



Ethnobotanical study of medicinal plants used in the treatment of high blood pressure in the region of Tlemcen (Northwestern Algeria)

[Estudio etnobotánico de plantas medicinales utilizadas en el tratamiento de la hipertensión en la región de Tlemcen (noroeste de Argelia)]

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Abstract

Context: This is the first ethnobotanical study that was conducted on the traditional treatment of arterial high blood pressure in the region of Tlemcen, in Northwestern Algeria.

Aims: To establish an inventory of medicinal plants recommended by herbalists and used by the local population of Tlemcen against this disease.

Methods: The survey was conducted with 242 hypertensive people and 11 herbalists, in 14 municipalities of the Wilaya (Province) of Tlemcen, using a pre-established questionnaire.

Results: At the end of this survey, 37 species belonging to 18 families were inventoried. The three most dominant families were *Apiaceae* (6 species), *Lamiaceae* and *Rosaceae* (4 species). The most cited species were *Allium sativum* L. (48.4%), *Citrus limon* (L.) Burm (42.7%), *Olea europaea* var. *sativa* L. (19.1%), *Rosmarinus officinalis* L. (9.6%), and *Origanum vulgare* L. (8.9%). The aerial parts were the most used (23.26%) and most of the remedies were prepared in the form of infusion and decoction (30.5%)

Conclusions: The results obtained constitute a highly valuable source of information regarding the traditional treatment of high blood pressure. The selected plants may be the subject of pharmacological studies in order to prove their effectiveness against this disease.

Keywords: ethnobotany; high blood pressure; medicinal plants; Tlemcen; traditional medicine.

Resumen

Contexto: Este es el primer estudio etnobotánico que se realizó sobre el tratamiento tradicional de la hipertensión arterial en la región de Tlemcen, en el noroeste de Argelia.

Objetivos: Establecer un inventario de plantas medicinales recomendado por herbalistas y utilizado por la población local de Tlemcen contra esta enfermedad.

Métodos: La encuesta se realizó a 242 personas hipertensas y 11 herbalistas, en 14 municipios de Wilaya (Provincia) de Tlemcen, utilizando un cuestionario preestablecido.

Resultados: Al final de esta encuesta, se inventariaron 37 especies pertenecientes a 18 familias. Las tres (3) familias más dominantes fueron *Apiaceae* (6 especies), *Lamiaceae* y *Rosaceae* (4 especies). Las especies más citadas fueron *Allium sativum* L. (48,4%), *Citrus limon* (L.) Burm (42,7%), *Olea europaea* var. *sativa* L. (19,1%), *Rosmarinus officinalis* L. (9,6%) y *Origanum vulgare* L. (8,9%). Las partes aéreas fueron las más utilizadas (23,26%) y la mayoría de los remedios se preparaban en forma de infusión y decocción (30,5%).

Conclusiones: Los resultados de este estudio constituyen una fuente de información valiosa sobre el tratamiento tradicional de la hipertensión arterial. Las plantas seleccionadas pueden ser objeto de estudios farmacológicos para demostrar su eficacia contra esta enfermedad.

Palabras Clave: etnobotánica; alta presión sanguínea; plantas medicinales; Tlemcen; medicina tradicional.

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INTRODUCTION

High blood pressure is a chronic metabolic disease that poses a major public health problem worldwide. In Algeria, approximately 30% of adults are affected by this disease. The incidence of arterial hypertension is 5% in subjects aged 30 years and 20% in those aged 60 (Boubchir, 2004).

According to the Algerian Ministry of Health, in terms of pathological consequences, hypertension is a major risk factor for many diseases such as coronary heart disease, stroke, heart failure and kidney failure. This risk for high blood pressure increases dangerously in the presence of other risk factors such as smoking, dyslipidemia or diabetes.

In Africa in particular, a large portion of the population continues to use traditional medicines rather than modern drugs for primary health care (WHO, 2001; 2002).

Several surveys have been carried out in Morocco on plants used against arterial hypertension (Ziyyat et al., 1997; Jouad et al., 2001; Eddouks et al., 2002; Tahraoui et al., 2007; Orch et al., 2015). While studies on the topic are much less numerous in the other African countries. In particular, in Algeria, research in this area remains scarce, howev-

er, the work of Bouzabata (2013) in the region of Souk Ahras (Northeastern Algeria) deserves to be mentioned.

