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Ethnopharmacological survey of antihypertensive remedies in the Rabat region

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ABSTRACT

Morocco's people have used medicinal plants for centuries to treat various ailments, but historical studies have not adequately documented and promoted this traditional knowledge precisely those treating high blood pressure. The purpose of this study, which was conducted in the Rabat region, was to discover aromatic and medicinal plants that the locals utilized to treat arterial hypertension and to document the related ethnomedical knowledge. The ethnomedical data was gathered from 500 subjects using online questionnaires and semi-structured interviews. Therefore, in the data analysis, the relative citation frequency was used. The study identified ten floristic species, with olive (*Olea europaea*), Acacia (*Acacia sensu lato*), and Inula (*Inula viscosa*) being the most frequently cited. The leaves of these plants are mainly used, commonly prepared as infusions or decoctions. The study's findings demonstrated that Moroccans residing in the Rabat region still rely heavily on aromatic and therapeutic herbs. The identified plants can be used as a starting point for next phytochemical and pharmacological research as well as for more studies on the knowledge of therapeutic plants in the area.

1. Introduction

Arterial hypertension (AH) is a major public health concern worldwide. It is characterized by abnormally high blood pressure in the blood vessels, leading to increased risk of serious cardiovascular complications, such as stroke, heart attack and kidney failure. This medical condition, also known as high blood pressure, affects millions of people worldwide, and its increasing prevalence over the decades makes it a major public health issue [1]. Phytotherapy is proving its effectiveness and proven health benefits, making natural medicine an integral part of our daily routines. Today, Western countries are showing a renewed interest in plant-based treatments, particularly to alleviate imbalances induced by modern lifestyles, such as stress or weight problems. However, despite advances in this field, cardiovascular disease remains a major cause of mortality worldwide, mainly affecting developing countries where over 80% of cardiovascular deaths occur. Hypertension,

currently affecting 26.4% of the world's population and set to rise to 29.2% by 2025, is one of the most worrying cardiovascular diseases. In the face of these challenges, traditional medicine is gaining in importance, being widely used by almost 80% of the population according to the WHO (2011). Exploiting traditional medicine and medicinal plants offers significant economic advantages [2]. Morocco stands out for its notable use of medicinal plants, being one of the Mediterranean countries that have exploited this traditional knowledge. Indeed, traditional medicine plays a key role in Moroccan medical tradition. Thanks to its privileged geographical location, Morocco, with its diverse climatic conditions and rich terrain, is blessed with an exceptionally abundant and varied flora. As a result, the medicinal and aromatic plant sector is one of the most prolific in the world. Morocco's natural ecosystems comprise over 41 different types and are home to some 7,000 plant species, of which 4,500 are vascular plants. Among this vast floral diversity, some 600 species

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are recognized for their aromatic and medicinal properties [3]. Also, Medicinal plants are increasingly being used for disease treatment due to their affordability and increasing demand, particularly in developing countries. Ethnobotanical surveys are being utilized to preserve and enhance the wealth of ethnobotanical information, serving as a valuable data base for researchers in fields like phytochemistry, pharmacology, and toxicology. To this end, the current study focused to gather knowledge and achievements of Rabat, Morocco's citizens and herbalists through an ethnopharmacological survey, recording botanical species used for arterial hypertension treatment.

2. Materials and Methods

2.1. Survey area

The study area is located in the Rabat-Sale-Kenitra region and also includes the Zemmour-Zaër region of Morocco. The region is located in northwest Morocco, bordered by the Atlantic Ocean to the west. It comprises fertile coastal plains, river valleys and hilly areas. The region is particularly characterized by rolling terrain and forests. The climate is typically Mediterranean, with hot, dry summers and mild, wet winters. Rainfall is mainly concentrated in winter, favoring a rich and diverse vegetation.

2.2. Descriptive Data

This research is a descriptive cross-sectional study focusing on the use of medicinal plants. The main objective is to collect and describe data on current practices regarding the use of medicinal plants within the study population. The study was conducted over a three-month period, starting in March 2024 and concluding at the end of May 2024. Our study targeted a population of 500 subjects, both hypertensive and non-hypertensive, residing in the Rabat-Salé-Kénitra region. This approach made it possible to encompass a diverse representation within the study population, offering a comprehensive and representative view of practices and perceptions relating to the use of medicinal plants in this specific region of Morocco. We excluded from our study anyone under the age of 18. This decision was taken in order to comply with ethical and regulatory standards concerning the participation of minors in research studies. By limiting our study to adults, we were able to focus on a population capable of providing informed consent and responding autonomously to the questionnaire questions.

