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Medicinal Plants Inventory and Ethnobotanical Study in the Region of Ath Voughardane (Tizi-Ouzou, Algeria)

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Abstract
The study focuses on an inventory of medicinal plants with an ethnobotanical survey carried out in the Ath Voughardane (Assi-Youcef) municipality in the Tizi-Ouzou department. Important information on medicinal plants has been provided and all information concerning the therapeutic uses practiced by the local population is gathered using 439 questionnaires distributed to 77 people in the region. Most people who have knowledge of herbal medicine are aged 50 and over and the majorities are women. We managed to inventory 120 species, belonging to 49 families, including the Asteraceae ranked first with 15 species. The analysis of the results showed that most of the plants listed are used for healing, using in the majority of cases the leaves which constitute the most used organ of the plant, prepared mainly by decoction and administered orally.

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INTRODUCTION

Man has always sought to use plants to ensure his survival and to extract remedies from them to cure his illnesses. He learned to discern the properties of plants, their virtues and their toxicity. From generation to generation, the ancestors transmitted their knowledge and their simple experiences orally and by striving when they could to record them in writing. Thus, even today, despite the progress of pharmacology, medicinal plants still remain a source of medical care in developing countries in the absence of a modern medicinal system (Tabuti et *al*., 2003). The World Health Organization (WHO) estimates that traditional medicine covers the primary health care needs of 80% of the population of developing countries (Bousta et *al*., 2011). Today, many works carried out in the field of ethnopharmacology show that the plants used in traditional medicine and which have been tested are often effective plants in the various pharmacological models and are almost devoid of toxicity (Bruneton, 1999; Bouzid and

al., 2017). In North Africa and in particular in Algeria, phytotherapy has always been used in the traditional medicine sector (Sayah et *al*., 2017). Algeria is recognized for its diversity in medicinal and aromatic plants, most of which exist in a spontaneous state, as well as for their popular use in all the territories of the country. However, the Algerian flora with its 3000 species belonging to several botanical families, 15% of which are endemic, remains very little exploited on the phytochemical and pharmacological levels (Quezel and Santa, 1963). In Kabylie, relative traditional knowledge and its properties are still quite widespread. Some species are recognized by the population as medically useful or, on the contrary, as toxic (Ait Youssef, 2006). The ethnobotanical investigation aims in particular at the way in which plants are used, managed and perceived in human societies, whether plants used for food, medicine, divination, cosmetics or dyeing (Choudhary et *al*., 2008). Our work is a survey carried out in the town of Ath Voughardane, which aims to enhance the knowledge of medicinal plants and to collect as much information as possible concerning the therapeutic uses practiced by the population; this information can be used for science, facilitating the task of researchers in the field of medicine, especially the fact that no study of this kind has been done before in the region.

MATERIAL AND METHODS

Presentation of the study area

The municipality of Ath Voughardane, is a locality of Tizi-Ouzou department, at the foot of the mountain of Djurdjura, located about 50 km south-west of Tizi-Ouzou town. It covers an area of 26.28 km2, at an average altitude of 750m and whose geographical coordinates are 36° 30' 26" Latitude North and 4°1'7" Longitude East. This region is characterized by a Mediterranean climate of the humid and cold type in winter, and dry and hot in summer. The winds are generally West-East and North. The sirocco in summer lasts an average of 2 to 3 days/year while in winter icy winds blow quite strongly for 3 to 5 days/year. The average rainfall exceeds 900mm/year but with a high concentration in the winter period.

Methodology

This study is a contribution to the knowledge of medicinal plants used in traditional herbal medicine by the local population of the municipality of Ath Voughardane. For this, an ethnobotanical field survey was conducted using 439 questionnaire sheets, which were completed in different villages in the study region by a total of 77 respondents (47 women and 30 men), aged between 20 and 80. Medicinal plant samples are taken and the different species are harvested in the different places indicated in the study region and identified.

RESULTS

The collection of medicinal plants used for therapeutic purposes in the study area allowed us to identify 120 species belonging to 105 genera and 49 plant families, the most important of which are the Asteraceae family with 14 species followed by the Lamiaceae of the Apiaceae and Fabaceae with 12, 09 and 05 species respectively. The other families are only represented by one to two species at most (Table 1).

