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Ethnobotanical survey and phytochemical screening of *Phragmanthera capitata* (Spreng.) Ballé and *Tapinanthus bangwensis* (Engl. and K. Krause) Danser (Loranthaceae) justifying their use in traditional medicine against

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Abstract

Loranthaceae, although considered pests of wild and cultivated trees and shrubs, are hemiparasitic plants that have been used since ancient times in traditional medicine to treat high blood pressure. In Daloa, two Loranthaceae species, *Phragmanthera capitata* and *Tapinanthus bangwensis*, are commonly sold in markets and used by traditional therapists to treat this condition. Ethnobotanical surveys were carried out using semi-structured interviews with 40 herbalists and traditherapists from three markets in Daloa. Species citation frequency (CF) and Medicinal Informant Agreement Ratio (*Med.IAR*) were calculated. In parallel, phytochemical analysis was carried out on aqueous extracts of both species to identify the main bioactive chemical groups. *P. capitata* obtained the highest citation frequency (45%), reflecting its importance in the treatment of hypertension. *T. bangwensis*, on the other hand, had the highest *Med.IAR* (0.71), indicating a strong consensus among practitioners regarding its efficacy. Analysis of the aqueous extracts revealed the presence of chemical groups likely to play a role in the regulation of cardiovascular parameters. The results confirm the therapeutic use of Loranthaceae in traditional medicine against hypertension in Daloa. The identification of the bioactive compounds obtained justifies further toxicological studies to validate their safety of use and envisage their development as antihypertensive phytomedicines.

Keywords: Loranthaceae; Hypertension; Traditional medicine; Phytochemical screening; Ethnobotanical survey

1. Introduction

Arterial hypertension (AH) is a chronic cardiovascular disease characterized by an abnormal and persistent rise in blood pressure. It results from various dysfunctions, notably endocrine, cardiac, renal and hepatic [1]. In Africa, more than 20 million people suffer from it, and worldwide, nearly 1.28 billion adults aged between 30 and 79 are thought to be affected, most of them (two-thirds) living in low- or middle-income countries [2]. HTA is classified into two forms: a primary form, with no identifiable cause, linked to lifestyle (≈ 95% of cases), and a secondary form, consecutive to underlying organic pathologies [1]. In Côte d'Ivoire, medical management of hypertension remains difficult to access for many low-income populations. Furthermore, the WHO [3] shows that around 4 out of 5 people suffering from hypertension are not properly treated due to lack of resources. This situation encourages recourse to traditional medicine [4]. For example, in Benin, a remedy based on *Schrankia leptocarpa*, *Garcinia kola* and *Ocimum americanum* is used in the treatment of hypertension [5]. In Africa, parasitic vascular plants of the Loranthaceae family, commonly known as "African mistletoe," have been used since ancient times against several ailments, including hypertension [6].

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However, these uses are still largely based on empirical knowledge, without rigorous chemical or biological validation. In this context, studies are focusing on the identification of natural antioxidants in certain species, notably *Phragmanthera capitata* [7]. This is the background to the present study, which focuses on *Phragmanthera capitata* and *Tapinanthus bangwensis*, two Loranthaceae species widely used by traditherapists in Daloa (Côte d'Ivoire) to treat hypertension. To our knowledge, little phytochemical work has been carried out on these species in this context. The aim of this study is twofold: (1) to determine the traditional use pattern of *P. capitata* and *T. bangwensis* in the treatment of hypertension in Daloa and (2) to identify the main groups of chemical compounds present in their leaves.

2. Materials and methods

2.1. Biological material

The biological material consisted of leaves and stems of *P. capitata* and *T. bangwensis* collected from cocoa trees in village plantations adjacent to the Jean Lorougnon Guédé University site (Daloa, Côte d'Ivoire). The identification of samples of these species was confirmed by comparison with specimens in the herbarium of the Centre National de Floristique (CNF) in Abidjan and with those described by Boussim [8] in Burkina Faso and Amon [9] in Côte d'Ivoire.

2.2. Methods

2.2.1. Selection of two Loranthaceae species

P. capitata and *T. bangwensis*, respectively called "Adjire" in Baoulé and "Ladon" in Malinké [10], were selected due to their high frequency of use in traditional medicinal preparations against various pathologies, notably hypertension, in several regions of Côte d'Ivoire.

