

Ethnobotanical survey of five wild medicinal plants used by local population in Taza province (Northeastern Morocco)



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Abstract Since ancient times, Moroccan people have used medicinal and aromatic plants as traditional medicine to treat various ailments. However, few studies have been made to document and promote traditional knowledge. The present study aims to collect information about folk knowledge on the medicinal use of five plants, namely *Globularia alypum*, *Inula viscosa*, *Chenopodium ambrosioides*, *Ajuga iva*, and *Urtica dioica* in Taza province (northeastern Morocco). We used semi-structured and unstructured interviews with herbalists, traditional healers, and the local population in Taza province. Indeed, 240 questionnaires were collected to gather information about each plant (parts used, methods of preparation and administration, treatable diseases, etc.). The collected data were analyzed using quantitative indices such as the use value (UV), fidelity level (FL), and informant agreement ratio factor (IAR). Most of the interviewees were 60 years old (58.33%), and 70% of them were women. Nearly 60% of the interviewees were illiterate, and heritage related to traditional medicine, was the main source of knowledge (50%). Ten indications were reported for the studied species in traditional medicine where dermatological and gastrointestinal disorders had the highest use reports, and two species had the highest FL (100%). The highest UV was found for *C. ambrosioides* (0.44) and *A. iva* (0.31). The main preparation forms were infusion (40%) and decoction (22%). The most frequently used plant parts were leaves (55.83%). The wide traditional uses of the studied species are largely supported. Future experimental research should be focused on their pharmacological properties and mechanisms of action.

Keywords: ethnobotany, ethnopharmacological study, medicinal plants, phytotherapy, traditional know-how, Taza

1. Introduction

Medicinal plants have been the primary therapeutic tool available to humans for long a time and across various civilizations. Herbal medicine has evolved and expanded through empirical practices (Mishra et al., 2018). Even today, despite advancements in modern medicine, the therapeutic use of medicinal plants remains common in many countries worldwide, particularly in developing nations (Sharifi-Rad et al., 2018).

Morocco, a North African country, boasts a rich ethno-medicinal heritage, with knowledge accumulated over time, and still prevalent in different regions (Salhi et al., 2010). Its biogeographical location offers significant ecological and floristic diversity, creating a substantial plant genetic reserve with approximately 4,500 species spanning 940 genera and 135 families (Salhi et al., 2010). Additionally, the Rif and Atlas Mountain ranges hold a special position within Mediterranean countries, possessing a long medical tradition and traditional knowledge based on medicinal plants (Scherrer et al., 2005).

Herbal medicine practices and the application of medicinal plants vary across cultures, geographical locations, socioeconomic regions, and even between neighboring villages. In much of Africa, traditional knowledge of plant-based healing is passed down orally from generation to generation and is rarely documented (Adia et al., 2014; Nyamukuru et al., 2017). Unfortunately, much of this traditional knowledge has been lost due to deforestation and rural-urban migration (Bussmann et al., 2018).

Ethnobotany and ethnopharmacology are interdisciplinary fields that focus on the empirical knowledge of indigenous peoples concerning medicinal substances, their potential health benefits, and associated risks (Castillo-España et al., 2009). The present ethnopharmacological investigation involves a field survey to gather information about the medicinal culture and traditional knowledge of the local population regarding the five most commonly used medicinal plants in the Taza province of northeastern Morocco: *Chenopodium ambrosioides* L., *Ajuga iva* (L.) Schreb, *Urtica dioica* L., *Inula viscosa* (L.) Aiton, and *Globularia alypum* L. The Taza region is characterized by rich floral diversity, primarily due to its mountainous terrain. This research represents the first survey in the study area, aiming to document local knowledge about these plants for future



conservation strategies and to enhance the traditional healing systems and herbal-based medicine. Additionally, details on traditional recipes for each remedy, including the plant parts used, methods of preparation and administration, types of treatable diseases, and dosage, are provided.

