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ETHNOPHARMACOLOGICAL AND ETHNOBOTANICAL INVESTIGATION OF MEDICINAL PLANTS USED FOR THE TREATMENT OF RESPIRATORY TRACT INFECTIONS IN HIGH ATLAS CENTRAL OF MOROCCO

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ABSTRACT

This ethnobotanical and ethnopharmacological study was carried out between 2015 and 2017 in the High Atlas Central of Morocco. Its main objective was to assess the potential of this region in medicinal plants used specifically in the treatment of diseases of the respiratory system.

In this region, 41 plants divided into 24 families and 38 genera were identified. The most represented families are: Lamiaceae (9 species), Apiaceae and Asteraceae (4 for each one). While the plants most used for the treatment of respiratory tract infections are *Eucalyptus globulus* Labill., *Marrubium vulgare* L. and *Ficus carica* L. the most commonly used method of preparation is decoction, while leaves are the most commonly used parts .

Keywords: Ethnobotanical, Ethnopharmacological, medicinal plants, Morocco

INTRODUCTION

Breathing is a physiological mechanism allowing gas exchanges and oxygenation of the body tissues. This function, which is fundamental to life, is ensured by the lungs and more generally by the respiratory system (Galmèse, 2013).

This apparatus can be the object of several infections (colds, asthma, chronic bronchitis or even cancer). These pose a significant public health problem because of their frequency, severity, and socioeconomic impact, especially in developing countries such as Morocco.

According to the World Health Organization, 80% of the world's population uses traditional medicines to meet primary health care needs (WHO, 2003).

Morocco has a long history of herbal medicine. Despite progress in pharmacology, the therapeutic use of medicinal plants is very present in some countries of the world, especially in developing countries. Approximately 35,000 plant species are used for medicinal purposes worldwide. Medicinal plants are herbal drugs, at least some of which have medicinal properties, their active ingredients are essential components of a large part of our medicines and care products (Hans, 2007). our present work consists in highlighting the species used by the local population in case of respiratory disorders, in order to preserve this know-how and this natural heritage, and to exploit the opportunities.

MATERIAL AND METHODS

Presentation of the study area: Due to its geographical position and climate, the High Atlas Central of Morocco offers a tremendous ecological and floristic diversity. Also, traditional phytotherapeutic knowledge is well represented in this region.

The study was conducted in the center of the atlas chain of Azilal North, Ouarzazate, and Tinghir South, in the High Atlas Central (Fig. 1).

The municipalities of Tannant, Wawla, Ait Tamlil, Aït Majden, Aït M'hamed, Zaouiat Ahansal, Tabant, Aït abbas, Aït blal, Sidi-boulkhalef, Tifni, Tidli-Fetouaka, Ouzoud, Aït Bou Oulli, belonging to the city of Azilal, which is geographically located in the center of the Kingdom and belongs to the Beni Mellal-Khenifra economic region, which existed from the regional division of 2015 from the three former regions: Meknes-Tafilalet, Chaouia-Ouardigha and Tadla-Azilal (Official Bulletin, 2015). It occupies an area of about 1 million hectares, all mountainous, with the exception of a tiny part of the Tadla plain.

The climate is generally Mediterranean. It characterizes by heavy rainfall during winter and spring and a very severe summer drought (Sauvage and Vindt, 1952). Administratively, the Beni Mellal-Khenifra region comprises five provinces: Azilal, Beni Mellal, Fquih Ben Salah, Khenifra and Houribga, 135 communes including 16 municipalities and 119 rural Communes (HCP, 2018). About 80% of the surface area of the Province is situated