Tlemcen is a very old town where people still preserve that culture of using medicinal plants in treating daily health problems. More than 80% of the local people use traditional medicine (El Yebdri et al., 2017).

The purpose of the present work is to inventory the plants used by the population of this region against high blood pressure in order to preserve this traditional medicine knowledge.

MATERIAL AND METHODS

Study area

The Wilaya (Province) of Tlemcen is located in Northwestern Algeria (34° 53' 24" N, 1° 19' 12" W), at the distance of 520 km, East of the capital city Algiers. It extends from the Mediterranean coast in the North to the steppe in the South. It is bounded in the North by the Mediterranean Sea, in the West by Morocco, in the South by the Wilaya of Naâma and in the East by the Wilayas of Sidi-Bel-Abbès and Ain Témouchent (Fig. 1). Tlemcen covers an area of 9017.69 km².

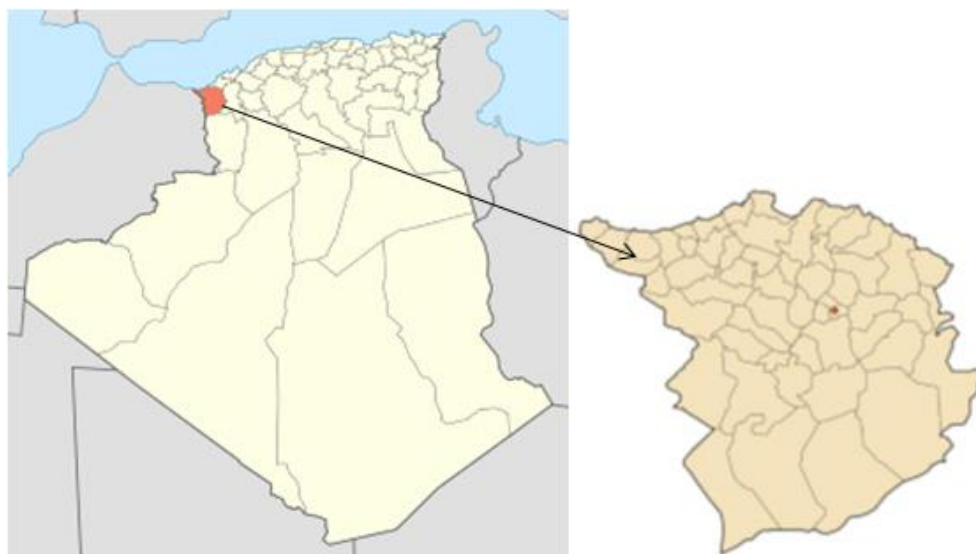


Figure 1. Location of the study area.

Source: (<http://toutsurtlemcen.info/tlemcen-la-carte-sanitaire-debattue/>)

This city is characterized by a Mediterranean climate. Its population was estimated at 949 135 inhabitants in 2008 (ONS, 2008).

The present study concerned 14 municipalities in the Wilaya of Tlemcen, namely the city center, and other villages and small towns like Hennaya, Honaine, Remchi, Ain Youcef, Ain Fezza, Ouled Mimoun, Wadi Chouli, Seb Dou, Beni Snous, Beni Mester, Sebra, Maghnia, and Ouled Ryah.

Plant material

Samples of medicinal plants were collected during the period of the survey. The botanical identification of the selected plants and the determination of their vernacular and scientific names were made according to the morphological description of the Algerian flora by Quezel and Santa (1963), as well as from botanists at the Faculty of Science of Abu Bakr Belkaid University. The Herbarium of the Pharmacognosy Laboratory at the Department of Pharmacy of the same University was also consulted for that purpose. Voucher specimens were deposited at this same Herbarium.

The scientific names of plants were confirmed using The Plant List website, which is a database of all known plant species identified by their scientific names (<http://www.theplantlist.org>).

Survey and data collection

The survey was conducted during the period 2015-2016. The survey was validated using a pilot test performed on a small sample. The interviews were conducted face-to-face after obtaining the endorsement of each participant. They were carried out according to the requirements of the Code of Ethics of the International Society of Ethnobiology. The interviews were conducted by A. Saïdi and O. Ali Belhadj.

A sample of 242 hypertensive individuals was selected. These people were interviewed in different health facilities and pharmacies in the 14 communes. In addition, 11 herbalists participated in the study. These were selected based on their knowledge of medicinal plants and their popularity with local residents of their respective municipalities.