2.3. Data collection

To obtain the information required for the study, a questionnaire was designed. This questionnaire includes the questions required to conduct a comprehensive study, providing relevant epidemiological and ethnopharmacological data. The study was carried out using two complementary approaches: online data collection via the Google Forms platform and the Facebook

and WhatsApp social networks, as well as oral interview data collection with each subject, where the questionnaire was completed by the interviewer. The information collected was recorded on dedicated cards for careful analysis at the close of the study. The data was then entered and processed using Microsoft Excel 2016. This process enabled structured and methodical data management, ensuring thorough and rigorous analysis to extract relevant and enlightening conclusions. To analyze the relationship between informants' socio-demographic data and their knowledge of ethnomedicine, the results of the ethnobotanical survey were evaluated using relative citation frequency (RFC) as a statistical parameter.

The relative citation frequency (RFC) is calculated by dividing the citation frequency (CF) by the total number of informants participating in the survey (N=500). The RFC value for medicinal species is determined according to the percentage of informants who mentioned each species [4]. The formula for calculating the RFC is as follows:

$$RFC = Fc/N$$

Where:

-Fc is the number of participants who cited the use of a particular plant.

-N is the total number of participants in the study.

In general, species with a very significant relative frequency of citation are those with a high level of use.

3. Results and discussion

3.1. Socio-demographic aspect

A total of 500 subjects were included in this survey to identify the various anti-hypertensive plant recipes. The use of medicinal plants affected all age groups, with the exception of individuals under 18, who were not included in the study. It is notable that this practice is particularly prevalent among people over 50. This trend can be explained by the fact that older people are more often exposed to chronic health problems, such as high blood pressure and diabetes, prompting them to seek alternative and complementary treatments. In addition, older people generally have more knowledge and experience with traditional remedies, which may also contribute to their greater use of medicinal plants. In our study, both sexes showed an interest in herbal medicine. However, it is notable that women are more inclined to use this method, accounting for 57% of users. This could be explained by various cultural, social and biological factors that influence women's perception and adoption of natural treatments. Their greater involvement could also reflect a greater sensitivity to holistic health approaches and a willingness to seek alternatives to conventional medicines. This trend is also documented by other national studies on medicinal plants, showing similar percentages of users [5–9]. These results can be explained by a number of factors; women tend to be more preoccupied with illness and its associated costs. They are also more attached to traditional practices than men. In addition, the transmission of information between women is often easier, contributing to their greater

use of medicinal plants. Other factors include a higher relative rate of illiteracy among women in our society, and greater credulity towards medical information, particularly that concerning medicinal plants. Of the patients surveyed, 61% were hypertensive, while 32% had normal blood pressure. This situation is attributable to the increasing prevalence of hypertension in our society. Several factors contribute to this growing trend, including modern lifestyles characterized by a diet high in salt and fat, insufficient physical activity, and high stress levels. In addition, the aging of the population plays a significant role, as hypertension is more common in the elderly. Social and economic changes, such as rapid urbanization and the adoption of Westernized behaviors, are also accentuating this public health problem. The use of herbs to treat hypertension is particularly widespread in the region studied, with 61.2% of patients surveyed resorting to this method. This number clearly illustrates that herbal medicine is deeply rooted in the traditional health practices of the region's population. This trend bears witness to the local population's enduring confidence in herbal remedies, despite the advances of modern medicine. Furthermore, various ethnobotanical studies carried out in other regions of Morocco confirm this observation, revealing a high rate of medicinal plant use among the Moroccan population. These studies show that Moroccans continue to prefer natural solutions to a variety of ailments, including high blood pressure. This is due to a combination of cultural, economic and natural resource availability factors.

Table 1
Socio-demographic aspect of interviewers.

