Ethnomedical insights into plants used by tribes in the Rif of Al Hoceima and in the Pre-Rif of Taza (two provinces in Northern Morocco)

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Research

Abstract

Background: Given the richness of Morocco's flora, the diversity of medicinal and aromatic plants, and their contribution to a long medical tradition, a comparative ethnobotanical study was carried out to bio-prospect and preserve their traditional uses. The aim was to identify similarities and differences in practices and beliefs linked to the use of these plants in three different tribes.

Methods: An ethnobotanical survey using a pre-established questionnaire was carried out in parallel with the Rif of Al-Hoceima and the Pre-Rif of Taza in two stages. The first stage aimed to record the uses of different medicinal plants by the populations of these two areas, while the second stage was complementary and comparative, focusing solely on the plants cited by one population without the other and verifying their uses by the second population based on samples of these medicinal plants (and/or their real photos).

Results: The results obtained allowed us to identify 96 plant species in 51 botanical families, of which Lamiaceae and Asteraceae are the most commonly used. The most commonly treated illness was that of digestive disorders, and the most frequently cited preparation methods were infusion for the pre-Rif and decoction for the Rif. In both provinces, people primarily use the leaf. However, significant distinctions were noted, particularly with regard to vernacular names. We identified 45 plants with different nomenclatures between the Rif and the Pre-Rif. These variations may arise from environmental disparities, distinct cultural traditions, and interactions with other ethnic groups.

Conclusions: This comparative ethnobotanical study highlighted both similarities and disparities in the use of medicinal plants between the two provinces. These findings establish a solid foundation for the preservation of traditional knowledge about

medicinal plants and suggest promising avenues for future pharmaceutical research and the promotion of sustainable exploitation of plant resources.

Keywords: Ethnobotanical survey, Comparative study, Pre-Rif of Taza, Rif of Al-Hoceima - Northern Morocco.

Background

Since antiquity, humanity has relied on medicinal and aromatic plants as remedies for their medical and dietary needs and considers them valuable resources for improving and healing human health (Benkhnigue *et al.* 2010). Currently, according to the World Health Organization (WHO), 80% of the inhabitants of African countries depend on traditional herbal medicines to deal with primary health problems (WHO, 2013).

In Africa, particularly in Morocco, both urban and rural populations remain linked to phytotherapy today (Bellakhdar 1997, Scherrer *et al.* 2005, Jamila & Mostafa 2014, Ghabbour *et al.* 2023, Ghabbour *et al.* 2024a, Ghabbour *et al.* 2024b, Khabbach *et al.* 2012, Khabbach *et al.* 2014, El Aboui *et al.* 2024) and the use of plants for their curative properties is therefore a practice deeply rooted in Moroccan culture (Bellakhdar 1997).

Morocco is situated along the Mediterranean Sea and boasts a unique natural landscape that encompasses a full spectrum of Mediterranean bioclimates (El-Hilaly *et al.* 2003). The country is renowned for its rich and diverse vegetation, with more than 500 species of natural aromatic and medicinal plants, representing approximately 12% of its total flora. The complete Moroccan flora becomes even more diverse with the inclusion of 261 species of doubtful presence, 54 ± 3 hybrids, 67 ± 4 adventitious plants, 74 ± 3 naturalized species, and 76 species with uncertain statuses (adventitious or naturalized) (Bouyahya *et al.* 2017, El Haouari *et al.* 2018, Ben-Ghabrit *et al.* 2019, Khamar *et al.* 2022).

Morocco has a long medical tradition and ancestral know-how based on medicinal plants, accumulated over the centuries (Fakchich & Elachouri 2014). The traditional Moroccan pharmacopeia includes nearly 863 species, 13 subspecies and 14 varieties of plants, belonging to 104 botanical families, including 602 spontaneous and/or acclimatized taxa of local origin, 181 cultivated or naturalized taxa and 114 taxa with derivatives imported from outside (Ennabili *et al.* 2023).

This traditional medicinal knowledge was regularly practiced within households and passed down from generation to generation over time (Ullah *et al.* 2010). However, this knowledge unfortunately runs the risk of disappearing if no safeguards are established (Salhi *et al.* 2010). It is therefore crucial to preserve this knowledge and guarantee its transmission for future generations (Ghabbour *et al.* 2024b). With this in mind, various scientific disciplines have been involved in the ethnobotanical approach which makes it possible to document the traditional knowledge of populations and to translate it into scientific knowledge based on know-how remains the most important discipline in this field, which makes it a reliable approach for exploring ancestral knowledge (Fleurentin & Balansard 2002).

Recent studies have highlighted the rich diversity of medicinal plants in various regions of Morocco (El Mekkaoui *et al.* 2024, Lemhadri *et al.* 2023). Ethnobotanical studies conducted in the provinces of Taza (Khabbach *et al.* 2012, Boulfia *et al.* 2018, El Haouari *et al.* 2018, El Brahimi *et al.* 2022, Ghabbour *et al.* 2023, Ghabbour *et al.* 2024a, Ghabbour *et al.* 2024b, El Aboui *et al.* 2024, El Hajli *et al.* 2024, El Aboui *et al.* 2025) and Al Hoceima (Chaachouay *et al.* 2020, Chaachouay *et al.* 2022, Smaili *et al.* 2023) have demonstrated that the Al Hoceima Rif and the Taza Pre-Rif represent an ethnobotanical treasure; indeed, in Taza province, a total of 202 medicinal plants are practically used to treat various diseases (Ghabbour *et al.* 2024a) and 14 groups of diseases are treated (Ghabbour *et al.* 2023).

This study aims to examine and compare the ethnobotanical knowledge of three tribes: Tsoul and Branès in Taza province, and Ait Ouriaghal in Al Hoceima province. Through a comparative approach, this research seeks to document the medicinal plant species used by these communities, analyze their associated therapeutic practices, and understand the dynamics of knowledge transmission within local populations. The study area is strategically positioned at the intersection of multiple ecosystems, including the Rif with its coastal and mountainous landscapes, the Pre-Rif, the Middle Atlas, the Fez-Taza corridor, and the steppe zone (HCP, 2000-2004). This environmental mosaic promotes exceptional botanical diversity while reflecting the cultural diversity of populations who have developed ethnomedicinal knowledge over time. By highlighting these practices and their evolution, this study contributes not only to the recognition and promotion of local ethnobotanical heritage but also to broader discussions on strategies for preserving traditional knowledge in a rapidly changing world.

Materials and Methods

Study areas presentation

Province of Taza

Geographically situated in the pre-Rif area, the province of Taza is administratively part of the Fez-Meknes region (Figure 1), located in the northeast of Morocco, it occupies 709 600 hectares of the total area of the region and presents a topology outside the common where the Rif and Middle Atlas Mountains meet (El Haouari *et al.* 2018).

The province of Taza is bordered to the north by the province of Al-Hoceima, to the northeast by the province of Nador, to the east by the province of Taourirt, to the south by that of Boulemane, and to the west by the province of Taounate and that of Sefrou (latitude: 34° 13'00"N longitude: 4°01'00"W and altitude: 550 m). This city has a total population of 528.419 inhabitants. (HCP.2000-2004).

Average temperatures in the region range from 3.2°C to 44.5°C. Annual rainfall has fluctuated between 84 and 120 mm over the last eight years (Mhaidi*et al.* 2018). Between 84 and 120 mm over the last eight years (Mhaidi*et al.* 2018), the climate is classified as subtropical to tropical. subtropical to tropical, characterised by extreme drought along the coast and increased precipitation at higher altitudes.

Province of Al Hoceima

Province Located in the Tangier-Tetouan-Al Hoceima region (Morocco), along the Mediterranean coast (Figure 1), it is characterized mainly by slopes varying from 10 % to 40 % and includes 12 000 hectares of which are plains. It is bordered to the west by Chefchaouen and Taounate, to the east by Nador and to the south by Taza, with a Mediterranean coastline to the north.

Al Hoceima has a Mediterranean climate, characterized by cool, rainy winters and hot, dry summers, with temperatures ranging from 10 °C to 30 °C. Based on the Köppen-Geiger classification (Hadria et al., 2019, Kottek et al., 2006, Rubel & Kottek 2010), it is classified as Csa, signifying a temperate climate with hot, dry summers. Ecologically, the province is significant, as it encompasses 29 % of the natural forests within the Tanger-Tetouan-Al Hoceima region (HCP, 2020).

According to Climates and Voyages (s.d.), Al Hoceima receives an average annual rainfall of approximately 305 millimeters, with the majority of precipitation occurring during the cooler months. March is the wettest month, with around 45 millimeters of rainfall, whereas July is the driest, receiving only about 1 millimeter. This seasonal variation in precipitation aligns with the region's typical Mediterranean climate, characterized by wet winters and arid summers.