2.2.2. Ethnobotanical survey

A preliminary ethnobotanical survey was carried out at three main markets in the town of Daloa, in west-central Côte d'Ivoire: Orly market (06°52.228' N, 006°27.332' W), Big market (06°52.899' N, 006°52.459' W) and Lobia market (06°53.891' N, 006°27.180' W). The survey was conducted using a semi-structured questionnaire, accompanied by photographs of *P. capitata* and *T. bangwensis*, to interview contacts familiar with Loranthaceae, notably herbalists and tradithérapeutes. The interviews focused on the use of these two species in the traditional treatment of high blood pressure (HTA), as well as on methods of preparation, administration and transmission of knowledge. Socio-demographic data (age, gender, level of education, ethnicity, experience, or level of knowledge) were also collected. The survey was carried out among 40 people, including 36 herbalists and 4 traditherapists, divided into 31 women and 9 men. Data were analyzed according to gender and mode of knowledge acquisition (family heritage, professional apprenticeship, observation, etc.) in order to determine:

- The frequency of citation (FC) according to the following formula:

$$FC = \frac{\text{Number of citations}}{\text{Number of respondents}}$$

- The Medicinal Informant Agreement Ratio (*Med.IAR*) according to the formula used by Phillips [11]:

$$Med.IAR = \frac{n_t - n_s}{n_t - 1}$$

Where nt - total number of citations recorded for species s and ns - number of diseases treated with this species. The *Med.IAR* of a species varies from 0 to 1. *Med.IAR* is equal to 0 when the number of diseases treated is equal to the number of citations. A low *Med.IAR* value indicates that respondents disagree on the use of the species in treating the disease.

2.2.3. Preparation of the aqueous extract

Samples of *P. capitata* and *T. bangwensis* leaves and stems were dried at room temperature, protected from light, and then stored in the laboratory. Once dry, they were ground using an electric grinder (RETSCH brand, model SM 100) to obtain a fine powder, then sieved and stored in opaque glass bottles, protected from light and humidity. For each species, 100 g of powder were separately macerated in 1 L of 70/30 (v/v) hydroethanolic solvent (ethanol/distilled water), according to the method described by Zirihi et al. [12]. Maceration was carried out in a blender for 30 minutes under constant agitation. The resulting homogenate was wrung out and filtered twice on absorbent cotton and twice on Whatman 3 mm filter paper. The filtrate was concentrated under reduced pressure at 40°C using a rotary evaporator, then the residual extract was dried in an oven at 60°C until the dry extract was obtained. The percentage yield of the dry aqueous extract of *P. capitata* and *T. bangwensis* was calculated according to the following formula [13]:

$$Y\ (\%) = \frac{FMAE}{IMP} \times 100$$

Where Y - Yield, FMAE - Final mass of aqueous extract obtained, IMP - Initial mass of powder.

2.2.4. Phytochemical screening

Crude extracts of *P. capitata* and *T. bangwensis* were tested for the presence of various families of secondary metabolites. Phytochemical screening, using staining and precipitation reactions, revealed the presence or absence of compounds such as alkaloids, polyphenols, tannins, flavonoids and saponins, known for their antihypertensive properties when combined. Depending on the type of metabolite sought, several specific reagents were used:

- Tannins: 3 drops of 2% iron chloride ($fecl_3$) ;
- Saponins: 10 ml distilled water added to the sample for 2 minutes, then stirred for a few minutes;
- Flavonoids: 5 ml hydrochloric alcohol (prepared by mixing 10 ml 96° ethanol, 10 ml distilled water and 10 ml concentrated hydrochloric acid, then diluted twice), adding 2 or 3 magnesium chips and 3 drops of isoamyl alcohol;
- Alkaloids: 6 ml alcohol at 60°C and 2 drops of Dragendorff reagent (aqueous solution of potassium iodobismuth);
- Phenols: one drop of 2% aqueous ferric chloride solution ($fecl_3$).

3. Results

3.1. Socio-demographic characteristics of respondents

Eleven herbalists and 29 traditherapists were interviewed about the therapeutic potential of the two Loranthaceae species (*P. capitata* and *T. bangwensis*) used in the treatment of hypertension (Table 1). The respondents comprised 9 men (22.5%) and 31 women (77.5%). The results reveal that 92.5% of the respondents stated that they had acquired their knowledge of the plants through ancestral transmission, while 7.5% had obtained it empirically.