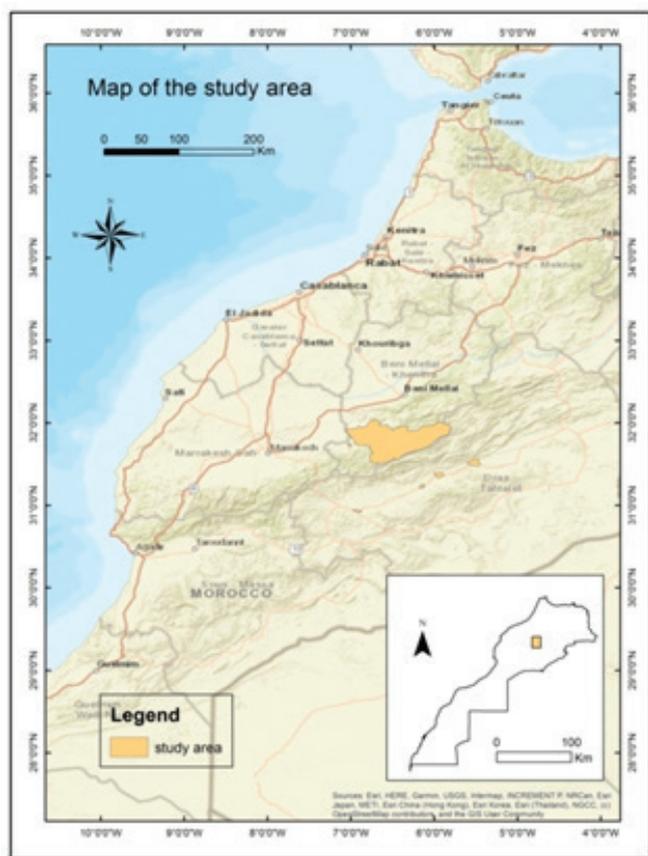


Fig. 1: Map situation of the study area: High Atlas Central (Realized by Belhaj according to the administrative division of 2015, Arcgis)

at an altitude of more than 1000 m and 60% above 1500 m (Tabuti *et al.*, 2003). Geologically, the area of the province extends over nearly one million hectares and covers a large part of the high limestone Atlas of the secondary age (Pique, 1994). Its population is 2520776 inhabitants, of which 1282037 are rural populations according to the national census of the population 2014 (HCP, 2018). The main plant formations in the area are as follows: The Holm oaks, which occupy an area of 205,000 Ha or 57.59% of total forest area of the province followed by Junipers with 18.15%.

The south side of the High Atlas Central (Fig. 1)

In the southern slope, our work was carried out in the provinces of Tinghir, Ouarzazate belonging to the Draa-Tafilalet region, which was established like the 11 other regions of the Kingdom, by the Decree of February 20st 2015, and published in Official Bulletin n ° 6340 of March 05st 2015 (Official Bulletin, 2015), encompasses an extension of 88,836 km:

With a total area of 1,112,460 ha, the province of Ouarzazate edges to the northern by the province of Azilal and Marrakech, to the east by the province of Tinghir, to the south by the province of Tata and Zagora and to the west by the province of Taroudant. It belongs to the arid bioclimatic zone with a continental tendency; the soils of this zone are 75% clayey-silt soils. The province's special crops occupy small areas, but still provide substantial

income to producers. This includes saffron, which occupies 85 hectares with an average annual production of 215 Kg (HCP, 2018).

With a total area of 908,960 ha, Tinghir province exists to the northern by the province of Azilal, to the east by the province of Errachidia, to the south and west by the province of Ouarzazate. It includes two circles, namely Tinghir, and Boumalne, tree municipalities (Tinghir, Kelaa M'gouna and Boumalne Dadés) and 17 rural commons. It belongs to the arid bioclimatic stage with a continental tendency. The total population of Tinghir Province is 22,966,666, of which 168,084 or 73.19% are rural. The soils of the two sub-basins, Todgha and Dades-Mgoun, are in most cases alluvial, undeveloped, deep, silty-sandy and sandy. These soils are 75% iso humic. Special crops in the province are in particularly perfume roses, which have produced an average of 2743 tons over the past five years (HCP, 2018).