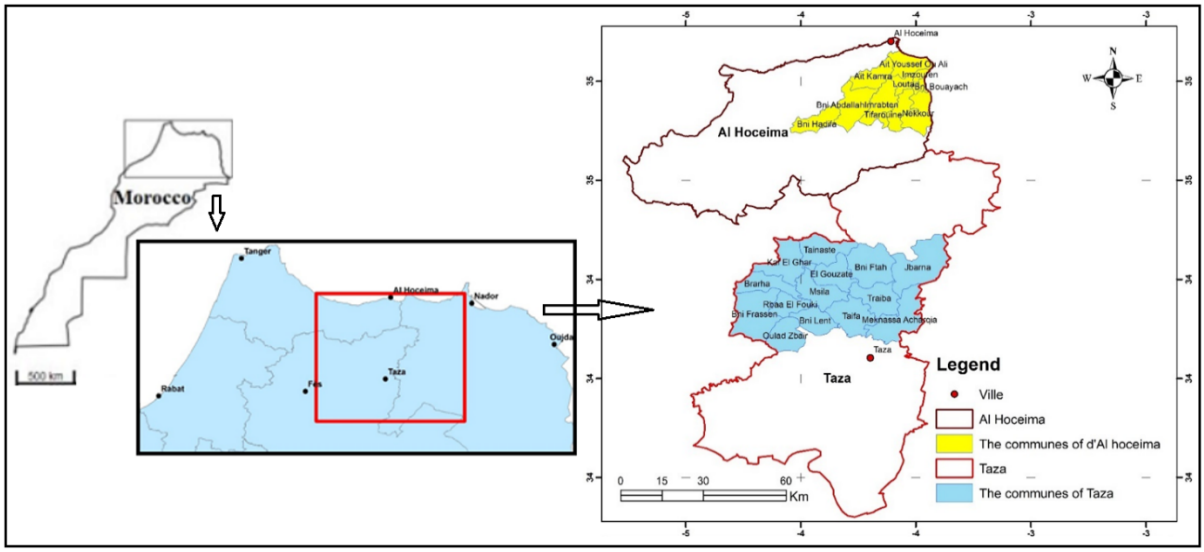

Figure 1. Map of 24 survey points studied in the Pre-Rif and Rif communes (Ghabbour *et al.* 2024a; Created via ArcGIS software)

Ethnobotanical survey

In order to collect information regarding plants used for therapeutic purposes, an ethnobotanical study was carried out in two complementary phases in the Rif of Al Hoceima and the Pre-Rif of Taza. During the first phase, an ethnobotanical survey was carried out in parallel in the Al Hoceima province (Rif geographical area) and the Taza province (Pre-Rif geographical area) using a pre-established questionnaire including precise questions on the informant, the vernacular identity of the medicinal plant, as well as other demographic characteristics (Age, Gender, family situation, education, reason for use), ethnobotanical (Part used, Form of use), and ethnopharmacological (Preparation, Administration).

The second phase of the study was both complementary and comparative. After collecting lists of medicinal plants used by each population, we identified certain taxa mentioned by one population but not by the other. To further analyze these differences, we conducted a follow-up survey specifically targeting these taxa. In this second survey, we directly asked the other population whether they were familiar with these plants, providing either their vernacular or scientific names. To facilitate identification, we supplemented our questions with visual aids such as photographs, illustrations, or physical plant samples. This approach allowed us to assess the extent of ethnobotanical knowledge differences between the two populations and gain deeper insight into the transmission and distribution of traditional plant-based knowledge.

Plant, collection, handling and identification

This work lasted from May 2022 to January 2023 where 840 files were used in a total of 14 stations in the Pre-Rif and 11 stations in the Rif. The attribution of scientific names, the identification and recognition of the plants recorded were done either in the field for known and common plants, or in the This work lasted from May 2022 to January 2023 where 840 files were used in a total of 14 stations in the Pre-Rif and 11 stations in the Rif. The attribution of scientific names, the identification and recognition of the plants recorded were done either in the field for known and common plants, or in the Laboratory of the Natural Resources and Environment of the Polydisciplinary Faculty of the Sidi Mohamed Ben Abdellah University in Taza with the help of Prof. Abdelmajid Khabbach. The nomenclature follows the available flora (Fennane *et al.* 1999, Fennane *et al.* 2007, Fennane *et al.* 2014, Nègre 1962, Quézel & Santa 1962, Valdés *et al.* 2002).

For plants whose plant material is imported from abroad, we took inspiration from recent local work carried out in the study area or neighboring areas (Ghabbour *et al.* 2023, Ghabbour *et al.* 2024a, Ghabbour *et al.* 2024b, El Aboui *et al.* 2024, Barkaoui *et al.* 2017, Benali *et al.* 2017, Ennabili & Gharnit 2000, Ennabili *et al.* 2006, Gharnit & Ennabili 2016, Khabbach *et al.* 2011, Khabbach *et al.* 2012, Khabbach *et al.* 2014, Libiad *et al.* 2011, El Hajli *et al.* 2024). Thus, almost all the plants reported used in local traditional medicine were collected and botanized, and a specimen was deposited in the herbarium at the Laboratory of Natural Resources and the Environment, Polydisciplinary Faculty of Taza, Sidi Mohamed Ben Abdellah University of Fez. The results obtained were then entered into a database to be processed and statistically analyzed using SPSS software. The scientific names of various taxa and botanical families have been updated and revised using resources such as the African Plant Database (APB, 2022) and (WOF, 2022).

A significant issue in ethnobotanical research is that naturalists are faced with challenges concerning vernacular plant names, which are often shaped by their ethnic and cultural origins and given this variability in the transliteration of vernacular names, we have used the standardization of the transcription of these names which is reported in Table 1, and which was adopted by Ennabili et al 2023; it has been undertaken, by associating each Arabic letter with a distinct symbol as specified, even, in some cases, the most common letter combinations in French have been assimilated to one of the symbols listed in this table 1. Thus, according to Ennabili *et al.* 2023, some phonetic representations can be simplified as follows: ‘ḍ’ replaces “th”, “ġ” replaces “gh” and “rh”, “ẖ” replaces “kh”, “š” replaces “ch” and “sh”, and “u” replaces “ou”. These adjustments help to standardize transliterations for greater clarity in searching (Ghabbour *et al.* 2024a).

Data processing

Quantitative Data Analysis

Data collected from the questionnaires were tabulated and analyzed with conventional methods of descriptive statistics.
To explore the sociodemographic and educational characteristics within two-study populations Factor Correspondence Analysis (FCA) was employed in this study. This methodology was implemented using Python (Figure 2).

The Jaccard index, also known as the Jaccard similarity coefficient, a commonly used measure in ethnobotanical research (El-Gharbaoui *et al.* 2017, González-Tejero *et al.* 2008) was used to compare the similarity between two sets.
The formula for the Jaccard index is:

$$J(A,B) = \frac{|A \cap B|}{|A \cup B|} = \frac{|A \cap B|}{|A| + |B| - |A \cap B|}$$

where A and B are any two sets to be compared and |A| and |B| are their respective cardinality (number of elements).

Table 1. Arabic letter encoding used for the transliteration of vernacular names.

Symbol	Arabic Letter	Symbol	Arabic Letter	Symbol	Arabic Letter	Symbol	Arabic Letter
a	أ	f	ف	l	ل	t	ت - ة
ä	ع	g	ڤ - گ	n	ن	ṭ	ط
ā (1)	ا - ى - آ	ġ	غ	o	ؤ	ṯ	ث
å	ئ - ء	h	ه - هـ	ō (1)	و	ū (1)	و
b	ب	ḥ	ح	p	پ	u (2)	و
d	د	ẖ	خ	q	ق	v	ڤ
ḍ	ذ	i	إ	r	ر	w (2)	و
ḏ	ض	ī (1)	ي	s	س	y (2)	ي
e	ؤ	j	ج	š	ش	z	ز
ē (1)	و	k	ك - ک	ṣ	ص	ż	ظ

(1) and (2), long and short vowels.

Results and Discussion

Demographic characteristics of respondents

The socio-demographic characteristics and experience of the communities surveyed provide key information on the relationship between the population and medicinal plants. As shown in Table 2, the analysis of the data collected and processed using SPSS software highlights several significant trends. The distribution of respondents by age, gender and level of education provides a better understanding of the dynamics of transmission of ethnobotanical knowledge. Furthermore, the experience of participants in the use of medicinal plants varies according to these factors, thus influencing practices and the preservation of traditional knowledge. These results provide a valuable basis for comparing the similarities and differences between the two study areas.

Table 2. Sociodemographic characteristics and experience of interviewed communes.