Table 1 Socio-demographic characteristics of respondents (n - number)

Characteristics		**Number of respondents**	**Frequency (%)**	**n**
Gender	Men	9	22.5	40
	Women	31	77.5	
Age	> 35 years	7	17.5	
	> 35 à ≤ 45 years	13	32.5	
	> 45 à ≤ 69 years	20	50	
Ethnicity of respondents	Agni	6	15	
	Baoulé	10	25	
	Malinké	15	37.5	

	Bété	1	2.5	
	Senoufo	8	20	
Respondent groups	Herbalists	11	27.5	
	Traditherapists	29	72.5	
Knowledge acquisition	Ancestral (ancestors))	37	92.5	
	Empirical	3	7.5	

3.2. *P. capitata* and *T. bangwensis*: therapeutic indications and use in traditional medicine

Phragmanthera capitata (Spreng.) Ballé and *Tapinanthus bangwensis* (Engl. and K. Krause) Danser are cited by all herbalists and traditherapists interviewed (100% of respondents) as being used in the preparation of traditional remedies for the treatment of hypertension and other pathologies (Table 2). Various parts of these plants, including leaves, stem bark and leafy twigs, are used to make potions (Figure 1). The citation frequencies (CF) for *P. capitata* and *T. bangwensis* are 45% and 37%, respectively. The calculated relative use indices, Médicinal Informant Agreement Ratio (*Med.IAR*), range from 0.17 to 0.71 (Table 2). The results of the ethnobotanical surveys revealed that 95% of respondents specified the reasons for the use of these two species in traditional medicine. Moreover, 40% of respondents specifically testified to their efficacy in the treatment of hypertension.

Table 2 Loranthaceae species and therapeutic indications

Species	**Dis cit**	**Nb cit**	**Pts us**	**Mtd prt**	**Md adm**	**FC (%)**	***Med.IAR***
P. capitata (Spreng.) Balle	*Hyp*	18	*Le tw*	*Inf + Ln*	*Drk*	45	0.17
	Sex ws		*Le, tw, Bk*	*Dec + Lt co*	*Drk*		
	Str		*Tw, Bk*	*Pdr + Lt co*	*Prg*		
	Pfl pds		*Le, St*	*Pdr + Ln*	*Drk*		
	Sth ac		*Le*	*Plg + Chl pep*	*Drk*		
T. bangwensis (Engl. et K. Krause) Danser	*Ulc*	15	*Le*	*Plge + Grc*	*Prg*	37	0.71
	Mal		*Le*	*Inf + Ln*	*Drk*		
	Ast		*Le tw*	*Inf*	*Drk*		
	Cg		*Le*	*Inf + Hny*	*Drk*		
	Drhe		*Le*	*Plge + Chl pep*	*Prg*		
	Hyp		*Le tw*	*Inf + Ln*	*Drk*		

Meaning of abbreviations: Dis cit - Diseases cited; Nb cit - Number of citations; Pts us - Parts used; Md adm - Method of administration; Bk - Bark; Tg - Stem; Le - Leaf; Inf - Infusion; Le tw - Leafy twigs; Pdr - Powder; Plge - Piling; Hyp - Hypertension; Cg - Cough; Pfl pds - Painful periods; Lt co - Little cola ; Sex ws - Sexual weakness; Mal - Malaria; Drhe - Diarrhoea; Asth - Asthma; Ulc - Ulcer; Ster - Sterile; Ln - Lemon; Chl pep - Chilli pepper; Prg - Purge; Sth ac - Stomach ache; Mtd prt - Method of preparation; Dk - Drink; Dec - Decotion; Hny - Honey; Chl pep - Chilli pepper; Grc - Garlic



Figure 1 Bunch of dried leafy branches of *P. capitata* sold on the Orly Daloa market

3.3. Phytochemical compounds

3.3.1. Extraction yields

The percentage yield of extracts obtained from the leaves and stems of *P. capitata* and *T. bangwensis* was 10.55% and 14%, respectively, for aqueous extracts and 13% and 15% for 70% hydroethanol extracts (Table 3).

Table 3 Extract yields of *P. capitata* and *T. bangwensis*

Extract types	Species of Loranthaceae	IMP	FMAE	Yield
Aqueous extracts	*P. capitata*	100	10.55	10.55%
	T. bangwensis	100	14	14%
Hydroethanol extracts	*P. capitata*	100	13	13%
	T. bangwensis	100	15	15%

Meaning of abbreviations: FMAE - Final mass of aqueous extract obtained; IMP - Initial mass of powder.

These variations in yield can be explained by the different polarity of the solvents used, which have a different influence on the extraction of bioactive compounds present in the organs of the two Loranthaceae species.