Table 1: Different Species collected in the study area

No.	Families	Species	No.	Families	Species
01	Amaranthaceae	*Spinacia oleracea*	22	Gentianaceae	*Centaurium erythraea*
02	Amaryllidaceae	*Allium cepa*	23	Juglandaceae	*Janglans regia*
		Allium porrum	24	Lamiaceae	*Melissa officinalis*
		Alllium sativum			*Salvia officinalis*
		Nacissus tazetta			*Lavandula stoechas*
		Allium triquetrum			*Rosmarinus officinalis*
03	Anacardiaceae	*Pistacia lentiscus*			*Ajuga iva*

04	Apiaceae	*Thapsia garganica*			*Mentha pulegium*
		Foeniculum vulgare			*Phlomis fruticosa*
		Cuminum cyminum			*Ocimum basilicum*
		Pimpinella anisum			*Marrubium vulgare*
		Apium graveolens			*Mentha spicata*
		Coriandrum sativum			*Salvia verbenaca*
		Petroselium crispum			*Mentha suaveolens*
		Ferula communis			*Thymus vulgaris*
05	Apocynaceae	*Nerium oleander*			*Origanum vulgare*
06	Araceae	*Arum italicum*	25	Lauraceae	*Laurus nobilis*
		Arisarum vulgare	26	Linaceae	*Linum usitatissimum*
07	Asparagaceae	*Asparagus officinalis*	27	Lythraceae	*Lawsonia inermis*
08	Apocynaceae	*Nerium oleander*			*Punica granatum*
09	Aspleniaceae	*Paragymnopteris marantae*	28	Malvaceae	*Malva sylvestris*
10	Asteraceae	*Dittrichia viscosa*	29	Moraceae	*Ficus carica*
		Carthamus caerulerus			*Morus alba*
		Pulicaria odorzn	30	Myrtaceae	*Syzygium aromaticum*
		Anthemis nobilis			*Eucalyptus globulus*
		Artemisia absinthium	31	Nitrariaceae	*Peganum harmala*
		Artemisia herba alba	32	Oleaceae	*Olea europaea subs.europaea va. sylvestris*
		Echinops spinosissmus			*Fraxinus angustifolia*
		Andryala integrifolia			*Olea europaea*
		Cynara cardunculus			*Jaminum polyanthus*
		scolymushispanicus	33	Oxalidaceae	*Oxalis pes-caprae*
		Sonchus oleraceus	34	Papaveraceae	*Papaver rhoeas*
		Taraxacum officinale	35	Pinaceae	*Pinus halepensis*
		Coleostephus myconys			*Cedrus atlantica*
		Reichardia picoidies	36	Plantaginaceae	*Globularia alypuma*
		Atractylis gummifera	37	Poaceae	*Arundo donax*
11	Boraginaceae	*Borrago officinalis*	38	Polypodiaceae	*Pteridium aquilinum*
		Echium vulgare	39	Renonculaceae	*Nigella sativa*
		Nasturtium officinale			*Clematis cirrhosa*
		Brassica rapa			*Ficaria verna*
12	Cactaceae	*Opuntia ficus-indica*	40	Rhamnaceae	*Ziziphus lotus*
13	Caryophylaceae	*Paronychia argentea*			*Rhamnus alaternus*
		Silene vulgaris	41	Rosaseae	*Sanguisorba minor*
		Stellaria media			*Robus ulmifolius*
		Portulaca oleracea			*Rosa*
14	Cistaceae	*Helianthemim nummularium*			*Citrus limon*
		Cistis monspeliensis			*Citrus sinensis*
15	Combretaceae	*Tarminalia bentzoe*	42	Scrofulariaceae	*Verbascum sinuatum*
16	Crassulaceae	*Helichrysum italicum*	43	Solaniaceae	*Solanum tuberosum*
17	Cucurbetaceae	*Ecballium elaterium*			*Hyoscymus albus*
		Cucumis sativum	44	Thymelaeaceae	*Daphne gnidium*
		Cucurbita maxima	45	Ulmaceae	*Ulmus minor*
18	Dioscoreaceae	*Dioscorea communis*	46	Urticaceae	*Urtica dioica*
19	Equisetaceae	*Equisetum arvense*	47	Verbenaceae	*Aloysia citriodora*
20	Ericaceae	*Erica arborea*	48	Xanthorrhoeaceae	*Asphodelus ramosus*
21	Fabaceae	*Viratonia siliqua*			*Aloe vera*