	Pre-Rif Of Taza		Rif Of Al Hoceima	
Characteristic	Number of interviewees	Percentage	Number of interviewees	Percentage
Age (years)				
< 40	42	8.6	82	24.8
40 - 60	154	31.4	96	29.1
> 60	294	60	152	46.1
Total	**490**	**100**	**330**	**100**
Gender				
Male	193	39.4	126	38.2
Female	297	60.6	204	61.8
Total	**490**	**100**	**330**	**100**
Education				
Illiterate	156	31.8	138	41.8
Primary	121	24.7	82	24.8
Secondary	129	26.3	51	15.5
University	84	17.1	59	17.9
Total	**490**	**100**	**330**	**100**

Reason for use				
Efficiency	334	68.2	162	49.1
Cheaper	97	19.8	168	50.9
none	59	12	-	-
Total	**490**	**100**	**330**	**100**
Family Status				
Single	79	16.1	40	12.1
Married	349	71.2	270	81.8
Divorced	36	7.3	12	3.6
Widower	26	5.3	8	2.4
Total	**490**	**100**	**330**	**100**

Use of medicinal plants according to gender

A total of 820 participants were included in this study, divided between 490 individuals from the pre-Rif region of Taza and 330 individuals from the Rif region of Al-Hoceima (Table 2). Among these participants, 297 women (60.6 %) and 193 men (39.4 %) were present in the Pre-Rif region, while the Rif region had 204 women (81.8 %) and 126 men (38.2 %).

Regarding the use of medicinal plants, women presented a higher frequency of use than men. These results are consistent with other similar studies conducted in the same province (Salhi *et al.* 2010, Hmamouchi 2001, El Aboui *et al.* 2024), other regions of Morocco (Alaoui *et al.* 2018, Merrouni *et al.* 2021), and international studies (Boutabia *et al.* 2022, Jdaidi & Hasnaoui 2016).

This difference can be attributed to the fact that women often play a key role in various activities related to plants, including their use in cooking, as well as the drying, storage, and preparation of herbal remedies to maintain their family's health (Mehdioui & Kahouadji, 2007). Additionally, their deep-rooted connection to cultural traditions enables them to preserve and pass down ethnobotanical knowledge across generations, reinforcing their crucial role in maintaining and evolving traditional healing practices. However, this goes against the results of a previous study (El Mansouri *et al.* 2011) carried out in 2023 which established that in Al Hoceima the men were more predominant.

Use of medicinal plants according to age

Individuals over the age of 60 make much more frequent use of plants for healing purposes in both regions. This use is 60 % in the Pre-Rif region and 46.1 % in the Rif region, respectively. Then, the age group of 40 to 60 years presents lower frequencies of use, either 31.4 % in the Pre-Rif and 29.1 % in the Rif. Finally, people aged under 40 are those who use plants less frequently, representing 8.6 % in the Pre-Rif and 24.8 % in the Rif.

These results showed that older people have more knowledge about traditional herbal medicine practices compared to the younger age group. Similar results were obtained through other ethnobotanical studies carried out in the province of Taza (Khabbach *et al.* 2012, Ghabbour *et al.* 2024b), as well as in different regions of Morocco (Barkaoui *et al.* 2017, Kachmar *et al.* 2021, Merrouni *et al.* 2021). However, an alternative study (El Mansouri *et al.* 2011) conducted in Al Hoceima offered a contrasting viewpoint, highlighting the 35 to 50 age group as the primary users of plants.

Reason for use

The main reason both populations turn to medicinal plants for healing is their perceived effectiveness and affordability. In addition to their abundance and accessibility, their efficacy plays a key role in their widespread use, this same finding was reported by the previous study (Jouad *et al.* 2001). Their economic accessibility is particularly crucial in rural areas where access to healthcare services is limited. Furthermore, Morocco's rich biodiversity supports the extensive use of medicinal plants, while the diversity of ecosystems facilitates their harvesting and daily utilization. These combined factors explain why medicinal plants remain an essential resource for healthcare in Morocco, blending ancestral knowledge with the preservation of natural heritage.

Family situation

The analysis of the data reveals significant differences in the use of aromatic and medicinal plants (PAM) between the two studied zones, depending on the respondent's education levels. In both regions, illiterate individuals represent the largest group relying on PAM with 31.8 % in the Pre-Rif and 41.8 % in the Rif, highlighting the importance of oral transmission of traditional knowledge. However, this trend is more pronounced in the Pre-Rif, where the use of PAM remains high across all educational levels (primary 24.7 % and secondary education 26.3 %) and continues to favor natural remedies, whereas in

the Rif, their adoption decreases significantly as education levels increase. Moreover, although university graduates are generally less likely to use PAM, their usage remains relatively common, particularly in the Pre-Rif. These results are consistent with findings reported by previous studies (Barkaoui *et al.* 2017, El Assri *et al.* 2021, El Hilah *et al.* 2016, Mechchate *et al.* 2020, Skalli *et al.* 2019). Limited access to modern healthcare, the availability of medicinal plants, and deep-rooted traditions promote the use of ethnobotanical practices. Their adoption is driven by perceived effectiveness, affordability, and accessibility, especially in rural areas. Morocco's rich biodiversity and diverse ecosystems facilitate their harvesting and daily use, making medicinal plants an essential resource that combines ancestral knowledge with the preservation of natural heritage.

Factor Correspondence Analysis (CFA)

The results of the Pre-Rif indicate that the two axes together represent 90.14 % of the explained variance where most variables were explained by the first dimension, while the rest were explained by the second dimension. While the rest was explained by the second dimension. The first dimension seems to include variables linked to marital status (married, single, divorced) as well as levels of primary, secondary and university education, and even illiteracy. On the other hand, the second dimension brings together variables such as gender, widowed status and lower cost. Regarding individuals: Individual 1 is associated with the variables single, divorced and having a university level. Individual 2 is associated with male gender and primary education level. Individual 3 is associated with illiteracy and married as a marital status. Individual 4 is associated with secondary education, female gender and efficiency. However, the status of the widower and the consideration of a lower cost seem to be little influenced by these axes and far removed from the profiles of the individuals analyze.

At the Rif level, the two axes together represent 79.1 % of the data. The first dimension includes gender variables (male and female), marital status (married), as well as primary and secondary education levels. Whereas illiteracy and secondary education levels, as well as the low-cost and effectiveness of these plants as a reason for use, are included in the second dimension. Concerning individuals, the first is associated with the variables divorced and having a university level. The second is associated with the male gender, marriage and primary education level. The third is associated with female gender, illiteracy and secondary education level, widower as marital status, and lower cost as a reason for use. The fourth is associated with single status and efficiency.

Systematic characterization

Botanical families

Our botanical inventory showed that 96 plant species belonging to 51 families were identified (Table 3). The analysis of data provided in table 3 reveals overall similarities concerning the predominance of families where the five main families cited by the two populations are the same with a difference at the level of the third family, Lamiaceae and Asteraceae with 29.6 % and 7.9 % for the Pre-Rif and 29.3 %, 8.5 % for the Rif respectively are the most cited for both, followed by the Myrtaceae 6.3 %, the Fabaceae 4.8 % and the Apiaceae 4 % at the level of the Pre-Rif while in the Rif are followed by Apiaceae 5 %, Myrtaceae 3.4 %, Fabaceae 3.2 %. The predominance of Lamiaceae and Asteraceae is in good agreement with previous ethnobotanical surveys conducted in northern Morocco (Ghabbour *et al.* 2024a, Boulfia *et al.* 2018, Chaachouay *et al.* 2022, El-Assri *et al.* 2021, El Haouari *et al.* 2018, Khabbach *et al.* 2012) and another region of Morocco (Belhaj *et al.* 2020, Bouyahya *et al.* 2017, Es-Safi *et al.* 2020, Ouhaddou *et al.* 2014).

Medicinal species

Our survey showed that the plants most commonly used in the Pre-Rif and Rif are *Origanum* spp., *Rosmarinus officinalis* L. and *Lavandula* spp., the widespread use of these plants in the two study areas is probably attributable to the large populations of these spontaneous taxa in these adjoining areas. These results are in line with previous studies (Ghabbour *et al.* 2024a, Boulfia *et al.* 2018, Benali *et al.* 2017, Khabbach *et al.* 2012). The similarity in the species used (Figure 3) is obvious: the two regions share complementary ecosystems, and the local populations, whether Berber or Arabic-speaking, have developed similar practices in the use of medicinal and culinary plants. Historical interactions and commercial exchanges between these two areas have facilitated the spread of ethnobotanical knowledge, reinforcing the convergence of plant uses despite certain environmental differences.