Methodology: The ethnobotanical and ethnopharmacological survey covered the period from 2015 to 2017. Using questionnaire sheets that were presented to the inhabitants and medicinal plant sellers (herbalists and druggists), the sociodemographic and professional information of the respondents was collected as well as information on plants used locally for the treatment of respiratory tract diseases. Simple random sampling was conducted in the study area (Fig. 1).

Interviews lasted about 30 minutes for each person. The questions were formulated orally in Arabic dialect and Amazigh as appropriate, and explained in simple terms that were accessible to all. Most informants responded to the questionnaire without difficulty and with enthusiasm.

Identification of inventoried plants: After the collection of samples of each plant listed by the local population (sampling or purchase), the determination of the scientific nomenclature of these plant species was carried out using documents concerning the vegetation and medicinal plants of Morocco such as, the medicinal plants of Morocco (Sijelmassi, 1993), Practical flora of Morocco (Fennane *et al.*, 1999), as well as comparing with the herbarium samples available in the laboratory of Plant, Animal Productions and Agro-industry of the Faculty of Sciences of Kenitra, Morocco.

RESULTS AND DISCUSSION

From the interviews, it was clear to us that the use of plants in traditional medicine is frequent in the population of our study area. In fact, among the 143 people interviewed, only 19.58% have used modern medicine, while 80.41% use traditional medicine.

Frequency of use of plants medicinal products according to the profile of the respondents (Table 1)

According to the analysis of the questionnaire forms, it was found that women (71.3%) and especially

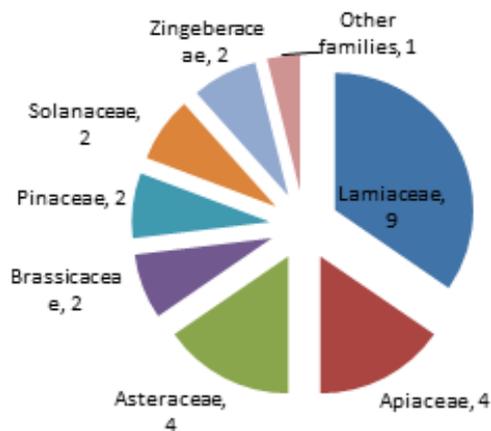


Fig. 2: Number of species by Family of medicinal plants.

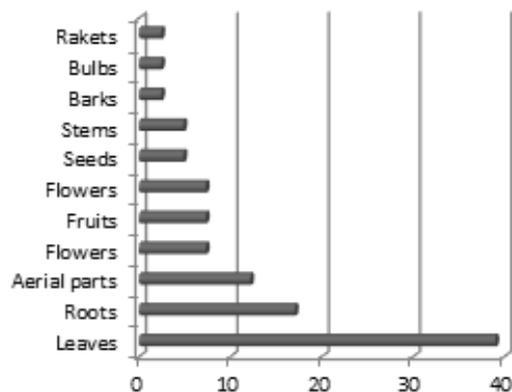


Fig. 3: Parts of used plant (%).

Variables	Catrgories	Total	Percentages (%)
Gender	Female	82	71.3
	Male	33	28.69
Age groups	16-30 years	18	15.65
	30-50 years	31	26.96
	>50 years	66	57.39
Family situation	Married	59	51.3
	Single	36	31.3
	Divorced	11	9.56
	Widower	9	7.82
Educational	Illiterate	63	54.78
	Primary	32	27.82
	Secondary	15	13.04
	University	5	4.35
Occupational categories	Employees	4	3.47
	Students	11	9.56
	Farmers	61	53.04
	Daily workers	18	15.65
	Unemployed	21	18.26

Table 1: Demographic profile of informants interviewed

older women (57.39%) have more knowledge of herbal medicine and play the most important role in the preservation of herbal therapeutic traditions. These results are consistent with other ethnobotanical studies carried out at the national level (Jouad *et al.*, 2001, Tahraoui *et al.*, 2007, Briguiche and Lahcen, 2019).