<http://jppres.com/jppres>

A questionnaire (Annex 1) was prepared in two languages (Arabic and French), from different surveys (Tahraoui et al., 2007; Azzi et al. 2012). The questions included in the questionnaire related to the personal information of the participants (age, gender, place of residence, occupation), the plants used (vernacular name, part used, method of preparation, associated or not with a conventional treatment), and the results obtained after treatment (improvement or not, adverse effects).

The questionnaire was distributed to selected hypertensive patients and herbalists.

Sometimes surveyors pretended they were patients requesting remedies for hypertension in order to obtain the collaboration of the herbalists who generally refuse to give detailed information to the curious for fear of competition.

Statistical analysis

For the purpose of showing the local importance of each species, the Relative Frequency Citation (RFC) was calculated using the following formula: $RFC = FC/N$

Where FC is the number of informants citing the use of the species, and N is the number of informants participating in the survey (Vitalini et al., 2013).

RESULTS AND DISCUSSION

Frequency of medicinal plants use

A group of 242 hypertensive subjects, including 147 women and 95 men, ranging in age from 28 to 85 years, were interviewed (Table 1). It was found that up to 65% of them had used medicinal plants, either alone or in combination with conventional medicines, for the treatment of high blood pressure. Similar findings were reported in studies conducted in other countries. For example, in Morocco, this percentage was 76% in the region of Fez-Boulemane (Jouad et al., 2001), 80% in Tafilalet in the South-East (Eddouks et al., 2002), and 78% in Errachidia in the South-East (Tahraoui et al., 2007). It was found to be 62.13% in Palestine (Ali-Shtayeh et al., 2013).

Medicinal plants used by the local population

A total of 37 plants were cited by the hypertensive individuals and herbalists who participated in the survey (Table 2). These plants belong to 18 families and those that are most represented are *Apiaceae* (6 species), *Lamiaceae* and *Rosaceae* (4 species).

The most frequently cited plants (with more than 8 citations, Fig. 2) were *Allium sativum* (117 citations) with the highest RFC (0.48), *Citrus limon* (101 citations, RFC =0.42), *Olea europaea var. sativa*

(46 citations, RFC=0.2), *Rosmarinus officinalis* (24 citations, RFC=0.09), *Origanum vulgare* (22 citations, RFC= 0.08), *Petroselinum crispum* (14 citations, RFC= 0.05), *Crataegus monogyna* (12 citations, RFC=0.05), *Apium graveolens* (9 citations, RFC= 0.037), *Zingiber officinale* (8 citations, RFC= 0.033), *Prunus persica* (8 citations, RFC= 0.033), and *Ammoides pusilla* (8 citations, RFC= 0.033). Most of these species (93%) grow spontaneously or are found locally. The present results are consistent with those reported by Bouzabata (2013) in the region of Souk Ahras (Eastern Algeria).

Table 1. The socio-demographic characteristics of respondents.

Respondent	Characteristics	Number of respondents	Total percentage (%)
Hypertensive patients	Age		
	20-29	2	0.82
	30-39	10	4.13
	40-49	24	9.90
	50-59	67	27.68
	60-69	68	28.10
	≥70	71	29.33
	Gender		
	Female	147	60.74
	Male	95	39.25
Herbalists	Residence		
	Urban	98	40.49
	Rural	144	59.50
	Age		
	30-39	1	9.10
	40-49	3	27.27
	50-60	2	18.20
	> 60	5	45.45
	Gender		
	Female	2	18.20
Male	9	81.80	

Table 2. List of medicinal plants used in the treatment of high blood pressure in the area of Tlemcen.