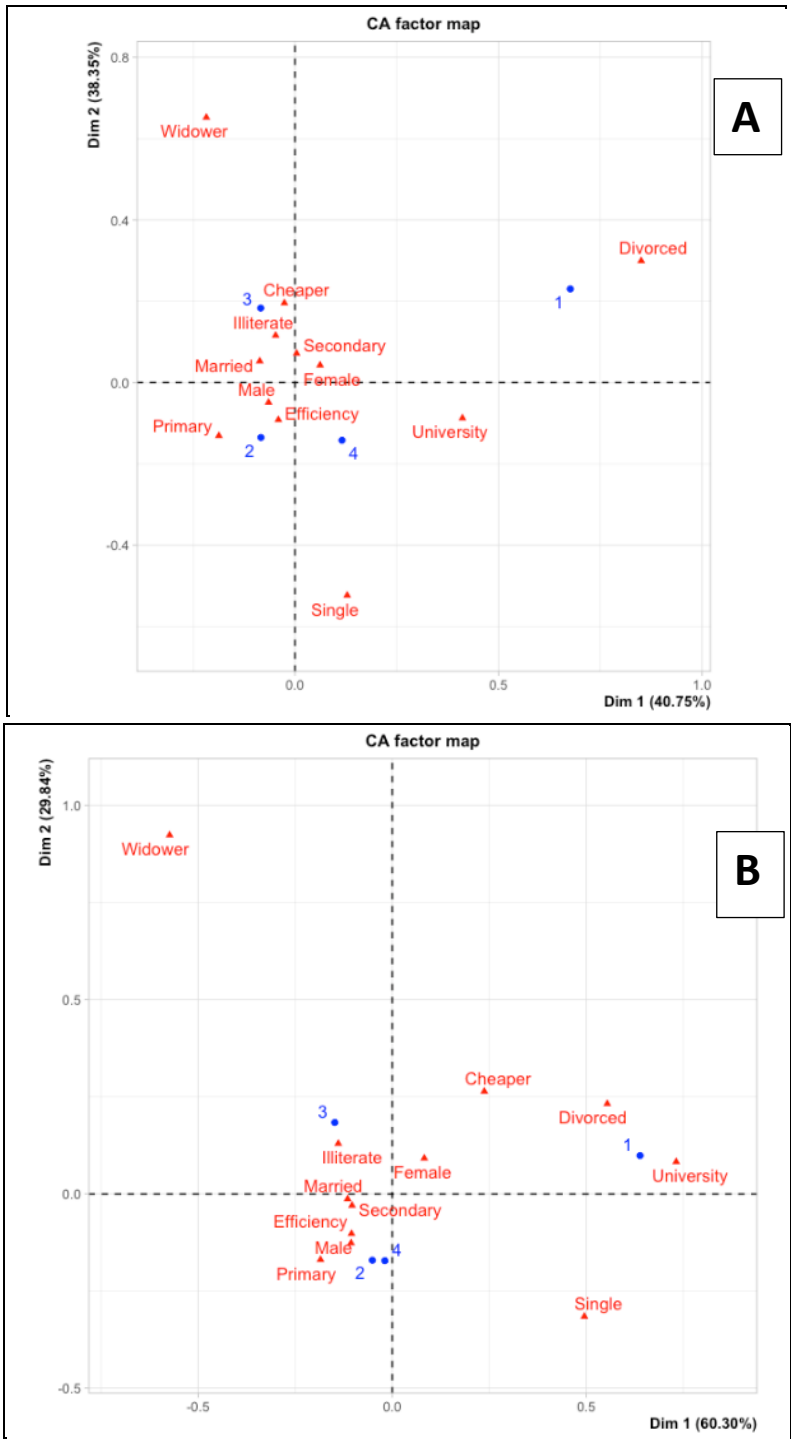

Figure 2. Factorial Correspondence Analysis (CFA): study of the dimensional structures of sociodemographic and educational characteristics within the population residing in the Pre-Rif of Taza (A) and in the Rif of Al-Hoceima (B). (with **1**: Age <40, **2**: Age 40-60, **3**: Age 60-80, **4**: Age>80).

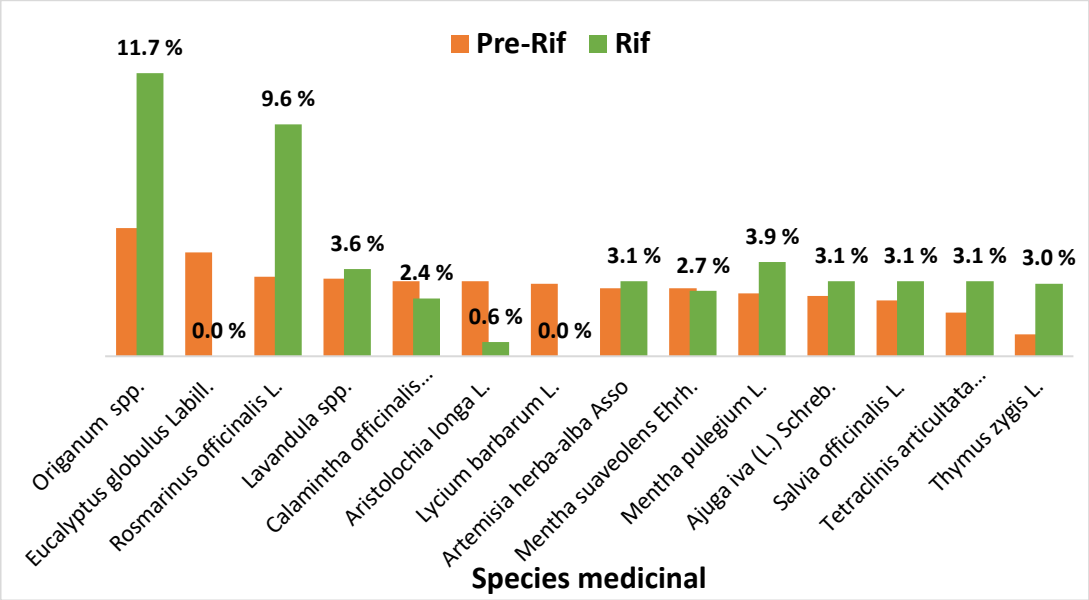

Figure 3. The most used medicinal species in the Pre-Rif of Taza and the Rif of Al Hoceima.

Vernacular name of plants

The plants identified in our study are designated by two to three different vernacular names. Of the 96 plants listed, 32 have the same name, while 13 are specific to a single study area. The remaining 51 plants have varied names, of which 44 have two different names and 7 are identified by more than two names Table 3. This diversity of names can be attributed to two main factors. First, it reflects the diversity of tribes present within the Pre-Rif of Taza, each with its own terminologies to designate these plants. Second, these name variations are also the result of cultural and linguistic differences between the Pre-Rif and the Rif of Al-Hoceima, where different communities use distinct dialects, thus leading to a plurality of names for the same medicinal plant. This is already mentioned in other studies (Ghabbour *et al.* 2024a, Smaili *et al.* 2023, Boulfia *et al.* 2018, Khabbach *et al.* 2011,).

Medicinal uses

The analysis of diseases associated with each plant highlights the diversity of therapeutic uses across the studied zones. When a plant is used to treat a disease exclusively the Pre-Rif of Taza [1] or in the Rif of Al Hoceima [2], this may reflect the local transmission of knowledge, the influence of environmental conditions on species availability, or cultural differences in the interpretation and application of traditional remedies. Conversely, when the same plant is cited in both zones for the same disease, it suggests a broader recognition of its potential effectiveness and an intercommunity transmission of ethnobotanical knowledge. Our results thus show that certain therapeutic uses are exclusive to the Pre-Rif and others for the Rif, reflecting local specificities, while others are shared between the Pre-Rif of Taza and the Rif of Al Hoceima [1 2], indicating a partial homogeneity of medicinal practices and underscoring the relevance of traditional knowledge in managing common ailments.

Table 3. Medicinal Plant Diversity: Vernacular Names, Ecology, Harvesting Period, Plant Condition, Utilized Parts, Preparation Methods, and Therapeutic Applications in the study area.