Indeed, the virtues of medicinal plants are ancestral knowledge that is transmitted from generation to generation, mainly orally. What makes them a treasure that is diminishing over time. This is due, on the one hand, to the lack of knowledge of the traditional medicinal uses of plants by the younger generation and, on the other hand, to the loss of memory and ancestral know-how among the elderly. Moreover, our results showed that the majority of users of medicinal plants are married, with a percentage of 51.3%. This can be explained by their responsibilities as parents that they must give the care for their families and especially their children.

The data from the study also showed a high use of traditional medicine by illiterate people (54.78%), compared to the interviewees with primary (27.82%), secondary (13.04%) and university (4.35%) levels. Given the high percentage of illiteracy in our study area, is mostly in the rural areas. These results confirm the findings of other ethnobotanical work carried out in Morocco (El Hilah *et al.*, 2015, Rhattas *et al.*, 2016, Chaachouay *et al.*, 2019).

The results of our surveys showed that the largest number of respondents (53.04%) have agriculture as their main activity. This situation can be explained by the fact that the High Atlas Central of Morocco is an area characterized by an altitude gradient (plain, foothills and mountains), and a generally Mediterranean climate, which allows for the layering of vegetation. In addition, these conditions favor the special crops of these provinces such as saffron and perfume roses.

Family	Scientific name	Arabic or amazigh name	Part used	Mode of preparation	Action Phyto-therapeutics	Frequency
Amaryllidaceae	<i>Allium sativum L.</i>	Touma/ Tishert	Bulbs	Cooked	Against cough and cold	41
Apiaceae	<i>Ammodaucus leucotrichus Coss. & Durieu</i>	Kamoun sofi	Leaves	Infusion	Against cough and colds	19
	<i>Carum carvi L.</i>	Lkarwya	Seeds	Decoction	Against cooling	22
	<i>Eryngium ilicifolium Lamk.</i>	Zerriga	Leaves	Powder	Against cooling and heal angina	27
	<i>Smyrniolum Olusatrum L.</i>	Lhayar	Leaves	Decoction	Stop asthma attacks	31
Apocynaceae	<i>Caralluma europaea (Guss.) N.E.Br.</i>	Caralluma	Rockets	Powder	Against cough, cold and asthma	39
Araliaceae	<i>Hedera helix L.</i>	Lwwaya	Leaves	Decoction	Against cough and cold	22
Aristolochiaceae	<i>Aristolochia baetica L.</i>	Brztam	Stems	Decoction	Against bronchial inflammation for children	16
Asteraceae	<i>Anacyclus pyrethrum (L.) Link</i>	Tiguentest	Leaves	Decoction	Against cough and cold	17
	<i>Antennaria dioica (L.) Gaertn.</i>	Ouden El-far	Leaves	Infusion	Against cough and cold	11
	<i>Artemisia herba alba Asso.</i>	Chih /izri	Leaves	Infusion	Against cooling	51
	<i>Echinops spinosus L.</i>	Tasekra	Roots	Maceration	Against cough and cold	42
Brassicaceae	<i>Brassica rapa L.</i>	Left	Roots	Syrup	Against cough and cold	51
	<i>Lepidium sativum L.</i>	Hab rchad	Seeds	Powder	Treats asthma and bronchitis	58
Capparaceae	<i>Capparis spinosa L.</i>	Lkabbar	Fruits	Cooked	Against cooling and cough	49
Caryophyllaceae	<i>Corrigiola telephiiifolia Pourret.</i>	Sarghina	Roots	Powder	Against cough and cold	16
Euphorbiaceae	<i>Mercurialis ambigua L.</i>	Harryga lmalsa	Leaves	Decoction	Against asthma	9
Fabaceae	<i>Glycyrrhiza glabra L.</i>	Aarq ssuss	Roots	Decoction	Against asthma	47
Lamiaceae	<i>Hyssopus officinalis L.</i>	Azzoufa	Leaves	Syrup	Treat cough, cold and chronic bronchitis	12
	<i>Lavandula multifida L.</i>	Wizghyoul	Flowers	Infusion	Treat cough and cold	27
	<i>Lavandula Stoechas L.</i>	Lhlhal	Leaves	Decoction	Treat cough and cold	46
	<i>Marrubium vulgare L.</i>	Marouyt	Aerial parts	Syrup	Treat cough and cold	62
	<i>Mentha pulegium L.</i>	Fliyyou	Aerial parts	Decoction	Against cooling and Cold	59
	<i>Rosmarinus officinalis L.</i>	Azir	Leaves	Syrup	Treat cough, cold and bronchitis	32
	<i>Thymus broussonetii Boiss.</i>	Azukni	Aerial parts	Decoction	Treat bronchitis	22
	<i>Thymus maroccanus Ball.</i>	Azukni	Aerial parts	Infusion	Treat cough and cold	36
	<i>Thymus satureioides Coss. & Ball.</i>	Azukni	Leaves	Decoction	Treat cough and cold	31
Moraceae	<i>Ficus carica L.</i>	Karmouss	Fruits	Maceration	Treat cooling and bronchitis	63