		Castanea sativa	49	Zingebaraceae	*Zingiber officinale*
		Trifolium			*Curcuma longa*
		Trigonella foenum- graecum			
		Lotus edulis			

Habitat

The medicinal plants identified by the surveyed population grow in different ecological environments that meet their needs for better development. The results presented, show that the majority of the species used grow in maquis, with a rate of 39%, which makes it the most widespread environment in the study region, followed by fields with 18% (Fig. 1). Then come rubble paths, rocks, forest, lawn-pasture and wet places with the frequency of 13%; 10%; 8%; 7% and 4% respectively.

Biological type

All plants do not have the same lifespan, nature is so made, the results of the biological type data of the 120 collected plants (Fig. 2). We see that out of a total of 120 plants used, 69% are classified as perennials and 30% are classified as Annual plants.

Origin

There are several categories of plant species, there are those that occur in the wild in their preferred environments and climates, but also others that can nevertheless be cultivated or even imported (exotic), the results of data of the origins (Fig. 3). Data shows that among the 120 species listed, 58% of them are of spontaneous origin, 35% cultivated and 7% for imported or exotic species.

Harvest period

Climate is quite important in the sense that a plant grows best in its natural climate; the more medicinal plants grow in conditions close to what is natural to them, the better they develop the active ingredients. From figure 04, we notice that in the region of the best period of plant harvesting it is spring, which represents a season of development and flowering of the majority of plants; followed by the summer period. However, winter and autumn remain unfavorable seasons for the harvest of medicinal plants with a rate of 11% and 29% respectively.

Toxicity

Some plants have managed to synthesize secondary metabolites that allow them to defend themselves against animals, making them bitter or toxic when eaten (Fig. 5). This figure shows that the largest number of plants mentioned, 87%, do not present any danger or risk to human health. Despite the various dangers they present, toxic plants associated with know-how, are also used in traditional medicine but with a small percentage, that is 13%.

Characteristics of the population surveyed

The use of medicinal plants in therapy differs according to several parameters (sex and age)

Use of medicinal plants by gender

The results of the data on the use of medicinal plants by gender are about 61% of women and 39% of men (Fig. 6). Out of 77 informants, 47 are women and 30 men. Regarding the use of medicinal plants, the results obtained show that herbal medicine in the commune of Ath Voughardane is more frequent among women than among men.

Use of medicinal plants according to age

Therapeutic knowledge differs from one generation to another. From Figure 07, we notice that the use of medicinal plants in our study area is more widespread among the elderly than among the young. The age group with the highest percentage, (43%) is that of 60 years and over. This show that the old villagers have more confidence in the knowledge transmitted by their great-grandparents, and that traditional medicine is more effective and harmless compared to modern medicine. Use of identified plant species

Most used part of the plant

The results of the most used parts of the plant presented in the figure 08 shows that the aerial part is the most used part with a rate of 84%. This high frequency is due to the ease and speed of the harvest. While the underground part is

little used (11%), however the whole plant is rarely used (5%).

State of use of the listed plants

Data on the state of use of medicinal plants in traditional herbal medicine (Fig. 9), show that the majority of medicinal plants are used fresh with a rate of 51%, this proves that the villagers only harvest medicinal plants when needed. While 35% is used in the dry state, because there are annual plants used by the population throughout the year such as *Ocimum basilicum*.

Most used vegetative organ

The results of the study carried out on the most used organs of the plant in therapeutic preparations are the leaves with a rate of 49% since the latter represent the seat of photosynthesis (Fig. 10). Then fruit with 14%, seeds, stem, flowers, root with 8%, 6%, 4% and 3% respectively. Concerning the other organs such as the bulb, the bark and the rhizome are rarely used with very low percentages.