Family	Plant name	Local name	Voucher number	Used part(s)	Method of preparation	Use citations	RFC
<i>Amaryllidaceae</i>	<i>Allium sativum</i> L.	Thoum	SHT-002	Bulb	Raw, external use	117	0.48
<i>Apiaceae</i>	<i>Petroselinum crispum</i> (Mill.) Fuss	Maâdnous	SHT-029	Aerial part	Raw	14	0.05
	<i>Apium graveolens</i> L.	Krafess	SHT-004	Aerial part, seeds	Raw, decoction	9	0.03
	<i>Ammoides pusilla</i> (Brot.) Breistr.	Noukha	SHT-003	Aerial part	Infusion, decoction	8	0.03
	<i>Pimpinella anisum</i> L.	Habethlawa	SHT-030	Seeds	Decoction, powder	1	0.06
	<i>Carum carvi</i> L.	Kirwiya	SHT-008	Seeds	powder	1	0.06
	<i>Coriandrum sativum</i> L.	Kosbor	SHT-013	Aerial part	Raw	1	0.06
<i>Asteraceae</i>	<i>Matricaria recutita</i> L.	Babounij	SHT-023	Flowers	Infusion	5	0.02
	<i>Taraxacum officinale</i> (L.) Weber ex F.H.Wigg.	Merrara	SHT-034	Aerial part, leaves, root	Infusion, decoction	6	0.02
	<i>Artemisia herba alba</i> Asso.	Chih	SHT-005	Aerial part	Decoction	1	0.06
<i>Berberidaceae</i>	<i>Berberis vulgaris</i> L.	Ghriss	SHT-007	Bark	Decoction, powder	1	0.06
<i>Brassicaceae</i>	<i>Lepidium sativum</i> L.	Habrchad	SHT-021	Seeds	Infusion	1	0.06
<i>Lamiaceae</i>	<i>Rosmarinus officinalis</i> L.	Halhal, yazir	SHT-033	Aerial part, flowers	Infusion, decoction	24	0.09
	<i>Origanum vulgare</i> L.	Zaâter	SHT-028	Aerial part	Infusion, decoction	22	0.08
	<i>Lavandula angustifolia</i> Mill.	Khezama	SHT-020	Aerial part	Infusion, decoction	5	0.02
	<i>Mentha spicata</i> L.	Naânaâ	SHT-024	Aerial part	Infusion, decoction	6	0.02
<i>Lauraceae</i>	<i>Cinnamomum zeylanicum</i> Blume	Karfa	SHT-009	Bark	Decoction	5	0.02
	<i>Laurus nobilis</i> L.	Rand	SHT-019	Leaves	Decoction	1	0.06
<i>Liliaceae</i>	<i>Allium cepa</i> L.	Besla	SHT-001	Bulb	Raw, decoction	6	0.02
<i>Linaceae</i>	<i>Linum usitatissimum</i> L.	Ziriatkan	SHT-018	Seeds	Powder, infusion	3	0.01
<i>Malvaceae</i>	<i>Hibiscus sabdariffa</i> L.	Karkadé	SHT-016	Corolla	Infusion, maceration, powder	5	0.02
<i>Myrtaceae</i>	<i>Commiphora myrrha</i> (Nees) Engl.	Rihane	SHT-012	Aerial part	Infusion, decoction	5	0.02
<i>Oleaceae</i>	<i>Olea europaea</i> var. <i>sativa</i> (Weston) Lehr.	Zitoune	SHT-026	Leaves, fruits	Infusion, oil	46	0.2
	<i>Olea europaea</i> var. <i>sylvestris</i> (Mill.) Lehr	Zebouj	SHT-027	Leaves	Infusion, decoction	5	0.01

Family	Plant name	Local name	Voucher number	Used part(s)	Method of preparation	Use citations	RFC
<i>Poaceae</i>	<i>Avena sativa</i> L.	Khirtal	SHT- 006	Leaves	Raw	5	0.02
	<i>Hordeum vulgare</i> L.	Cha'ïr	SHT- 017	Leaves	Decoction	1	0.06
<i>Punicaceae</i>	<i>Punica granatum</i> L.	Romane	SHT-032	Leaves, fruit pericarp	Infusion, decoction	6	0.02
<i>Ranunculaceae</i>	<i>Nigella sativa</i> L.	SanoujHabasawda	SHT-025	Seeds	Infusion	1	0.06
<i>Rosaceae</i>	<i>Crataegus monogyna</i> Jacq.	Ainbagra	SHT- 014	Leaves	Infusion, decoction	12	0.05
	<i>Prunus persica</i> (L.) Batsch	Khoukh	SHT-031	Leaves, fruits	Infusion, juice	8	0.03
	<i>Malus domestica</i> Borkh.	Teffah	SHT-022	Leaves	Juice, vinegar	1	0.06
<i>Rutaceae</i>	<i>Citrus limon</i> (L.) Osbeck	Lim, Kariss	SHT-010	Fruits	Juice	101	0.42
	<i>Citrus sinensis</i> (L.) Osbeck.	Tchina	SHT-011	Fruits	Juice	3	0.01
<i>Verbenaceae</i>	<i>Verbena officinalis</i> L.	Louisa	SHT-035	Leaves	Infusion	1	0.06
<i>Zingiberaceae</i>	<i>Zingiber officinale</i> Roscoe	Zanjabil	SHT-036	Rhizome	Decoction, maceration, powder	5	0.02
	<i>Curcuma longa</i> L.	Kourkoum	SHT- 015	Rhizome	Powder	8	0.03

The scientific names of plants were confirmed using The Plant List (<http://www.theplantlist.org>).