2. Materials and Methods

2.1. Study Area

The present study was conducted in the Taza province, located in the north-eastern part of Morocco (34°12' N, -4°00' W). It belongs to the Fez-Meknes region and extends over an area of 7,098.5 km² (Figure 1). It is delimited by the following five provinces: AL Hoceima and Driouch to the north, Taounate to the west, Guercif to the east, and Sefrou to the south. Taza forms the contact area between the external foredeep basin of the Rif front and the northern part of the Middle Atlas (Krijgsman & Langereis, 2000). The climate is semi-arid Mediterranean with a mean annual precipitation of around 595 mm, which is marked by a very noteworthy interannual fluctuation and recurrent drought periods (Belmahi et al., 2023).

From a demographic point of view, the total population of the province is about 526,986 (74 inhabitants per km²) with 320,435 in rural area and an illiteracy rate of 41.5% (for people over 10 years) (HCP, 2024). Agriculture represents the most important sector of activity in Taza, with a total area of around 643,640 ha (DGCL, 2015; Belmahi et al., 2023). In the Fez-Meknes region, Taza province occupies the first place in the livestock production (DGCL, 2015). Geomorphologically, Taza province is predominated by mountainous relief, where altitudes are from 184 to 3010 m (Belmahi et al., 2023).

The importance of the study area comes from the presence of one of the oldest Moroccan protected areas; the Tazekka National Park located in the southwest of Taza province and established in 1950 over an initial area of 680 ha, then extended to 13,737 ha in 2004. The floristic diversity of Tazekka massif was reported to reach 727 taxa belonging to 78 families and 348 genera, with 11.4 % (24 taxa) are rare, 49.3 % (41 taxa) are very rare, and 3 taxa are vulnerable (Fougrach, 2007). This flora encompassed 64 strict Moroccan endemic species, 26 of which are rare or threatened (Fougrach, 2007). The Tazekka National Park was created to conserve Atlas cedar forest *Cedrus atlantica* (Endl.) Manetti ex Carrière, which is present with five other major tree species in Morocco: zen oak (*Quercus faginea* Lam.), cork oak (*Q. suber* L.), *Q. rotundifolia* Lam. (holm oak), *Quercus coccifera* L. (Kermes oak), and *Tetraclinis articulata* (Vahl) Masters (Berber thuja) (Fougrach, 2007). The Park's fauna is also rich and diversified with not less than 16 mammalian species (mainly the Barbary macaques *Macaca sylvanus* L. and the Barbary deer *Cervus elaphus barbarus* L. reinstated in the park in 1994) and 86 avifauna with several vulnerable and endangered species (Chellik et al., 2024).



Figure 1 Localization of the study area.

2.2. Collection of Ethnopharmacological Data

Our survey was conducted from February to August 2020, targeting herbalists, traditional healers, and the local population. We utilized semi-structured questionnaires and free listings during face-to-face interviews, adhering to the standard methodology outlined by Martin (2004) and using the Moroccan dialect (*Darija*).

The selection of study plants was primarily based on information provided by herbalists and traditional health practitioners in the Taza region during our initial meeting. They confirmed the widespread use of five medicinal plants (*C. ambrosioides*, *A. iva*, *U. dioica*, *I. viscosa*, and *G. alypum*) by the local people for treating various diseases.

Our questionnaire comprised two sections: The first part gathered demographic information about the informants, while the second part collected detailed information about the five study species used for disease treatment (e.g., parts used and methods of preparation).

A total of 240 informants, including herbalists, practitioners, and therapists knowledgeable about these plant species and qualified as healthcare professionals, were randomly selected for interviews. The informants ranged in age from 20 to 80 years old and included 72 males and 168 females from various socioeconomic levels within the Taza province.

Prior to the fieldwork, we evaluated the survey and questionnaire methodological standards in accordance with the recommendations of (Heinrich et al., 2009; Weckerle et al., 2018). Additionally, before collecting ethnobotanical data, we provided a brief explanation to the informants about the objectives of the study and the importance of the information they would provide, ensuring their consent to participate in the study.

2.3. Collection of Plant Material and Identification of Specimens

The standard method was used for collecting plant materials, which included: drying, mounting, preparing, and preserving plant specimens (Jain 1964). The identification of collected plants and their scientific name assignment was adjusted using standard floras available on this Moroccan area, including: The Medicinal Plants of Morocco (Sijelmassi, 1993) and the Practical Flora of Morocco (Fennane et al., 1999). Scientific names were cross-checked using the website: <http://www.theplantlist.org>. Voucher specimens of all species collected were deposited at the Herbarium of Laboratory of Biology, Ecology and Health, Department of Biology, Faculty of Sciences of Tetouan, Abdelmalek Essaadi University.