Pharmaceutical operations carried out

There are several modes for the preparation of traditional herbal remedies; the results of the data of the pharmaceutical operations show that the decoction represents the most used method of preparation with a rate of 41% (Fig. 11). This explains why users often seek the simplest and fastest method to prepare remedies, then infusion (27%), followed by juice, powder, maceration and plants used without preparation with 9%, 7%, 3%, 13% respectively.

Association with other substances

Several substances are added during the preparation of traditional remedies. We see from Figure 12 that water is the most indicated substance with a rate of 64%. This can be explained on the one hand by its high dissolving power and the ease of its ingestion, and on the other hand, by the high number of pharmaceutical operations that require the use of water whatever for infusion, decoction, etc. Then the plants used without additives, i.e. 17%, then the olive oil (11%), this amounts to the use of the latter in Kabylie almost in all remedies, as there is honey which is used with a rate of 5% thanks to its benefits on human health, for milk and vinegar are rarely used in certain remedies only.

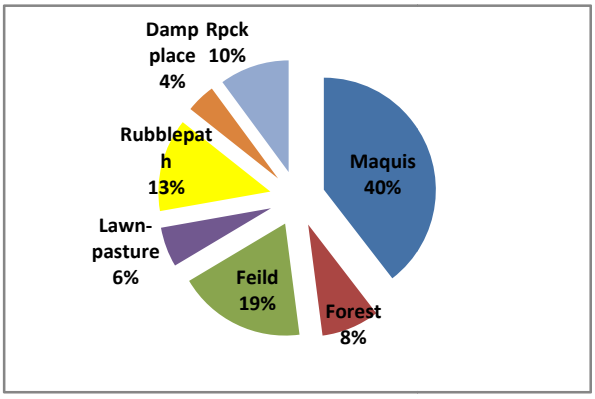


Figure 1: Species according to habitat.

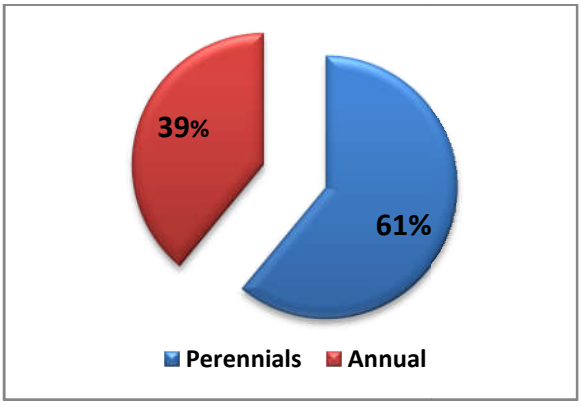


Figure 2: Species according to biological type

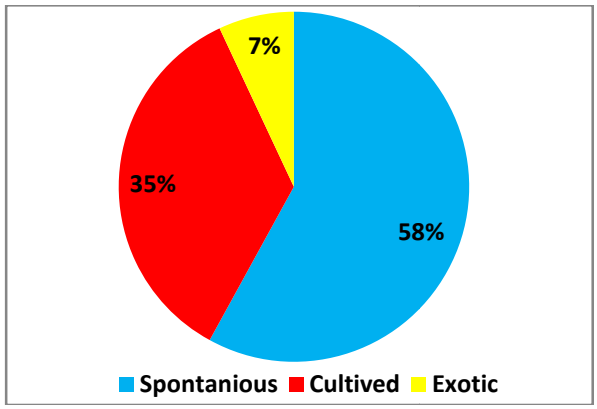


Figure 3: Species according to origin.

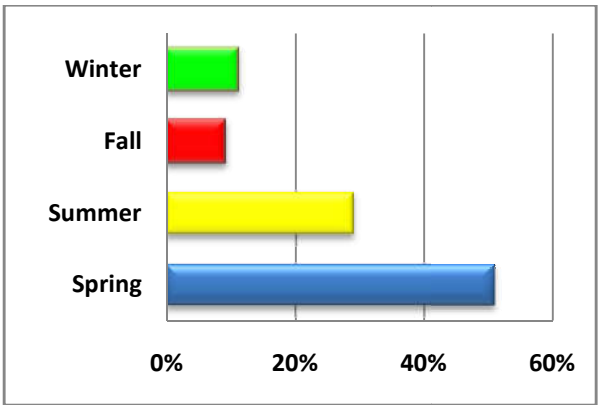


Figure 4: Species according to the harvest period.