Scientific name	Vernacular name Pre-Rif	Vernacular name Rif	Ecological distribution	Collection period	Plant state	Part used	Forme of employement	Preparation	Administration	Dose used	Medicinals uses	Use of the plant	Results
Agavaceae													
***Agave americana* L. (E01comp LRNE)**	sᶜa:ba:r *	fa:ḍa: *	S	All year Summer	F	L	Cr	Po	Ex.ap		Headaches[2] Acne[1 2]	Decorative product	
Aloaceae													
***Aloe vera* (L.) Burm. f. (E02comp LRNE)**	Olivi:ra *	a:kfi:r *	S	All year	F	L	Cr	Po Br	Ex.ap	H	Traces of wounds[1 2] Skin[1 2] Sexual Impotence[1 2] Abscess[1]	Medicine Decorative product	Improvement
Anacardiaceae													
***Pistacia atlantica* Desf. (E04comp LRNE)**	Lbtᶜa:m * Lbʃa:m *		S	All year	D	Sd	Pd	Pd	Ex.ap	Sp	Hair treatment[1]	Medicine	Ineffective
***Pistacia lentiscus* L. (E03comp LRNE)**	Dru: *	f,a:ḍi:s *	S	All year	F D	L	Ht	De I	O	Sp Pi	Digestive system[1 2]	Medicine Religious beliefs and practice	Improvement
Amaranthaceae													
***Dysphania ambrosioides* (L.) Mosyakin & Clemants (E05comp LRNE)**	Mxinza: [a]	Mxinza: [a]	S	All year	F	L	Ex Ht Lo Br	De M Pd Po Br	O Ex.ap	Sp H Pi	Fever[1 2] Sexual diseases[2] O. diseases[1 2]	Medicine Insect Repels	Healing Ineffective Improvement
Apiaceae													
***Ammodaucus leucotrichus* Coss. & Durieu (E06comp LRNE)**	Lka:mu:n sᶜu:fi:		Id	Summer	D	Sd	Ht Pd Sy	De Pd Br	O In	Sp H Pi	Digestive syste[1] Intestinal pain[1] Cold[1] Diarrhea[1] Diieritic[1]	Medicine	Healing Ineffective Improvement
***Apium graveolens* L. (E09comp LRNE)**	Lkra:fsᶜ *	Rkra:fsᶜ *	C	All year	F	L	Ht	De	O	Sp H Pi	Digestive system[1 2] Hypertension[1] Kidney problems[1] Diieritic[1 2]	Medicine Food	Healing Ineffective Improvement
***Carum carvi* L. (E10 comp LRNE)**	Krwija: [a]	Krwija: [a]	Id	All year	F	Sd	Pd	Bo	O	Sp	Aphrodisiac[2]	Medicine	Ineffective

***Coriandrum sativum* L.** **(E11 comp LRNE)**	Qu:zbr *	Lku:zbu: *	C	All year	F	Ap	Ht	De	O	Sp H Pi	Digestive system[1 2] Sexual diseases[2] Goitre[1] Insomnia[1 2]	Medicine Food	Healing Ineffective Improvement
Foeniculum vulgare* Mill.** ***(E08 comp LRNE)	Na:fʔˤ [a]	Na:fʔˤ [a]	C Sp	Summer Spring	F D	St L Sd	Br Ht Pd	Br De I	O	Pi Sp H	Diabetes[2] Digestive system[1] Sexual diseases[2] Stress[1 2]	Medicine Food	Healing Ineffective Improvement
***Petroselinum crispum* (Mill.) Fuss** **(E12 comp LRNE)**	Mʔˤdˤnuːsˤ [a]	Mʔˤdˤnuːsˤ [a]	C	All year	F	L	Ht	De	O	Sp H Pi	Hypertension[1 2] Kidney problems[1] kyste[1] Rheumatism[1 2] Prostate[12]	Medicine Food	Healing Ineffective Improvement
***Visnaga daucoides* Gaertn.** **(E07 comp LRNE)**	Bʃnixa: *	ḍbwʃnixt *	S	Summer	D	Fr	Ex Br	M Br	O Ex.ap	Sp H	Hepatitis[2] Hair treatment[1] Influenza[2] Digestive system[1 2]	Medicine Religious beliefs and practice	Healing Ineffective Improvement
						Apocynaceae							
***Nerium oleander* L.** **(E13 comp LRNE)**	ðˤa:fla: *	a:ri:ri: *	S	All year	F	L	Ju Ex Ht Pd	De I Pd Dy Ju Bo	O In Ex.ap	Sp H Pi	Diabetes[1] Cold[1 2] Cough[1 2] Immune deficiency[1] Hair treatment[1] Hepatitis[1] Poisoning[1]	Medicine Decorative product Religious beliefs and practice Insect Repels	Healing Ineffective Improvement
						Arecaceae							
***Chamaerops humilis* L.** **(E14 comp LRNE)**	ðˤoum *	ḍa:gzi:nθ *	S	Spring Summer	D	Fr Ap	Ht	De I	O	Pi Sp H	Digestive system[1] Anemia[2] Goitre[2]	Medicine	Healing Improvement
						Aristolochiaceae							
Aristolochia fontanesii Boiss. & Reut. **(E15 comp LRNE)**	Brztˤa:m * ħa:ntˤa:l *	Brztˤa:m *	S	All year	D	Ro	Ht Sy Pd Lo	De M Pd Dy Po	O Ex.ap	Sp H Pi	Digestive system[1 2] Kidney problems[1] Cancer[1] Scar[1] Mouth sores[1 2] Influenza[2] Poisoning[2] Infection[1]	Medicine	Healing Ineffective Improvement
						Asparagaceae							
***Asparagus acutifolius* L.** **(E16 comp LRNE)**	sku:m *	a:sku:m *	S	Spring	D	Ro	Ht	I	O	Pg	Cough[1 2]	Medicine Food	Ineffective Improvement
						Asphodelaceae							
***Asphodelus ramosus* L.** **(E17 comp LRNE)**	*brwa*:g		S	Printemps	F D	Ro	Pd	Pd Po	Ex.ap	Sp	Dermatological diseases[1] eczema[1] Cancer[1]	Medicine	Improvement Ineffective

Asteraceae													
***Argyranthemum foeniculaceum* (Willd.) Webb ex Sch.Bip. (E19 comp LRNE)**	ʔˤʃbt dˤraːs		S	All year	F	L	Br	Br	O	Sp	Molar pain[1]	Medicine Decorative product	Improvement
***Artemisia arborescens* L. (E18 comp LRNE)**	ʃiba: [a]	ʃiba: [a]	C	All year	F	L	Br Ht Pd Lo	De I Cru Pd Dy	O Ex.ap	Sp H Pi	Cold[1 2] Microbial infection[1] Dental pain[1] Tiredness[2] Influenza[2] Bone diseases[1]	Medicine Food	Healing Ineffective Improvement
***Artemisia herba-alba* Asso (E20 comp LRNE)**	ʃiħ [a]	ʃiħ [a]	S	All year	D	L Ap	Ht Pd	De I	O	Sp H Pi	Diabetes[1] Digestive system[1] Cold[1] Cough[1] Microbial infection[1] Fever[2] Tiredness[2] Inflammation[1] Abortive[1]	Medicine	Healing Ineffective Improvement
***Centaurea benedicta* (L.) L. (E21 comp LRNE)**	ħliːba: *	ḍiːfaːf *	S	Spring	F D	L Sd	Pd Br	Pd Cd	O Ex.ap	Sp	Digestive system[1] Stomachique[1] Bone diseases[1 2]	Medicine Food	Ineffective Improvement
***Cynara humilis* L. (E22 comp LRNE)**	xrʃuːf *	Rxuːʃf *	C	Autumn	F	L	Pd	De	O	Sp	Digestive system[1]	Medicine	Healing
***Dittrichia viscosa* (L.) Greuter (E23 comp LRNE)**	Maːgraːmn [a]	Maːgraːmn [a]	S	All year	F	L Ro Ap	Br Sy Lo Ht Ex Pd	De Pd Po Bo	O Ex.ap	Sp H Pi	Tiredness[1] Influenza[1] [2]Abortive Allergy[2] Hemostatic[1 2]	Medicine	Healing Ineffective Improvement
***Matricaria chamomilla* L. (E24 comp LRNE)**	Lbaːbounj *	ɣaːduːmriːr *	S	Spring	D	Fl	Br Sy Lo Ht Ex Pd	De I	O	Sp H Pi	Digestive system[1] Intestinal pain[1 2] Nervous system[1] Stress[1] Allergy[1]	Medicine Decorative product	Healing Ineffective Improvement
***Scolymus hispanicus* L. (E25 comp LRNE)**	kerniːnaː *	Faːḍʃaːs *	S	Spring	D	Ro	Br	Br	O Ex.ap	Sp H	Diabetes[1] Cardiac[2]	Medicine Food	Healing Ineffective Improvement
Boraginaceae													
***Borago officinalis* L. (E26 comp LRNE)**	Buːħaːmduːnaː *	ħaːmduːn *	S	All year	F	Wp	Br	Po	Ex.ap	Sp	Headache[1 2]	Medicine	Improvement
Brassiceae													