2.4. Data Analysis

In order to analyze the socio-demographic data of the informants, a descriptive and quantitative statistical method was applied. Furthermore, the collected data of the plant survey were analyzed using quantitative indices such as the Use Value (UV), Informant Agreement Ratio (IAR), and Fidelity Level (FL). All statistical analyses were performed using Statistical Package for Social Science (SPSS) version 26.0.

2.5. Use Value (UV)

It reflects the relative importance of each plant species known locally to be used as herbal remedy, and it was calculated using the following formula (Vijayakumar et al., 2015): $UV = \sum u / n$. Where UV is the use value of a species; u is the number of quotations per species, and n is the total number of informants. The UV is helpful in determining the plants with the highest use in the treatment of an ailment. The UV is high when there are many use-reports for a plant while it is low when there are few reports related to its use.

2.6. Informant Agreement Ratio (IAR)

It was used to assess whether there is agreement among the plant users on the use of the studied plants against the disorders in the study area; it was calculated using the following formula (Heinrich et al., 1998): $IAR = (Nur - Nt) / (Nur - 1)$

Where IAR is the Informant Agreement Ratio, Nur refers to the number of use-reports for a particular ailment category, and Nt designates the number of taxa used for a particular ailment category by all informants. The product of this factor ranges from 0 to 1. A high value (close to 1) indicates that relative few taxa are used by a large proportion of the informants, while a low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness.

2.7. Fidelity Level (FL)

It was calculated to determine the most frequently used plant species for treating a particular ailment category by the informants in the study area; using the following formula (Kadir et al., 2015): $FL (\%) = Np / N - 100$. Where Np is the number of use-reports of a given species for a particular ailment category, and N is the total number of use-reports cited for any given species.

Generally, high FLs are obtained for plants for which almost all use-reports refer to the same way of using it, whereas low FLs are obtained for plants that are used for many different purposes (Srithi et al., 2009).

3. Results and Discussion

3.1. Socio-demographic Features of the Informants

The present paper focuses primarily on the therapeutic uses of five studied plants, specifically detailing remedies for various diseases in one of Morocco's least studied regions, Taza province. Our ethnobotanical study initially explored the socio-cultural background and medicinal knowledge related to diseases treated by traditional healers in this area. We conducted interviews with 240 informants, including traditional healers, herbalists, and knowledgeable villagers. Among them, 72 were men (30%) and 168 were women (70%) (see Table 1). These findings indicate that women possess greater knowledge of traditional medicine and are more actively involved in the use of medicinal plants compared to men. This heightened involvement among women may stem from their caregiving responsibilities during illness and their strong adherence to traditional practices. This accounts for their extensive knowledge compared to men, who primarily gather plants. These results align with previous ethnobotanical studies conducted nationally (Benkhiguel et al., 2010; El Hafian et al., 2014; Benlamdini et al., 2014; Eddouks et al., 2017; Jahjah et al., 2024) and internationally (Pratami et al., 2024).

Concerning age demographics, findings from this survey reveal that nearly all families in the study area utilize plants for daily care, predominantly among the eldest age group (over 60 years old), constituting 58.33% of usage compared to other age groups, particularly younger generations who are less inclined towards herbal remedies (see Table 1). These results underscore the significant role of elders in ethnopharmacological research, given their extensive knowledge of the properties and traditional uses of medicinal plants, accumulated through years of experience and ancestral herbal therapy practices. Similar observations have been documented in prior studies (Aribi, 2013; Benlamdini et al., 2014; Eddouks et al., 2017). This highlights the impact of modernization and lifestyle changes, particularly through education, which contribute to the gradual erosion of traditional knowledge. Consequently, there is a risk of interrupted transmission of valuable knowledge from elders to younger generations.

Table 1 Demographic and socioeconomic profiles of the informants interviewed.