Family	Scientific name	Arabic or amazigh name	Part used	Mode of preparation	Action Phyto-therapeutics	Frequency
Myrtaceae	<i>Eucalyptus globulus Labill.</i>	Eucalyptus	Leaves	Syrup	Treat cough, cold and chronic bronchitis	67
Papaveraceae	<i>Papaver rhoeas L.</i>	Belnaaman	Flowers	Infusion	Treat cough and cold	43
Pinaceae	<i>Cedrus Atlantica Marnetti ex (Endl.)</i>	Arz	Barks	Syrup	Treat could, cough and bronchitis	18
	<i>Pinus halepensis Mill.</i>	Snaoibar-Tayda	Leaves	Infusion	Treat cough and cold	12
Plantaginaceae	<i>Plantago major L.</i>	Lmassas	Aerial parts	Decoction	Against asthma and bronchitis	9
Polygalaceae	<i>Polygala rupestris Pourret</i>	Laachba dlhlib	Roots	Decoction	Against asthma	15
Rosaceae	<i>Crataegus monogyna Jacquin</i>	Azzairour	Flower	Decoction	Treat cough and cold	8
Citraceae	<i>Citrus limon (L.) Burm.f.</i>	Lhamed	Fruits	Juice	Against angina	43
Solanaceae	<i>Solanum Dulcamara L.</i>	Ainab dib	Stems	Decoction	Against chronic bronchitis	33
	<i>Withania frutescens (L.) Pauquy</i>	Tirnet	Leaves	Decoction	Against asthma	15
Verbenaceae	<i>Aloysia triphylla (L'Herit.) Britton</i>	Louiza	Leaves	Infusion	Treat cough and cold	55
Zingiberaceae	<i>Curcuma longa L.</i>	Kherqum	Roots	Powder	Against cooling	41
	<i>Zingiber officinale Roscoe</i>	Zanjabil	Roots	Decoction	Against cooling and angina	61

Table 2: List of medicinal plants used in the treatment of respiratory diseases in the High Atlas Central of Morocco.

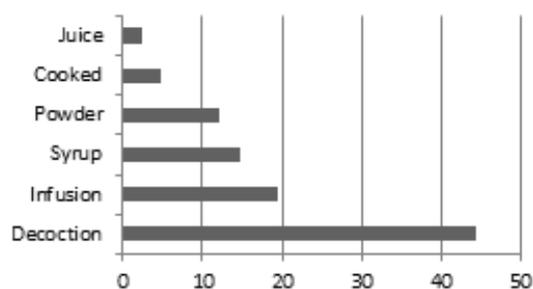


Fig. 4: Percentage of the methods of preparation.