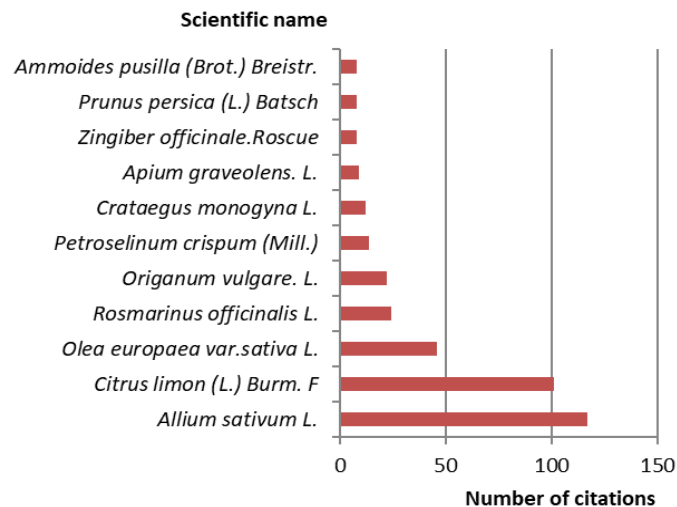


Figure 2. Number of citations of medicinal plants most commonly used against high blood pressure in the region of Tlemcen.

Up to 70% of the species identified in this study have also been cited at least once in other surveys conducted in different regions of Morocco (Jouad et al., 2001; Eddouks et al., 2002; Tahraoui et al., 2007; El-Haoudi, 2015; Orch et al., 2015). This similarity is explained by the fact that the populations of Morocco and the region of Tlemcen share the same traditions, the same climate and the same geographical situation.

On the other hand, some species were mentioned for the first time and are reported in this study. These were *Crataegus monogyna*, *Prunus persica*, *Citrus lemon*, *Citrus sinensis*, *Curcuma longa*, *Taraxacum officinale*, *Berberis vulgaris*, *Linum usitatissimu*, *Calotropis procera* and *Avena sativa*.

Among the different plants mentioned by the participants in the survey, some have already been the subject of several studies with regard to their antihypertensive effect. One can mention *Allium sativum* (Xiong et al., 2015), *Citrus sp.* (Razavi et al., 2015; Asgary and Keshvari, 2013), *Olea europea var. sativa* and *Hibiscus sabdariffa* (Micucci et al., 2016), *Rosmarinus officinalis* (Hassani et al., 2016), *Origanum vulgare* (Muller et al., 2008), *Petroselinum crispum* (Mirzaie Damabi et al., 2010), *Crataegus monogyna* (Walker et al., 2002), *Apium graveolens* (Dianat et al., 2015), *Zingiber officinale* and *Curcuma longa* (Akinyemi et al., 2016a;b), *Prunus persica* (Kono et al., 2013), *Punica granatum* (Asgary et al., 2014), *Allium cepa* (Brüll et al., 2015), *Taraxacum officinale* (Clare et al., 2009), *Cinnamomum zeylanicum* (Nyadjeu et al., 2013), *Myrtus communis* (Bouaziz et al., 2015), *Berberis vulgaris* (Atehi-Hassanabad, 2005), *Linum usitatissimu* (Sawant and Bodhankar, 2016), *Carum carvi* (Lahloua et al., 2007), *Artemisia herba alba* (Zeggwagha et al., 2014), *Coriandrum sativum* (Jabeen et al., 2009), *Nigella sativa* (Jaarin et al., 2015), *Hordeum vulgare* (Gan-gopadhyay et al., 2016).

Plant parts used

The most frequently used plant parts in this study are the aerial parts (23.26%). They are followed by the fruits (the whole fruit or pericarp on-

ly), the leaves (18.6%) and the seeds (13.95%), as indicated in Fig. 3.