***Brassica napus* L.** **(E27 comp LRNE)**	La:ft *	Ja:ft *	C	Winter All year	F	Ro	Ht	I	O	Sp	Cold[1 2]	Medicine	Improvement
***Lepidium sativum* L.** **(E28 comp LRNE)**	Hbrʃa:d [a]	Hbrʃa:d [a]	Id	Summer All year	D	Sd	Ht Pd	De I Pd	O Ex.ap	Sp H Pi	Diabetes[1] Cold[1] Bone diseases[1] Digestive system[1]	Medicine Food	Healing Ineffective Improvement
Cactaceae													
***Opuntia ficus-indica* (L.) Mill.** **(E29 comp LRNE)**	Lha:ndi:a: *	ḍa:hndi:ʃ *	S C	Spring All year	F D	Fl L Fr	Ht Lo Ju Br	De I Ju Br	O In	Sp H Pi	Diabetes[1] Digestive system[1] Cold[1] Analgesic[1] Sexual diseases[1 2] Prostate[1 2] Kidney problems[1 2]	Medicine Food	Healing Ineffective Improvement
Capparaceae													
Capparis spinosa* subsp. *spinosa **(E30 comp LRNE)**	Ka:ba:r *	Rka:ba:r *	S	Summer	F D	L Fr Sd	Ht Pd Br	Pd Br	O	Pi	Digestive system[1] O. diseases[1] Rheumatism[1 2] Fertility[1 2]	Food	Improvement
Caryophyllaceae													
***Corrigiola litoralis* subsp. *telephiifolia* (Pourr.) Briq.** **(E31 comp LRNE)**	Sᶜa:rɣina: *	ḍa:Sᶜrɣi:nt *	S	Summer	D	Ro	Ht Pd	De I	O Ex.ap	Sp H Pi	Diabetes[1 2] Digestive system[1 2] Cough[1] Headache[1 2]	Medicine	Healing Ineffective Improvement
***Herniaria hirsuta* L.** **(E32 comp LRNE)**	Ha:ra:st Lħʒa:r [b] Ndʒa:m [b]	Pi:pi:dra: [b]	S	Summer	D	Ap	Ht Pd	De I	O In	Sp H Pi	Kidney problems[1] Sexual diseases[2] Antiseptic[2]	Medicine	Healing Ineffective Improvement
***Silene vulgaris* (Moench) Garcke** **(E33 comp LRNE)**	Ti:ɣa:ʃt *	Ti:ɣʃ *	S	All year	F D	L Ro	Pd Ht Br	De Br	Fu O	Sp H	Cough Microbial Infection[1] Headache	Medicine	Improvement
Cistaceae													
Cistus ladanifer* subsp. *ladanifer **(E34 comp LRNE)**	Tu:za:lt *	ḍa:msa:skt *	S Id	Spring	D	Sd	Br	Br	O	Sp H Pi	Digestive system[1]	Medicine Food	Healing Ineffective Improvement
***Cistus salviifolius* L.** **(E35 comp LRNE)**	MʃtbaːS		S	Spring Winter	D	L	Bo	Bo	O	Sp	Digestive system[1]	Medicine	Improvement
Cucurbitaceae													
***Citrullus colocynthis* (L.) Schrad.** **(E36 comp LRNE)**	ħa:nda:l *	R*ħa:ndl* * ḍa:mna:t *	C	Summer	F	Fr	Lo Lo Ju	M Pd Ju	O Ex.ap	Sp H	Diabetes[1 2] Cancer[1] Acne[1] Diieritic[1 2]	Medicine	Healing Ineffective Improvement
Cupressaceae													

***Tetraclinis articulata* (Vahl) Mast.** **(E37 comp LRNE)**	Lʔˤrʔˤa:r *	i:mɣzi: * a:ʔˤa:ʔˤa: * a:mdzi: *	S	All year	F D	L	Ht Pd Br	De I Pd Br	O Ex.ap	Sp H Pi	Cancer Diabetes[1] Digestive system[1] Cold[1] Hair treatment[1] Sexual diseases	Medicine	Healing Ineffective Improvement
						Euphorbiaceae							
***Euphorbia resinifera* O. Berg** **(E38 comp LRNE)**	ðˤa:ɣmu:s		Id	All year	D	Wp Ap	Ht Pd Ju	De I Pd Ju	O In	Sp H	kyste Diabetes[1] Cold[1] Asthme[1] Fever[1] Cancer[1] Nervous system[1] Goitre[1] Fertility[1]	Medicine Food	Healing Ineffective Improvement
						Fabaceae							
***Ceratonia siliqua* L.** **(E39 comp LRNE)**	xa:roub *	ḍa:sri:ɣa: *	S	Summer	D	Fr	Ht Pd Br	De Pd Br	O	Sp H Pi	Digestive system[1 2] Microbial infection[1] Diarrhea[1] Sexual diseases[2] O. diseases[2]	Medicine	Healing Ineffective Improvement
***Glycine max* (L.) Merr.** **(E40 comp LRNE)**	Soʒa: [a]	Soʒa: [a]	Id	Summer	F	Sd	Ht Sy	De Pd	O Ex.ap	Sp H Pi	Cardiac[1] Tiredness[2] AperitIf[1]	Medicine	Healing Ineffective Improvement
***Glycyrrhiza glabra* L.** **(E41 comp LRNE)**	ʔˤra:q su:s [a]	ʔˤra:q su:s [a]	Id	All year	D	Ro	Ht	I	O	Sp	Intestinal pain[1] Tiredness[1 2] Inflammation[2] Allergy[1 2] Helicobacterium[1]	Medicine	Improvement
***Lupinus albus* L.** **(E42 comp LRNE)**	Trmi:s		Id	Summer	D	Fr	Pd	I	O	Sp	Diabetes[1]	Medicine	Improvement
***Trigonella foenum-graecum* L.** **(E43 comp LRNE)**	Ha:lba: *	Rhu:bḍ *	C	Summer	D	Sd	Ht Pd Br	De I Br	O Ex.ap	Sp H	Hypertension[1] Diabetes[1] Digestive system[1 2] Cold[1] Tiredness AperitIf[1] Allergy[2] Weight gain[1 2]	Medicine Food	Healing Ineffective Improvement
						Fagaceae							
***Quercus ilex* L.** **(E44 comp LRNE)**	Ku:ri:ʃ [a]	Ku:ri:ʃ [a]	S	All year	D	B	Ht	De	O	Sp	Digestive system[1]	Medicine	Ineffective
***Quercus suber* L.** **(E45 comp LRNE)**	Lbloutˤ *	a:ba:ju:d *	S	Autumn	F D	Fr Ro	Ht Pd Ju Br	De Bo Br	O Ex.ap	Sp H Pi	Diabetes[1] Digestive system[1] Cancer[1] Sexual diseases[2]	Medicine	Healing Ineffective Improvement
						Iridaceae							
***Crocus sativus* L.** **(E46 Comp LRNE)**	Zʔˤfra:n lħu:r [a]	Zʔˤfra:n lħu:r [a]	C	Autumn	F	Fl	Ht	I	O	Sp	Nervous system[1] Fertility[1 2]	Medicine Food	Ineffective

												Religious beliefs and practice	
Juglandaceae													
***Juglans regia* L. (E47 comp LRNE)**	Swa:k [a]	Swa:k [a]	C Id	All year	D	P	Ht Br	De Br	O Ex.ap	Pi H	Dental pain[1 2] Hair treatment[1]	Medicine	Ineffective
Juncaceae													
***Juncus acutus* L. (E48 comp LRNE)**	Sma:r [b]	ḍi:ku:ʃi:n [b] a:zra:f [b] u:a:zra:f [b]	S	All year	D	Fl	Ht Pd	I Pd	O Ex.ap	Sp	Digestive system[1 2] Dermatological diseases[1]	Medicine	Ineffective
Lamiaceae													
***Ajuga iva* (L.) Schreb. (E49 comp LRNE)**	ʃndgu:ra [a]	ʃndgu:ra [a]	S	Summer	F	L Ap	Ht	De I	O	Sp H Pi	Diabetes[1] Hypertension[1] Digestive system[1 2] Anemia[1 2] Pulmonary inflammation[1 2] Cardiac[1 2] Hair treatment[1] Influenza[2] Sexual diseases[2]	Medicine	Healing Ineffective Improvement
***Clinopodium nepeta* subsp. *spruneri* (Boiss.) Bartolucci & F.Conti (E50 comp LRNE)**	Ma:nta: [a]	Ma:nta: [a]	S	All year	D	L Ap	Ht Pd	De I	O	Pi Sp H	Digestive system[1] Cold[1] Cough[1] Fever[1] Dental pain[1] Sexual diseases[2] Inflammation[1] Headache[2]	Medicine	Healing Ineffective Improvement
***Lavandula* spp. (E51 comp LRNE)**	xza:ma: [a]	xza:ma: [a]	S	All year	F D	Fl Ap	Ex He Ht Pd	De I M Pd Ju	O In Ex.ap	Sp H Pi	Digestive system[1] Cold[1 2] Microbial infection[1] Fever[1 2] Respiratory system[1] Cancer[2] Hair treatment[1 2] Sexual diseases[2] Bone diseases[1 2] Urinary diseases[1 2] Rheumatism[2]	Medicine Decorative product Religious beliefs and practice	Healing Ineffective Improvement
***Lavandula stoechas* L. (E52 comp LRNE)**	ħa:lħa:l [a]	ħa:lħa:l [a]	S	All year	D	L	Ht	De	O	Sp H	Respiratory system[1] Bone diseases[1]	Medicine	Healing Improvement
***Marrubium vulgare* L. (E53 comp LRNE)**	Ma:rri:wa: *	Ma:rru: *	S	All year	D	L St	Ht Pd	De I	O	Sp H Pi	Diabetes[1] Digestive system[1] Cold[1 2] Cough[1] Cancer[1] Hepatitis[2] Poisoning[2]	Medicine	Healing Ineffective Improvement