Variables	Categories	Total	Percentage
Gender	Female	168	70%
	Male	72	32%
Age	20-40	28	11.67%
	40-60	72	30%
	>60	140	58.33%
Educational status	Illiterate	143	59.58%
	Primary	47	19.58%
	Secondary	44	18.33%
	university	6	2.5%
Income/month	Unemployed	120	50.03%
	Low income	72	30.25%
	Medium income	41	17%
	High income	7	2.75%
Origin of medicinal knowledge	Heritage	168	70%
	Other sources	72	30%

Regarding the educational background of informants, the majority are illiterate (59.58%), while 40.41% are literate, including those with primary, secondary, and university education levels. Specifically, 19.58% have completed primary school, 18.33% secondary school, and only 2.5% have attained a university degree. This distribution suggests that individuals with higher education levels tend to have less familiarity with traditional pharmacopeia and are more inclined towards modern medicine. Numerous studies have indicated that individuals with lower educational attainment possess greater knowledge of traditional medicine and folk medical practices. Hence, it is evident that the use of medicinal plants decreases as educational attainment increases. These findings align with previous research (Lahsissene et al., 2009; El Hilah et al., 2015; Bouzid et al., 2017).

Furthermore, the economic status of the informants significantly influences the use of medicinal plants for daily healthcare. In our study area, 50.03% of respondents have low incomes, 30.25% are unemployed, 17% fall into the medium income bracket, and only 2.75% have high incomes. The informants turn to herbal medicine for various reasons, including the high costs and side effects associated with modern medical treatments. Consequently, the use of traditional herbal medicine appears to rise as the monthly income of informants decreases. These findings are consistent with studies by Douiri et al. (2007) and Guedje et al. (2010).

In our study area, ancestral heritage serves as the primary source of knowledge acquisition for informants, with 70% attributing their knowledge to parents and grandparents. The remaining 30% acquired knowledge from sources such as traditional herbalists, books on traditional medicine, television programs, or personal experiences.

Moreover, family members, friends, and neighbors play a crucial role in transmitting expertise among informants. Folk and oral communication are the primary means of knowledge dissemination. Unfortunately, this knowledge is often not formally documented. Similar observations have been noted by Srithi et al. (2009) and Eddouks et al. (2017).

3.2. Quantitative Analyses

3.2.1. Use Value

To assess the relative significance of the medicinal plants studied, the use value (UV) was calculated based on the informants' citations for each plant. The UV ranged from 0.18 to 0.44, with the highest value recorded for *C. ambrosioides* (UV=0.44). This high value is attributed to its widespread recognition among informants for its effectiveness in treating various ailments, particularly fever and sunstroke. Many informants reported growing *C. ambrosioides* at home for use against fever. In Moroccan traditional medicine, it is also employed to treat cough, vomiting, headache, diarrhea, cardiac diseases, respiratory and nervous disorders, hepatic disorders, influenza, hair loss, and hematoma, and it is known for its antihypertensive and hypoglycemic properties (Benlamdini et al., 2014; Ouhaddou et al., 2014; El Hilah et al., 2015; Chroho et al., 2016; Eddouks et al., 2002, 2017; Laadim et al., 2017; Hinad et al., 2022). In Cameroon, *C. ambrosioides* is used to treat female infertility (Telefo et al., 2011). In Jordan, it serves as an antispasmodic, diuretic, and treatment for bladder diseases (Hudaib et al., 2008; Al-Qura'n, 2009). In Mexico, it is utilized as a vermifuge and for stomach pains (Alonso-Castro et al., 2012).

Ajuga iva ranks second with a UV of 0.31 and is traditionally used in Spain to treat injuries and contusions (Benítez et al., 2010). In Algeria, it serves as an antiseptic, aids in kidney dialysis (Sarri et al., 2014), and it is used for diabetes treatment (Azzi et al., 2012; Telli et al., 2016). Additionally, it is known for treating migraines, stomach pains, female infertility, and menstrual pains (Abouri et al., 2012). In the regions of Tanger-Tetouan, Fez-Boulmane, Meknes-Tafilalt, and Marrakesh-Tansift-Al Haouz, it has been used for rheumatism, allergies, and cancer (El Hamsas et al., 2016). In the Ksar Lakkbir district of northwestern Morocco, it is used as a carminative, stomachic, and for rheumatic pains (Merzouki et al., 2000).