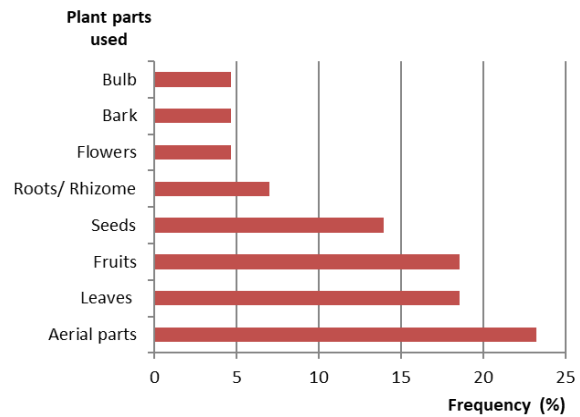


Figure 3. Frequency of use of various plant parts for the preparation of remedies.

All these plant parts are mainly used in the form of infusion or decoction (30.5%). This is the most widely used mode of preparation as reported in many studies (Bouzabata, 2013; Elyebdri et al., 2017; Azzi et al., 2012; Bouzid et al., 2016; Benarba et al., 2015). Other forms of use, such as the powder form (11.8%) and the raw form (10.1%), have also been mentioned previously as displayed in Fig. 4. The vast majority of these plants are taken orally and only 1.9% of them are used externally.

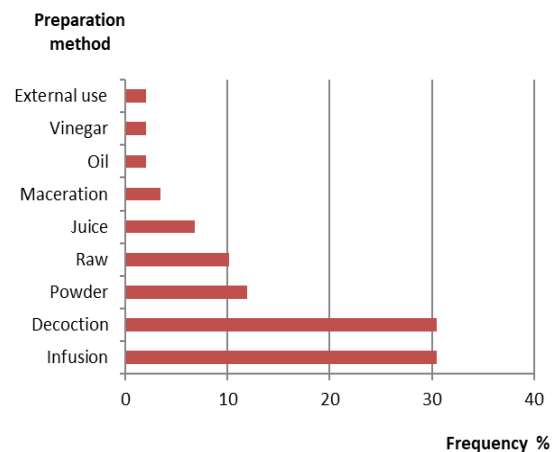


Figure 4. Methods of preparing remedies for high blood pressure according to their frequency of use.

Some difficulties, such as the reticent attitude of herbalists to collaborate, were encountered during the survey.

CONCLUSIONS

This study allowed us to identify the plants used for the treatment of high blood pressure by the population of the city of Tlemcen (Algeria). The inhabitants of this region have preserved their ancestral traditions. They have remained attached to traditional medicine for generations. Therefore, there is an urgent need for health personnel to realize that the use of medicinal plants has become a reality. This issue needs to be addressed seriously in order to provide the best care possible to patients. The results of this study may initiate further research to identify the active ingredients responsible for the antihypertensive activity of these plants.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTION:

Contribution	Hassaïne S	Saïdi A	Belhadj OA
Concepts or ideas	x	x	x
Design	x		
Definition of intellectual content	x	x	x
Literature search	x	x	
Experimental studies		x	x
Data acquisition		x	x
Data analysis		x	x
Statistical analysis		x	
Manuscript preparation	x		
Manuscript editing	x		
Manuscript review	x	x	x

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Annex 1. Questionnaire on traditional treatment of hypertension.*Questionnaire on Traditional Treatment of Hypertension*

1. N °: _____

2. Plant user: Traditional Healer 3. Age: _____4. Gender: Female Male

5. Profession: _____ 6. Place: _____

7. For the traditional healer:Origin of knowledge: Empiricism Family initiation Training**8. For the consumer:**Type of hypertension: Systolic DiastolicDo you have medical treatment for hypertension? Yes NoDo you have other diseases? Yes No

If yes, which one (s): _____

Plant Information:

1. The name of the plant (s) used: _____

2. Origin of the plant (place of harvest): _____

3. Part used: Stem Flower Fruit Seed Bark Root Bulb Leaves Whole plant Aerial part Other combinations: _____

4. Preparation method:

 Infusion (extinguish the fire then put the plant in hot water) Decoction (boil the plant in water) Maceration (put the plant in cold water for a few hours) Other: _____5. Are plants used in associations? Yes No

If Yes, which one (s): _____

6. Frequency of use (frequency of treatment) Regularly Occasionally (during a blood pressure spike)7. Results: Improvement Ineffective8. Side effects: Yes No

If Yes, which one (s): _____