***Mentha pulegium* L.** **(E54 comp LRNE)**	Fliːu: *	Friːu: *	S	Summer	D	L Ap	Ht Pd	De I Pd	O Ex.ap	Pi Sp H	Cold[1 2] Respiratory system[1] Scar[1] Urinary diseases[1]	Medicine Food	Healing Ineffective Improvement
***Mentha suaveolens* Ehrh.** **(E55 comp LRNE)**	Ti:mrsiːtˤaːn [b] MʃaːʃtruːMʃiːʃruː [b]	MʃiːʃruːMʃaːʃtruː [b]	S	Spring	F D	L Ap	Ht	De	O	Pi Sp H	Digestive system[1] Cold[1 2] Tiredness[1 2] Sexual diseases[2] O.diseases[1] Headache[1] Goitre[12] Poisoning[1] Influenza[1 2] Fever[1 2] Respiratory system[1 2]	Medicine Food	Ineffective Improvement
***Mentha spicata* subsp.** ***spicata* (E56 comp LRNE)**	Enʔˤnaːʔˤ [a]	Enʔˤnaːʔˤ [a]	S C	All year	F	Ap	Ht	De I	O	Sp H	Depression[1] Respiratory system [1] Analgesic[1 2]	Medicine Food	Healing Ineffective Improvement
***Ocimum basilicum* L.** **(E57 comp LRNE)**	Lhbaːq [a]	Lhbaːq [a]	C	Spring All year	F	L	Ht	I	O	Sp	Digestive system[1 2]	Medicine Decorative product	Ineffective
***Origanum* spp.** **(E59 comp LRNE)**	ZʔˤtˤaːrZuːiː *	Zuːiː *	S	All year Summer	D	L Ap	Ht Pd Br	De I Pd Br	O Ex.ap	Sp H Pi	Diabetes[1 2] Digestive system[1 2] Cold[1 2] Cough[1 2] Microbial infection[1 2] Fever[1 2] Respiratory system[2] Dental pain[2] Tiredness[1 2] Hair treatment[1 2] Influenza[1 2] Hepatitis[1] Poisoning[1] AperitIf[1] Headache[1 2] Antiseptic[1 2]	Medicine Food Decorative product	Healing Ineffective Improvement
***Origanum majorana* L.** **(E58 comp LRNE)**	Maːrdaːdoʃ [a]	Maːrdaːdoʃ [a]	S	Summer	D	L	Ht Pd	De I Po Bo	O In	Sp H	Hypertension[1] Cold[1] Cough[1] Depression[1] Cancer[1] Acne[1] Influenza[1 2] Sexual diseases[1] O.diseases[1] Poisoning[2] Allergy[2]	Medicine Food	Healing Ineffective Improvement
***Salvia officinalis* L.** **(E61 comp LRNE)**	Sˤaːlmiːaː [a]	Sˤaːlmiːaː [a]	C	All year	F	L Ap	Ht Pd	De I	O Ex.ap	Sp H Pi	Diabetes[1] Hypertension[1] Digestive system[1] Cold[1 2] Fever[2] Liver diseases[2] Influenza[1] Bone diseases[2]	Medicine	Healing Improvement Ineffective

***Salvia rosmarinus* Spenn. (E60 comp LRNE)**	A:zi:r [b]	A:zma:ra:z [b] Inrki: [b] A:za: [b]	S	All year	D	L	Ht Pd	De I	O Ex.ap	Sp H Pi	Diabetes[1] Hypertension[2] Digestive system[1] Cold[1] Cough[1] Microbial infection[1] Immune deficiency[2] Blood circulation[2] Hair treatment[2] Influenza[1 2] Sexual diseases[1 2]	Medicine Food	Healing Ineffective Improvement
***Thymus zygis* L. (E62 comp LRNE)**	Zʔˢitˢra: [a]	Zʔˢitˢra: [a]	S	All year	D	L Ap	Ht Pd	De I	O	Sp H	Hypertension[1] Digestive system[1] Cold[1] Microbial infection[2]	Medicine Decorative product	Healing Improvement Ineffective
Lamiaceae													
Cinnamomum loureiroi* Nees *(E63 comp LRNE)	_ka:rfa: *	_Lka:rfa: *	Id	Summer	D	Ro St	Ht Pd	De I Pd	O	Sp H	Diabetes[1 2] Digestive system[1 2] Microbial infection[1] Blood circulation[1] O.diseases[2]	Medicine Food Decorative product	Healing Improvement Ineffective
***Laurus nobilis* L. (E64 comp LRNE)**	Si:dna: mu:sa: *	ɣa:r *	C	Spring	D	L	Pd	De	O	Sp	Rheumatism[1] Influenza[2]	Decorative product	Improvement
Liliaceae													
***Allium sativum* L. (E65 comp LRNE)**	Θu:ma: *	ḍi:ʃa:ḍ *	C	Summer	F	Bu	Ht Pd	De	O Ex.ap	Sp H	Diabetes[1 2] Hypertension[1 2] Poisoning[1 2] Osteoporosis[2] Cancer[1] Intoxication[2] Alzheimer[2]	Medicine Food	Healing
***Leopoldia comosa* (L.) Parl. (E66 comp LRNE)**	Bsˢi:la: [b]	ḍa:bsˢi:ʃ [b] a:wʃn [b] Bsˢi:lt di:b [b]	S	All year	F	Bu	Ht	De	O	Pi	Digestive system[1]	Medicine	Improvement
Linaceae													
***Linum usitatissimum* L. (E67 comp LRNE)**	Za:riʔˢt Lkta:n		C Id	Summer	D	Sd	Ht He Pd	De Pd	O Ex.ap	Sp H	Diabetes[1] Digestive system[1] Hair treatment[1] Sexual diseases[2] Allergy[2]	Medicine	Healing Improvement Ineffective
Lythraceae													
***Lawsonia inermis* L. (E68 comp LRNE)**	*ħna*: *	*Rħni*: *	C	All year	D	L	Ht Pd	De I Pd Dy	O Ex.ap	Sp H Pi	Dental pain[1] Hair treatment[1] Burns[1 2]	Medicine	Healing Improvement Ineffective
Malvaceae													

***Hibiscus sabdariffa* L.** **(E69 comp LRNE)**	Ka:rka:dˁi:l		Id	Spring	D	Fl	Ht Pd	De I	O	H	Diabetes[1] Hypertension[1] Stress[1 2]	Medicine	Healing Ineffective
						Myristicaceae							
***Eucalyptus globulus* Labill.** **(E70 comp LRNE)**	*ka:li:tu:s*		S	All year	F	L	Ht Ex	I Ju	In Fu	Sp H	Cold[1] Microbial infection[1 2] Analgesic[1] Influenza[1] Antiseptic[1 2] COVID19[1]	Medicine Religious beliefs and practice	Healing Improvement Ineffective
***Myrtus communis* L.** **(E71 comp LRNE)**	*Ra:i:ħa:n* [a]	*Ra:i:ħa:n* [a]	S	Spring Summer	D	L	Ht Pd	De I	O	Sp H	Hypertension[1] Digestive system[1] Cancer[1 2] Tiredness[2] Hair treatment[1 2] Stress[2]	Medicine	Healing Improvement Ineffective
***Myristica fragans* Houtt.** **(E72 comp LRNE)**	ju:za: [a]	ju:za: [a]	C	Autumn	D	Sd	Pd	Pd	O	Sp	Digestive system[1] [2]Cold[1] Influenza[2] Abortive[1]	Medicine Food	Ineffective
Syzygium aromaticum* (L.)** ***Merr. & L.M.Perry **(E73 comp LRNE)**	kru:nfa:l *	ra:kna:fr *	Id	Spring Summer	D	Fr	Ht Pd	De I Pd	O	Pi Sp H	Cold[1] Dental pain[1 2] Influenza[1 2] Bone diseases[2] Urinary diseases[2] Inflammation[1 2] Rheumatism[2] Antiseptic[1]	Medicine Food	Healing Improvement Ineffective
						Oleaceae							
Olea europaea* L. subsp.** ***Europaea **(E74 comp LRNE)**	*lba:ri*:		S	All year	F	L	Ht	De	O	Sp	Diabetes[1 2]	Medicine	Ineffective
Olea europaea subsp. ***europaea*** **(E75 comp LRNE)**	Zi:tu:n [a]	Zi:tu:n [a]	C	All year	F	L	Ht Lo Pd	De M	O Ex.ap	Pi Sp H	Diabetes[1 2]	Medicine	Healing Improvement Ineffective
						Papaveraceae							
***Papaver rhoeas* L.** **(E76 comp LRNE)**	*Blʔˁma:n* *	*Bnʔˁma:n* *	C	Spring	D	Fl	Ht Pd	I Bo	O Ex.ap	Sp H	Intestinal pain[1] Cold[1 2] Cancer[1 2]	Medicine	Healing Improvement Ineffective
						Pinaceae							
***Pinus halepensis* Mill.** **(E77 comp LRNE)**	*Ta:jda*: *	ḍa:jda: *	C	All year	D	L	Ht	De I Pd	Ex.ap	Sp	Digestive system[1] Cold[1] cough[1] Diarrhea[1] Burn[2]	Medicine	Improvement Ineffective
						Plantaginaceae							
***Plantago major* L.** **(E78 comp LRNE)**	*Msˁa:sˁa*:		S	All year Spring	F D	L	Pd	Pd	Ex.ap	Sp	Dermatological diseases[1] Intestinal pain[1]	Medicine	Improvement Ineffective