Urtica dioica (UV=0.28) is well-known in phytotherapy across numerous countries. For instance, in Morocco's Sidi Kacem province, it is used to treat digestive infections (Ennacerie et al., 2017). In Iran, it is employed for diabetes management and rash treatment (Bahmani et al., 2014; Bahran et al., 2014). In Portugal, this medicinal plant is commonly used as a diuretic, a stimulant for hair growth, to reduce menstruation, to stimulate milk secretion, and to treat asthma, allergic rhinitis, arthritis, sciatica, and prostate gland enlargement (Neves et al., 2009). In Turkey, it is utilized to combat cold and flu, rheumatism, and for weight loss (Cakilcioglu et al., 2011). In Spain, it is used to purify the blood, improve blood circulation, lower blood pressure, and to treat throat problems and catarrh (Calvo et al., 2011).

Globularia alypum (UV=0.22) is utilized in Morocco for managing kidney stones, pyelonephritis, burns, and wounds (Bencheikh et al., 2021; El-Ghazouani et al., 2021). In Algeria, it is employed for treating gastrointestinal ailments, as hypoglycemic remedies, eczema, and as a leishmanicidal agent (Eddouks et al., 2002; Boudjelal et al., 2013; Benarba et al., 2015; Telli et al., 2016).

Inula viscosa, with a UV of 0.18, is recognized for its efficacy in treating dermal wounds (Leonti et al., 2009; Chaachouay et al., 2019). In Algeria, it is traditionally used to alleviate edema and ulcers (Bouasla & Bouasla, 2017). In north-western Morocco, specifically in Sidi Slimane and Ksar Elkibir cities, this plant is noted for its applications in managing diabetes (Laadim et al., 2017; Hinad et al., 2022), cardiac diseases, and hypertension (Eddouks et al., 2002).

The plants under study appear to be highly favored among Taza's population. Our findings revealed significant similarities in the various uses of these species in our survey and those documented elsewhere. The Use UV analysis emphasized each plant's significance in traditional healing systems across regions. We rarely encountered individuals with no knowledge of at least one of the five studied species in traditional medicine, underscoring their importance in Moroccan folk medicine. Further evaluation of these medicinal plants through phytochemical and pharmaceutical analyses is recommended to identify their bioactive compounds for drug development. Additionally, efforts should prioritize their conservation due to the risk of overexploitation jeopardizing their future presence.

3.3. Fidelity Level (FL) Index

This index is essential for determining which ailments of a particular species is more effective. Overall, a FL of 100% for a specific plant indicates that all the use-reports reveal the same use method of the plant in the treatment (Srithi et al., 2009). As shown in Table 2, two plants had the highest FL of 100%, i.e., *C. ambrosioides* and *I. viscosa*. All informants' responses agree about the use of each species in the treatment of one principal disease. *Chenopodium ambrosioides* is considered as the perfect remedy for healing fever and sunstroke in many Moroccan regions (Chroho et al., 2016; Eddouks et al., 2017). Regarding *I. viscosa*, it has been reported to be used for the treatment of dermal wounds and injury.

Table 2 Fidelity level (FL) values for the five medicinal plants.

Ailment category	Plants	FL (%)
Fever/ Sunstroke	<i>Chenopodium ambrosioides</i> L.	100%
Hair care	<i>Urtica dioica</i> L.	87%
Diabetes	<i>Ajuga iva</i> (L.) Schreb.	70%
Gastro-intestinal ailments	<i>Globularia alypum</i> L.	65%
Dermatological diseases	<i>Inula viscosa</i> (L.) Greuter	100%

3.4. Informant Agreement Ratio (IAR)

The diseases identified in this survey study were regrouped into 9 main categories, Table 3 shows the values of informant consensus factor that ranged from 0.947 to 1. The IAR value of 1 (maximum) was observed for the categories related to fever, sunstroke, hair care, dermal wounds, and injury, but only one species was recorded in each category. Additionally, high value was always associated with a few plants that had high use reports for treating a single disease category. The results showed convergence between values of IAR that are close to the maximal value. This could be attributed to the fact that we assessed a limited number of species (i.e., five medicinal plants), thus there was low species diversity.

