reported in some surveys conducted in Guinea (Diallo et al., 2012; Traore et al., 2013). In view of the rapid loss of natural habitats of plant species, traditional community life, cultural diversity and knowledge of medicinal plants, there is an urgent need to explore and valorize the potential of these ancestral practices. Inheritance was the main source of acquisition (75.6%), followed by a practical experience of more than 10 years (65.9%). This fact demonstrates the urgent need to document the traditional healers' knowledge. Similar findings on the traditional practitioners' socio-demographic characteristics, such as educational level, age, and the source of their traditional knowledge, have been reported in Kenya (Keter and Mutiso, 2012).

Regarding the identified plant species, previous ethnobotanical surveys on plants used traditionally in the management of hypertension conducted in several African countries, including Nigeria, (Gbolade, 2012; Lawal et al., 2009; Olisa and Oyelola, 2010), Morocco (Tahraoui et al., 2007) and Congo (Nsuadi et al., 2013) already revealed the anti-hypertensive use of *Hymenocardia acida* (Congo, Nigeria), *Allium sativum* (Morocco), *Tamarindus indica, Carica papaya, Adansonia digitata, Jathropha curcas, Cymbopogon citratus, Nauclea latifolia, Allium sativum, Dialium guineense, Fagara zanthoxyloides, Khaya senegalensis, Parkia biglobosa, Persea Americana, Xylopia aethiopica, Spondias mombin, Mangifera indica* and *Rauwolfia vomitoria* (Nigeria). Thus, the predominant use of leaves, which constitute a classic method for traditional medicine in general, is interesting because it preserves the plant species.

Previous biological and phytochemical investigations provide evidence to support the anti-hypertensive activity of some collected plant species. Indeed, the methanolic extracts from *Hymenocardia acida* leaf, trunk, and root bark showed a concentration-dependent vasorelaxant effect on isolated rat aortic rings with functional endothelium. *Hymenocardia acida* root bark extract also exerted a significant *in vivo* effect in spontaneously hypertensive rats (Nsuadi et al., 2013). Isovitexin and isoorientin were isolated from the ethanolic extract of the leaves of this plant (Diallo et al., 2019). A phytomedicine (Guinex-HTA®) made from the ethanolic extract of leaves of *Hymenocardia acida* is at present marketed in Guinea.

Combretum micranthum is widely known in traditional medicine and folk beliefs for its anti-hypertensive effect. This traditional bush tea is also used as a diuretic. The leaves contain mainly flavonoids and catechins with potential anti-hypertensive activity (Welch, 2010). Moreover, a double-blind and randomized clinical study of phytomedicines (tablet and infusion) elaborated from standardized extracts of *C. micranthum* demonstrated its effectiveness in uncomplicated hypertensive patients (Bourqui et al., 2021; Seck et al., 2017).

In vivo anti-hypertensive and *in vitro* vasodepressor activities of the leaf extract of *Syzygium guineense* have been demonstrated (Ayele et al., 2010). The use of *Ocimum basilicum* as an anti-hypertensive plant could be beneficial for the cardiovascular system due to the vasorelaxant and anti-platelet aggregation effects of the aqueous extract of aerial parts (Amrani et al., 2009). Flavonoids and the total phenolic fraction of *Anacardium occidentale* exhibited anti-hypertensive

effects in the isolated aorta from rats (Nugroho et al., 2013). The flavonoids hesperidin and naringin from *Citrus* species showed anti-hypertensive and diuretic effects on normotensive rats and spontaneously hypertensive rats (Galati et al., 1996; Perez et al., 2010). The aqueous crude extract of *Solanum melongena* produced a hypotensive response in normotensive rats (Shum and Chiu, 1991). The hydroalcoholic and aqueous bark extract of *Parkia biglobosa* caused vasorelaxation and decreased blood pressure in rabbits (Kassi et al., 2008). The ability of *Parkia biglobosa* leaf extract to induce redox-sensitive endothelium-dependent relaxations in porcine coronary artery rings was reported (Tokoudagba et al., 2010). The ethanolic extract of *Pavetta crassipes* showed a dose-dependent hypotensive effect in cats and rats. According to Amos et al. (2003), this anti-hypertensive activity of the plant could be due to a synergistic effect with beta-adrenergic receptors. Ethanol extract of *Allium sativum* produced hypotensive and bradycardic effects on arterial blood pressure and heart rate in anesthetized normotensive rats after an intravenous administration (Gbolade, 2012).

CONCLUSION

This survey shows that a large number of medicinal plants are used to manage arterial hypertension in Guinea. The use of these herbal medicines is not only motivated by inaccessibility to conventional anti-hypertensive drugs but also sociocultural belief and confidence in herbal medicine. Scientific validation of the use of these plant species could enhance their progressive integration into the formal healthcare system.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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AUTHOR CONTRIBUTION:

Contribution	Traore MS	Camara A	Balde MA	Diallo MST	Diallo NS	Balde ES	Balde AM
Concepts or ideas	x	x					x
Design	x	x	x	x	x	x	x
Definition of intellectual content	x	x					
Literature search			x				
Experimental studies							
Data acquisition	x		x	x	x	x	
Data analysis	x	x					
Statistical analysis	x	x	x				
Manuscript preparation	x	x	x				
Manuscript editing	x	x					
Manuscript review	x	x	x	x	x	x	x

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