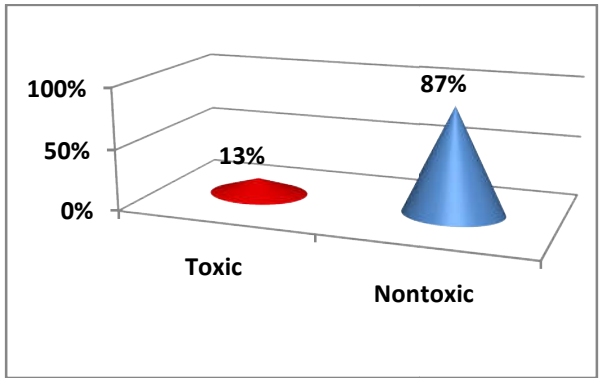


Figure 5: Species according to toxicity

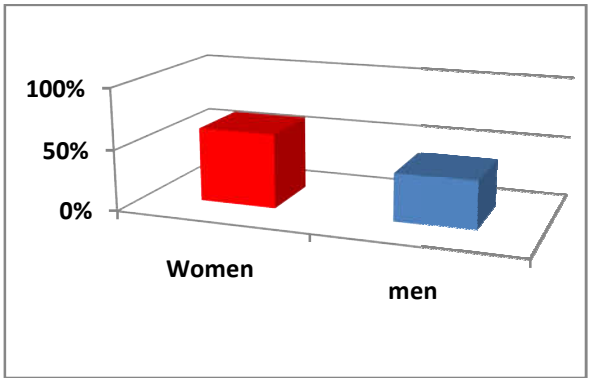


Figure 6: Use of medicinal plants by gender

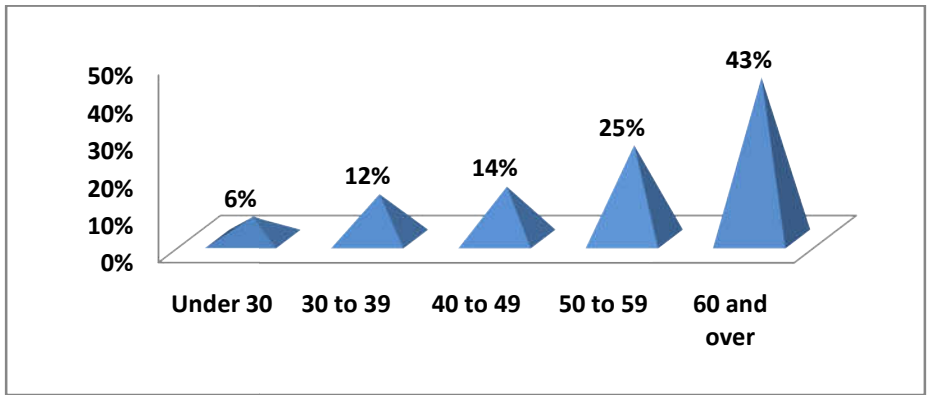
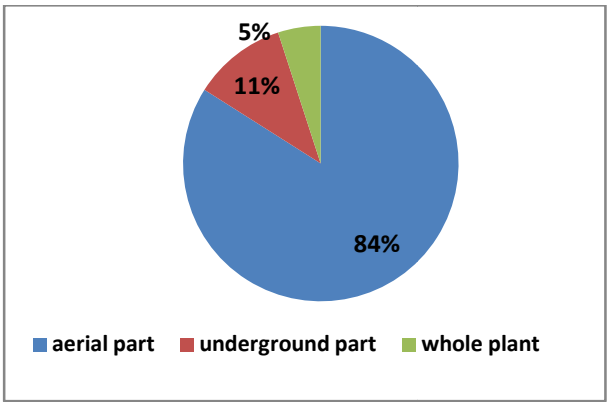


Figure 7: Use of medicinal plants according to age.