Floristic analysis: This work has shown a great diversity of species used in the treatment of respiratory diseases; indeed the 41 species identified are divided into 38 genera and 24 families. Among the latter, the most represented families in our study area are: Lamiaceae, with 9 species (21.95%), Asteraceae and Apiaceae with four species for each one (9.75%) (Fig. 3).

The results of the study are presented in Table 2; the plants are arranged in alphabetical synopsis. For each species, the following information is provided: plant family, scientific name, local name, part used, method of preparation, phytotherapeutic action and frequency of use of these species.

Analysis of questionnaire sheets reveals that leaves are the most commonly used parts for the treatment of respiratory diseases (Fig. 3). The frequent uses of

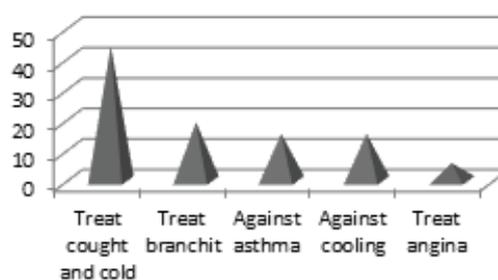


Fig. 5: Importance of species by cause of-treatment(%).

leaves are justified by the abundance of chemical groups they contain. They are the site of synthesis of secondary metabolites. These results are in line with the work of (Slimani *et al.*, 2016, Ghourri *et al.*, 2012).

The recipes used in the treatment of respiratory diseases are made in seven preparation methods, whose citation frequencies differ significantly. Consequently, decoction is the most used method of preparation with 41.46% followed by infusion which represents 19.5% (Fig. 4). The dominance of the decoction is explained by the fact that this mode of preparation collects the most active ingredients and reduces or cancels the toxic effect of some recipes (Salhi *et al.*, 2010). Our results are in agreement with those of a number of authors (El Houssine Bouiamrine and Laila, 2017, Bouayyadi *et al.*, 2015, Hassani *et al.*, 2013). of these plants are of considerable local importance. It is clear that *Eucalyptus globulus* Labill, *Marrubium vulgare*

L. and *Ficus carica* L. are much more indicated for the treatment of respiratory diseases. Fig. 4 shows the most used plants according to the number of citations. These plants should be selected for phytochemical, toxicological and pharmacological studies.

Relative importance of species by cause of treatment of respiratory diseases: A total of five causes of respiratory infections were identified according to the respondents' perceptions (Fig. 5). From one cause to another, the number of citations of the species varies. As a result, the number of herbal medicines used for the rate and the common cold where bronchitis is relatively higher than all the species used for colds, asthma and angina. The proportions of each of the conditions are as follows: rate and cold (44.23%), bronchitis (19.23%), cooling (15.38%), asthma (15.38%) and angina (5.77%).

Many plants cited by our interviewees from the High Atlas Central of Morocco for the treatment of one or other of the causes of respiratory diseases also recognized by their uses in other regions of Morocco, such as the Doukkala region (Briguiche and Zidane, 2019), and in the Moroccan Central Plateau (El Hilah *et al.*, 2015). This is the case for *Allium sativum* L, *Artemisia herba Alba* Asso, *Marrubium vulgare* L., and *Zingiber officinale* Roscoe. This confirms that there is a perpetual exchange of information on the use of medicinal plants among the populations of Morocco.

CONCLUSION

The present work has made it possible to make a first evaluation of the diversity of medicinal plants used against respiratory diseases in the Central High Atlas of Morocco. The data of the study having confirmed the strong use of traditional medicine by the Moroccan population in the treatment of several diseases. This study keeps a transcribed trace of phytotherapy practices, whose transmission is based on oral tradition, which will help to safeguard the knowledge of local populations which tends to disappear. Phytochemical screening in the laboratory is necessary to know the chemical compounds contained in the main plants used locally and their degree of toxicity.

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