Information	Percentage %
Age	
[18-30]	26
[30-50]	34
>50	40
Gender	
Female	57
Male	43
Are you suffering from the disease?	
Yes	61
No	32
No idea	7
Herbal treatment	
Yes	61.2
No	37.8

3.2. Ethnobotanical aspect

The information gathered during our study confirms the diversity of medicinal plants used in our region. Data concerning the family, scientific name, vernacular name, common name, and relative frequency of citation (RFC) of each plant are presented in Table 2. This information provides a detailed overview of local phytotherapeutic

practices and highlights the plants most commonly used to treat hypertension. The survey revealed 10 botanical species used as remedies to balance blood pressure. Among these plants, those most frequently used by the patients surveyed were: Olive (*Olea europaea*), Acacia (*Acacia sensu lato*), Inula (*Inula viscosa*), Watercress (*Lepidium sativum*), Garlic (*Allium sativum*), Caraway (*Carum carvi*), Chamomile (*Chamaemelum nobile*), Verbena (*Verbena officinalis*), Tobacco (*Nicotiana tabacum*), Eucalyptus (*Eucalyptus globulus*).

Table 1
Antihypertensive plants used by survey respondents.

Family	Scientific name	Vernacular name	FRC
Oleaceae	<i>Olea europaea</i>	Zaytoun	0,7
Fabaceae	<i>Acacia sensu lato</i>	Laalk	0.45
Asteraceae	<i>Inula viscosa</i>	Maqraman	0,32
Brassicaceae	<i>Lepidium sativum</i>	hab rchad	0,20
Liliaceae	<i>Allium sativum</i>	Touma	0,15
Apiaceae	<i>Carum</i>	Carwiya	0,02
Asteraceae	<i>Chamaemelum nobile</i>	Babounj	0,02
Verbenaceae	<i>Lippia citriodora</i>	Lwiza	0,01
Solanaceae	<i>Nicotiana tabacum</i>	Tibgh	0,01
Myrtaceae	<i>Eucalyptus globulus</i>	Eucalyptus	0,01

Some of the plants identified in our survey have also been reported by ethnobotanical studies carried out in different regions of Morocco for the treatment of hypertension. For instance, a study carried out in eastern Morocco identified several commonly used plants, such as White wormwood (*Artemisia herba-alba*), Fenugreek (*Trigonella foenum-graecum*), Garlic (*Allium sativum*), and Olive (*Olea europaea*) [10]. Another study carried out in the Fès-Boulemane region also highlighted the use of Fenugreek (*Trigonella foenum-graecum*), Olive (*Olea europaea*) and Lemon Verbena (*Lippia citriodora*) [9]. In addition, the study carried out in the province of Errachidia listed white wormwood (*Artemisia herba-alba*), goosefoot (*Chenopodium ambrosioides*), onion (*Allium cepa*), Garlic (*Allium sativum*), Myrtle (*Myrtus communis*), Olive (*Olea europaea*), Black Cumin (*Nigella sativa*) and Lemon Verbena (*Lippia citriodora*) as antihypertensive plants [11]. A survey conducted in the Izarène region (northern Morocco) highlighted the use of Garlic (*Allium sativum*), Fenugreek (*Trigonella foenum-graecum*), Sage (*Salvia officinalis*), Olive (*Olea europaea*) and Black Cumin (*Nigella sativa*) [8].

Spontaneous plants are widely used, accounting for 60% of all species. This prevalence is explained by their year-round availability. We also note that cultivated species are used in a significant proportion (36%) (Fig. 1). This dominance of spontaneous plants was referred to in the

work of Hamad and Hamroun (2017) in Tizi Ouzou and Fréha, where they found that 59.57% of plants used were spontaneous and 38.3% were cultivated [12].

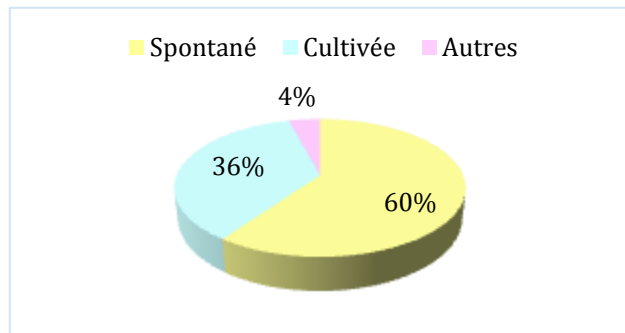


Fig. 1. Type of plants used by survey respondents.

The results also show that leaves are the most commonly used organs, accounting for 64% of cases (Fig. 2). This preference may be attributed to their ease and speed of harvesting, as well as to their role in photosynthesis and their possible function as storage for secondary metabolites responsible for the plant's biological properties. These results are in line with those of several studies [13,14]. The majority of medicinal plants are used in dried form mainly to prepare herbal teas or powders.