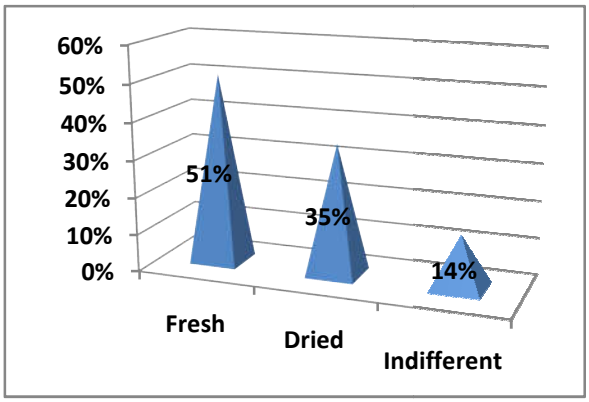


Figure 8: Most used part of the plant

Figure 9: State of use of the species identified.

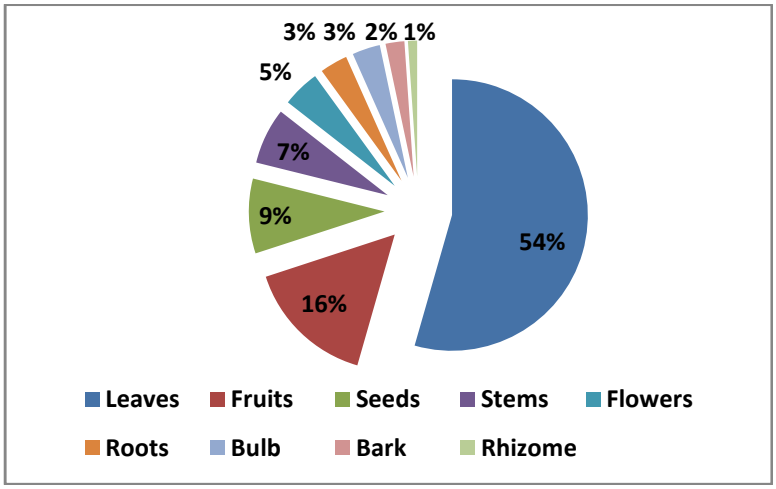
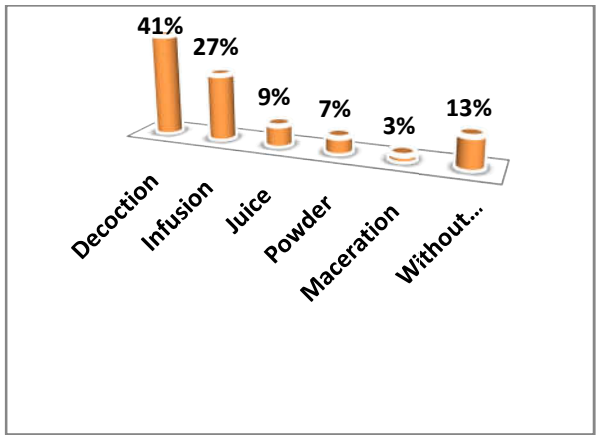


Figure 10: The different most used organs of the plant.



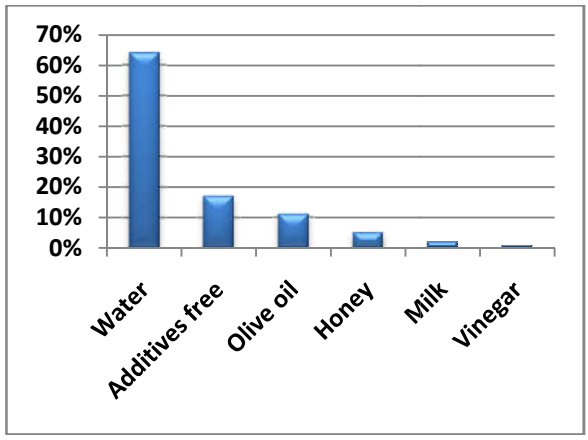


Figure 11: Pharmaceutical operations performed.

Figure 12: Associated substances.