3.3.2. Phytochemical screening of Phragmanthera capitata and Tapinanthus bangwensis extracts

Phytochemical analysis of aqueous and hydroalcoholic (70%) extracts of *P. capitata* and *T. bangwensis* leaves and stems revealed the presence of several groups of secondary metabolites, notably saponins, polyphenols, flavonoids, tannins and alkaloids (Table 4). Sterols and terpenes, on the other hand, were absent from all the extracts analyzed. Aqueous extracts of both species are characterized by a high content of saponins and flavonoids (+++), while these compounds

are absent (-) or weakly represented (+) in hydroalcoholic extracts. Tannins are present in moderate quantities (++) in all extracts, regardless of species or solvent. Polyphenols and alkaloids were detected in low proportions (+) in all extracts. The results of the analysis also showed that the two species marketed and used in the treatment of arterial hypertension (AH) have very similar secondary metabolite profiles, with no sterols or terpenes.

Table 4 Phytochemical screening of P. capitata and *T. bangwensis* leaf extracts

Compounds	*Phragmanthera capitata*		*Tapinanthus bangwensis*	
	Aqueous extract	**Hydroalcoholic extract**	**Aqueous extract**	**Aqueous extract**
Saponin	+++	-	+++	-
Polyphenol	+	+	+	+
Flavonoids	+++	+	+++	+
Tannins	++	++	++	++
Alkaloids	+	+	+	+

Meaning: - : Absent; + : Low abundance; ++ : Medium abundance; +++ : Very high abundance.

4. Discussion

The study revealed that *Phragmanthera capitata* and *Tapinanthus bangwensis* are used by herbalists and traditherapists surveyed in Daloa markets. The results also show that respondents have inherited knowledge of these plants (Loranthaceae) from their ancestors [14]. Arterial hypertension (AH) was cited by respondents as one of the pathologies for which these plant species are marketed and used by patients. This result corroborates the observations of Ladoh et al. [15] and Amon et al. [10], who have previously reported the use of Loranthaceae species in the treatment of hypertension. The parts of Loranthaceae most commonly used in the preparation of remedies are the leaves and leafy twigs [16]. Ethnobotanical studies carried out in Côte d'Ivoire [17, 18, 19] and Burkina Faso [20] have also shown the predominance of leaf use in therapeutic preparations. In addition, the antihypertensive capacity of *P. capitata* and *T. bangwensis* leaves has been confirmed by Ladoh et al. [7] and Amon [9]. The ethnobotanical survey revealed that respondents have strong traditional knowledge of Loranthaceae, with a particularly high degree of consensus regarding their use in the treatment of AH [21]. These findings justify the choice of our two study species. Phytochemical screening of aqueous extracts from *P. capitata* and *T. bangwensis* leaves revealed the presence of alkaloids, phenols, tannins, flavonoids and saponins. These results confirm those of Ladoh et al. [7], who had also identified these compounds in *P. capitata*. However, we note the absence of saponins in the hydroalcoholic extracts of *P. capitata*, which could be explained by differences linked to the host plants. Tannins, alkaloids, flavonoids, saponosides and phenols possess antihypertensive properties [22], supporting the traditional use of these two species by herbalists and traditherapists in the treatment of hypertension. Flavonoids were particularly abundant in aqueous extracts but only weakly present in hydroalcoholic extracts. In addition to their anti-inflammatory and antioxidant properties, flavonoids possess venotonic effects [23], which may explain their use in antihypertensive phytotherapy based on *P. capitata* and *T. bangwensis* leaves. These compounds are present in almost all parts of these plants, in varying concentrations, where they play a key role in the defense system as antioxidants [24]. Tannins and flavonoids are of particular interest because of their many biological activities, including their antihypertensive effects in patients [5]. The synergistic action of flavonoids and saponins gives *P. capitata* and *T. bangwensis* their antihypertensive properties. In addition, they can induce the production of nitric oxide (NO), an endothelial vasodilator, which causes relaxation of the arteries and thus a reduction in blood pressure [25].

5. Conclusion and recommendations

The ethnobotanical and phytochemical study carried out on *P. capitata* and *T. bangwensis* highlighted their traditional use in the treatment of arterial hypertension (AH) by herbalists and traditherapists in Daloa. It revealed that the knowledge of the respondents has been passed down from generation to generation, with a high degree of consensus on the use of leaves and leafy twigs in therapeutic preparations for treating hypertension. Phytochemical screening revealed the presence of bioactive secondary metabolites, notably flavonoids, saponins, tannins, phenols and alkaloids, scientifically corroborating the traditional uses reported. These compounds, recognized for their antihypertensive properties, make both species of real therapeutic interest in the traditional management of hypertension. It would therefore be appropriate to promote in-depth pharmacological studies to scientifically validate their antihypertensive

effects. The identification of these bioactive compounds also warrants further toxicological studies, with a view to ensuring their safe use and promoting the development of antihypertensive phytomedicines based on solid scientific evidence.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have declared that no conflicts of interest exist.

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