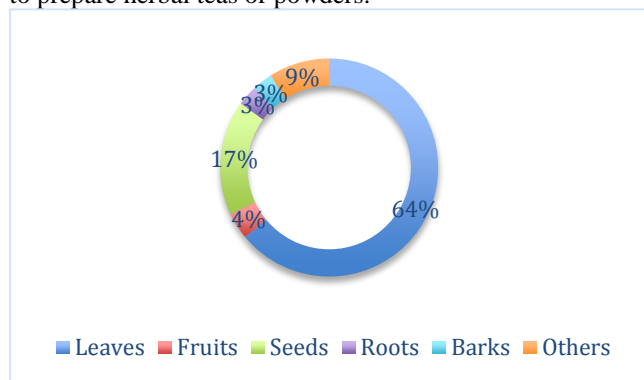


Fig. 2. Used parts of medicinal plants.

3.3. Ethnopharmacological aspect

The majority of recipes are administered orally, accounting for 94% of cases. This mode of administration is preferred because it is the most effective, rapid and simple. This is in line with other studies, such as that carried out by Barkaoui and another by Hamad and Hamroun, who found a percentage of 100% for oral administration [12,15]. The plants studied are consumed in various forms of preparation: infusion (35%), decoction (27%), herbal tea (27%), plant-based dietary supplement (7%), powder (2%), and mixture or maceration (1%). Infusion is the most commonly used preparation method, probably due to its simplicity and convenience. Dosage of herbal remedies does not require the same strict precision as that of drugs, as the margin of tolerance is wider. However, it is important not to exceed the recommended posology. Our results show that a single daily dose is the most commonly used, accounting for 67% of cases. The length of treatment

varies from person to person. Our study shows that the majority of people surveyed do not give a precise duration (90%). This result could be explained by the fact that hypertension is a chronic disease, requiring lifelong management from the moment of onset. The survey revealed that 45% of hypertensive people lack physical exercise, an essential factor in maintaining good cardiovascular health. What's more, 39% of these people consume a diet rich in salt, which can aggravate their hypertension by increasing blood volume. These findings underline the importance of promoting regular exercise and a low-salt diet to manage and prevent hypertension. In addition, the survey results show that 52% of those questioned claimed to have a family antecedent of high blood pressure or cardiovascular disease. This underlines the importance of genetics in this disease, and the need for appropriate preventive measures.

Table 2
Ethnopharmacological profile of medicinal plants recorded in this survey.

Information	Percentages %
Method of administration	
Oral	94
Cutaneous	4
Cataplasm	2
Preparation mode	
Infusion	35
Decoction	27
Herbal tea	27
Plant-based dietary supplement	7
Powder	2
Maceration	1
Mixture	1
Posology	
1/day	67
2/day	22
1/week	2
Others	9
Lifestyle	
Lack of physical activity	45
Salt-rich diet	39
Smoking	14
Alcohol consumption	2

4. Conclusion

Hypertension is a chronic and fatal disease, considered a major risk factor for cardiovascular disease. Today, it is one of the most serious health problems, both in Morocco and in many other countries. In Morocco, the incidence of hypertension has risen considerably over the years, reflecting worrying global trends. The management of this disease requires continuous attention and appropriate medical interventions to prevent serious complications. Many people turn overwhelmingly to herbal remedies to treat hypertension. In this study, we conducted an ethnobotanical survey to identify the plant species traditionally used by hypertensives in the Rabat region. Our

aim is to document local knowledge and enhance this natural heritage, while shedding light on the traditional practices and remedies used to manage this chronic condition. This approach not only preserves traditional knowledge, but also has the potential to uncover new therapeutic avenues for the treatment of hypertension. This ethnobotanical survey enabled us to draw up an inventory of 10 medicinal plants used to treat hypertension. These results provide a valuable information base that can serve as a starting point for pharmacological research aimed at assessing the therapeutic effects and safety of plants with traditional antihypertensive properties. However, it is crucial to note that this study represents an initial investigation, and that further research is needed to validate and deepen the findings obtained. Thus, antihypertensive medicinal plants may offer a substantial solution to the complex problem of arterial hypertension and provide therapeutic perspectives for improved management

Conflicts of interest statement

The authors declare no competing financial interest.

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