DISCUSSION

The inventory and ethnobotanical study in the region of Ath Voughardane (Assi Youcef) allowed us to identify 120 species belonging to 49 plant families, the most important of which are the Asteraceae family with 14 species (11.66%) followed by Lamiaceae of Apiaceae and Fabaceae with 12 (10%), 09 (7.5%) and 05 (4.15%) species respectively. The other families are only represented by one to two species at most. During our sampling, 69% of the species inventoried are perennials. According to Zebo et *al*. (2011), a predominant use of perennial species is noted among users of medicinal plants. The perennial nature of the plants allows the populations to have the different parts of them throughout the year in each season for care. Of the 120 plants inventoried, 51% are spontaneous, our results are similar to those obtained elsewhere by various authors, Lazli et *al*. (2019) in the Bougous region (Algeria), El Alami et *al*. (2016) in the northern slope of the Atlas of Azilal (Morocco), which showed that most species are of spontaneous origin. Among medicinal plants harvested 51% in spring and 29% in summer; our results are similar to those obtained by Bentabet et *al*. (2022) in the Ain Timouchent city who found that the majority of species grow in spring and summer. From the point of view of toxicity, only 13% of the harvested species can express toxicity when they are misused. Our results corroborate those of Chaachouay et *al*. (2020) in the Rif (northern Morocco), who showed that only a few species can be toxic, but remain a remedy for certain diseases provided the necessary dose is not exceeded. According to Charbier (2010), it is also possible to have a specific therapeutic action on each of the organs of the body in a precise and targeted way for each plant used. It is important to specify that to know a plant it is also to be aware of its limits and its dangers because in no case phytotherapy is not a trivial technique. Its therapeutic use requires a good knowledge of materia medica. For the know-how of medicinal plants, women represent 61% of the population questioned. Our results corroborate those obtained by Béné et *al*. (2016) who showed that 66.67% of women are more interested in this medical art. Our results are comparable to those obtained by Mahdioui and Kahouadji (2007) in the province of Essaouira, El Hafian et *al*. (2014) at the level of the prefecture of Agadir-Ida-Outanane (Morocco), El Yahiaoui et *al.* (2015) in the province of Laayoune, which show that women hold more traditional phytotherapy knowledge than men. Regarding age, the survey shows that people aged 60 and over are the ones who use medicinal plants the most, these values confirm the results obtained in other studies on the use of medicinal plants. El Yahiaoui et *al*. (2015) in the province of Laayoune, Lazli et *al*. (2019) in the Bougous region, El Hilah et *al.* (2016), in the Moroccan central plateau, which effectively show that the elderly know traditional herbal medicine better than other age groups. During our study we noted various parts are taken from the plant, the aerial part of the plant is the most used, in particular the leaves. Our results are close to those of Zebo et *al*. (2011) in the Burkina Faso region. For these authors the leaves are mostly used (31%); then come the bark of the trunk (25%), the root (23%) and the fruits (10%). The results of the study carried out by Béné et *al.* (2016) show that the leaves are the most used organ with 63.48%. For our part 54% are the leaves that are used compared to other organs of the plant. Also, Bouzabata (2015) observed that the used part of the *Myrtus communis* plant is presented mainly by the leaves with a percentage of 75.68%. However, other parts have been indicated: the stems (16.05%), the fruits (6.88%) and more rarely the flowers (1.38%). Regarding the method of use, our survey has shown that 40% of cases concern the decoction. Our results are similar to those obtained by Béné et *al*. (2016) for which the most used pharmaceutical form is the decoction with 36%. Our results are close to those of Charbier (2010); Dibong et *al.* (2011) because the oral route in aqueous form is the most dominant (94.44%). The organs consumed in the fresh state are much more effective since their conservation leads to the alteration of the active ingredients. Similar studies have been made and the dominance of leaves is confirmed by the work of Ould El Hadj et *al.* (2003) in the region of Ouargla, who recorded a rate of 31.37%, Kemassi et *al.* (2014) in the M'Zab region, show that the leaves are the most used part with a rate of 22%. Diatta et *al*. (2013) in the

Ziguinchor region of Senegal find a rate of 46%. Our results compared to other ethnobotanical studies done, citing the results of Lazli et *al.* (2019) in the Bougous region show that decoction is the most common mode of preparation. The same result obtained by Idm'hand et *al*. (2019) in the province of Tarfaya (Morocco).

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