Table 3 Informant Agreement Ratio (IAR).

Ailment category	Number of use-reports (Nur)	Number of taxa (Nt)	Informant agreement ratio (IAR)
Fever	60	1	1
Hair care	30	1	1
Gastro-intestinal ailments	120	5	0.966
Cancer	33	2	0.968
Diabetes	20	2	0.947
Rheumatism	70	3	0.971
Sunstroke	42	1	1
Ovarien and menstrial pains	65	2	0.984
Dermatological infections	48	1	1

3.5. Plant Parts Used and Modes of Remedy Preparation

Overall, different parts of the studied plants were used in the traditional medication against various diseases (Table 4). In our study area, the most frequently used parts were leaves with a percentage of 55.83%, followed by aerial parts (24.17%), and finally roots (20%). The predominance of using leaves and aerial part does not mean that the other parts are not rich on bioactive compounds, but it could rather be due to the ability to collect quickly and easily the leaves than other parts and to the fact that plant aerial parts are the center of the photosynthetic phenomenon (Geoffrey, 2015). Our results agree with similar findings that mentioned leaves as a major dominant plant part used in Morocco (Asase et al., 2010; Asnake et al., 2016; Mukungu et al., 2016; Chroho et al., 2016; Chaachouay et al., 2019).

Table 4 Part used, method of preparation, and medicinal uses reported for the five studied plants.

Species scientific name and family	Voucher specimen	Local name	Part used	Preparation	Medicinal use
<i>Chenopodium ambrosioides</i> L. Amaranthaceae	CA-LABP05	Mkhinza	Leaves	Infusion Poultrice	Fever Sunstroke Ovarian and menstrual cramps Rheumatism Gastro-intestinal disorders Diabetes
<i>Ajuga iva</i> (L.) Schreb. Lamiaceae	AI-LABP04	Chendkoura	Leaves, arial parts	Decoction	Digestive disorders Diabetes
<i>Urtica dioica</i> L. Urticaceae	UD-LABP03	Lhriga	Leaves	Decoction Poultrice	Hair loss /dandruff Acne Rheumatism
<i>Inula viscosa</i> (L.) Greuter. Asteraceae	IV-LABP02	Magramane	Leaves Roots	Poultrice Powder	Dermal wounds Stomach ulcer Cancer
<i>Globularia alypum</i> L. Plantaginaceae	GA-LABP01	Ain Larnab	Leaves, arial parts	Decoction	Gastro-intestinal disorders Diabetes

Various methods are employed to prepare plant remedies to maximize the benefits of their bioactive compounds. The study findings indicate that infusion was the most common method (40%), followed by decoction (22%) and poultrice (20%). Other methods such as fumigation, maceration, raw application, inhalation, and juice extraction each accounted for less than 18% (Table 4). The preference for infusion can be attributed to its effectiveness in extracting bioactive elements while minimizing the potential toxicity of certain preparations. In Morocco, ethnobotanical studies consistently reported infusion as the predominant preparation method (Salhi et al., 2010; El Hilah et al., 2015; Slimani et al., 2016), suggesting ongoing knowledge sharing among Moroccan communities regarding medicinal plant use. Similarly, at the international level, infusion is widely documented as the primary preparation method (Okello et al., 2010; Stangeland et al., 2011; Yetein et al., 2013). Additionally, our survey noted the use of non-plant ingredients such as honey, olive oil, and rose water mixed with herbal medicines. Honey and olive oil are particularly prominent in Moroccan pharmacopeia, underscoring their significant role in

traditional medicine for enhancing the palatability of bitter plants. Similar practices have been documented globally (Marghitas et al., 2008; Kaškonienė et al., 2009; Mascitelli & Goldstein 2013; Bouarroudj et al., 2016), reflecting the widespread use of honey and olive oil due to their rich content of bioactive compounds.

3.6. Conditions of medicine preparation

In our study area, we found that 61.7% of the remedies were prepared from fresh plant parts, while the remaining 38.3% from dried parts. This is related to the efficiency of fresh medicinal plants in treatment as some contents are not lost compared to the dried forms. Other studies reported similar finding (Abdurhman, 2010; Chaachouay et al., 2019). Furthermore, this may be due to the fact that fresh plants are much simpler and faster to prepare for remedy than the other form.

3.7. Traditional Remedies Recommended by the Informants

3.7.1. *Chenopodium ambrosioides*

Fever, Sunstroke:

Preparation of fresh juice made with fresh leaves of the plant, fresh leaves of mint, and orange juice. This preparation should be drunk morning and evening.

Preparing a mixture containing fresh leaves of *C. ambrosioides*, mint, rose water, a few drops of vinegar, and slices of red onion. The mixture is applied on the forehead and on the belly, for hours, two times a day morning and evening.

Ovarian and menstrual pains, rheumatism, gastro-intestinal disorders, and Diabetes:

Preparation of a beverage made from boiled fresh leaves of the plant. A cup of this infusion is drunk before and during menstrual period. The same preparation is indicated for rheumatism and gastrointestinal disorders, and diabetes.

3.7.2. *Inula viscosa*

Vulnerary (treatment of wounds):

Preparing a mixture with dried or fresh leaves and roots of *I. viscosa* lightly toasted which makes it easier to grinding, with or without honey. The pasty preparation is applied two times per day on the affected areas as a poultice until the physical symptoms of the disease disappear.

Stomach ulcer, Cancer:

A mixture of dried leaves of *I. viscosa*, powder of Nigelle and Oregano mixed with honey is prepared; then a spoon of this preparation is taken two times per day.

3.7.3. *Urtica dioica*

Hair loss / Dandruff:

A decoction of fresh leaves of *U. dioica* is prepared with water. The mixture is boiled for 15 to 20 min, filtered and cooled to ambient temperature. The remedy is applied on the scalp for one hour before taking the shower.

A maceration is made with fresh leaves of *U. dioica* and olive oil. The mixture is stored in a glass bottle, kept in darkness for at least 15 days prior to use. Finally, the product is applied on the scalp for one or two hours before taking the shower.

Acne:

A mixture is prepared with fresh or dried leaves of *U. dioica* and honey until reaching a homogeneous paste. The mixture is applied as a poultice on the acne pimples for 20 to 45 minutes, then the face is clean with a natural soap. The preparation is repeated two to three times a week.

Rheumatism:

A warm soup is made with leaves of *U. dioica* (fresh or dried), oregano, pennyroyal, and olive oil. The soup is drunk in the evening before sleeping.

Menstrual pains and Digestive problems:

An infusion is prepared with the leaves of *U. dioica* and Sage. A cup of this beverage is drunk every morning during menstrual period.

The same beverage is indicated for digestive problems, but it is made with *U. dioica* only.

3.7.4. *Ajuga iva*

Diabetes:

An infusion is prepared based on the leaves or aerial parts of the plant (fresh or dried). This beverage is drunk every morning on an empty stomach.

Digestive disorders:

An infusion is made with leaves of *A. iva* and oregano (fresh or dried). Two cups per day of this preparation are drunk evening and morning.

3.7.5. *Globularia alypum*

Gastro- intestinal disorders / Diabetes:

Fresh or dried leaves of *G. alypum* are used as a decoction to relieve gastro-intestinal pains, pains. The same preparation is recommended as a long-term treatment for diabetes.

4. Conclusions

The results of the present survey revealed an important local knowledge expressed by all informants, as shown by the variety of traditional remedies used to treat several ailments using the five medicinal plants investigated. In addition, this study highlighted the relationship between socio-demographic data of informants and the frequency of plant use. However, the transmission of traditional knowledge heritage is declining, as younger generations are losing the tradition of the medicinal plant use. Traditional medicine is used only by old people for the treatment of various diseases using different methods of remedy preparation. The preserved ethnopharmacological knowledge was based on the collective tradition and the oral memories of their parents and grandparents. Our study could contribute to preventing the loss of ethnopharmacological traditions. This natural, rare, and precious heritage should be protected for the next generations. Moreover, phytochemical and biological activities of the studied plants should be further investigated to isolate their bioactive components, which could be used in drug enhancement.

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Ethical considerations

All the people interviewed were fully consenting and gave their agreement consent to participate in the surveys.

Conflict of Interest

The authors declare no conflicts of interest.

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