Poaceae													
***Cenchrus americanus* (L.) *Morrone* (E79 comp LRNE)**	*i:la:n* [a]	*i:la:n* [a]	Id	Autumn	D	Sd	Ht	Pd	O	Sp	Bone diseases[1]	Medicine	Ineffective
***Zea mays subsp. mays* (E80 comp LRNE)**	*du:ra:* *	*dra:* *	C	Summer	D	Fr P	Ht Br	I Br	O	Sp H	Diabetes[1] Intestinal pain[1] Cough[1]	Medicine Food	Healing Ineffective
Polygonaceae													
***Emex spinosa* (L.) *Campd.* (E81 comp LRNE)**	*ħu:ma:jda:* [b]	ḍa:ssa:ma:nt [b] ḍa:ssmu:nt [b]	S	Summer	F	Ap	Ht	De	O	Sp H	Diabetes[1] Digestive system[1] Tiredness[2] Liver diseases[1]	Medicine Food	Healing Improvement Ineffective
Punicaceae													
***Punica granatum* L. (E82 comp LRNE)**	*Rma:n* *	*A:rma:n* *	C	Autumn	D	Pe P	Ht Pd	De Pd Dy Bo	O Ex.ap	Sp H	Digestive system[1] Cancer[2] Tiredness[2] Hair treatment[1] Mouth sores[1 2] Influenza[2] Sexual diseases[1]	Medicine Food	Healing Improvement Ineffective
Ranunculaceae													
***Nigella sativa* L. (E83 comp LRNE)**	*Sa:nu:ʤ* [a]	*Sa:nu:ʤ* [a]	Id	Summer	D	Sd	Ht Sy Pd	De Pd Dy	O In	Sp H	Diabetes[1] Digestive system[1] Cold[1] Cardiac[2] Nervous system[2] Influenza[1] Poisoning[2] Aperitlf[2] Allergy[2]	Medicine Religious beliefs and practice	Healing Improvement Ineffective
Rhamnaceae													
***Ziziphus lotus* (L.) *Lam.* (E84 comp LRNE)**	ðˁra: [b] nba:g [b]	ḍza:xt [b] i:za:ɣn [b]	S	Summer	D	L Fr	Br Ht Pd	De Pd Dy Bo Br	O Ex.ap	Sp H	Diabete[1]s Hypertension[1] Digestive system[1] Intestinal pain[1] Microbial infection[1] Kidney problems[1] Cancer[1 2] Tiredness[2] Sexual diseases[2]	Medicine Food	Healing Improvement Ineffective
Rosaceae													
***Crataegus monogyna Jacq.* (E85 comp LRNE)**	*Zʔˁru:r* *	*A:dma:m* *	S	Autumn	D	L	Ht	De	O	H	Digestive system[1]	Food	Improvement
***Rosa centifolia* L. (E86 comp LRNE)**	*Lwa:rd* [a]	*Lwa:rd* [a]	C	Spring	D	Fl	Ht	De Pd Dy	O	Sp	Digestive system[1] Cold[1] Fever[1] Hair treatment[1 2] Sexual diseases[1 2] Bone diseases[1 2]	Medicine	Improvement Ineffective

Rutaceae													
***Ruta montana* L.** **(E87 comp LRNE)**	*Fi:dgl* [a]	*Fi:dgl* [a]	Id	Summer	D	Ro Ap	Ht	De Pd Dy	O	H	Intestinal pain[1 2] Abortive[1]	Medicine	Improvement
Salicaceae													
***Populus alba* L.** **(E88 comp LRNE)**	Sa:fsa:f *	A:fanSa:fsa:f *	S	All year	D	L	Ex	M	In		Coronavirus[2]		
Solanaceae													
***Lycium barbarum* L.** **(E89 comp LRNE)**	*ʔᶜa:wʃi:ʃ*		S	Spring Winter	F	L	Ex	G	Ex.ap	H	Eye diseases[1]	Medicine	Healing
***Solanum melongena* L.** **(E90 comp LRNE)**	Xu:dnʤa:l [a]	Xu:dnʤa:l [a]	Id		D	Rh	Ht Pd	De I	O		Blood circulation[2] Analgesic[2] Burn[1 2] Cholesterol[2] analgesic[2] Rheumatism[1 2] Fertility[1] Sexual stimulant[1 2]	Medicine	
Styracaceae													
***Styrax officinalis* L.** **(E91comp LRNE)**	ʤa:wi: [a]	ʤa:wi: [a]	S	All year Summer	F D	L	Pd Cr	Pd Ju	Ex.ap		Burn[1 2] Rheumatism[2]	Medicine	
Thymelaeaceae													
***Daphne gnidium* L.** **(E92 comp LRNE)**	La:za:z * Mtna:n *	La:za:z *	S	Summer	D	L	Pd	De Pd Dy Bo	Ex.ap	Sp	Hair treatment[1 2] Cancer[1]	Medicine	Improvement Ineffective
Urticaceae													
***Urtica dioica* L.** **(E93 comp LRNE)**	*ħa:r i:ga:* *	ḍa:gzi:nt *	S	Spring	F D	L Ro	Ht Pd	I Bo	O	Sp H	Diabetes[1] Cough[1] Respiratory system[1] Cancer[1] Acne[1 2] Diarrhea[1] Bone diseases[2] Allergy[1 2]	Medicine Food	Healing Improvement Ineffective
Verbenaceae													
Aloysia citrodora Paláu **(E94 comp LRNE)**	Lwi:za: *	Ma:lwi:za: *	C	Summer	D	L	Ht Pd	De I	O In	Sp H	Hypertension[1] Digestive system[1] Cold[1 2] Respiratory system[1] Tiredness[2] Stress[1 2]	Medicine	Healing Improvement Ineffective
Zygophyllaceae													
***Peganum harmala* L.** **(E95 comp LRNE)**	ħa:rma:l *	rħa:rmr *	S	Summer	F D	Ap	Ht Pd	M Pd	O Fu	Sp Pi	Diabetes[2] Insomnia[1 2] Epilepsiy[1]	Medicine	Ineffective

												Religious beliefs and practice	
Zingiberaceae													
***Zingiber officinale Roscoe* (E96 comp LRNE)**	Ski:ndʒbi:r [a]	Ski:ndʒbi: [a]	Id	Summer	D	Rh	Ht Pd Sy	De Pd	O In	Sp H	Cardiac[1 2] Cold[1] Influenza[1] Poisoning[1]	Medicine	Healing Improvement Ineffective

Legend:
E0.comp LRNE = Echantillon 0. Natural Resources and Environment Laboratory; **Ecological distribution: S** = Spontaneous **C** = Cultivated **Id** = Introduced; **Plant state: D** = Dry **F** = Fresch **Forme of employment: Cr** = Cream **Br =** Brute **Pd** = Powder **Ex** = Extract **He** = Huile essential **Ht** = Herbal tea **Ju** = Juice **Lo** = Lotion **Sy** = Syrup **M** = Maceration **I =** Infusion; **Preparation: De** = Decoction **Po** = Poultice **Bo** = Boiled **Cd** = Cooked **Dy** = Dyeing **G** = Grinding; **Part used**: **Ap** = Areal Plant **B** = Bark **Bu** = Bulb **L** = Leaves **P** = Peel **Pe** = Pericarp **Rh** = Rhizomes **Ro** = Roots **Wp** = Whole plant **Fl** = Flowers **Fr** = Fruit **Sd** = Seeds **St** = Stem; **Administration: Ex.ap** = External app **In** = Inhalation **O** = Oral **Fu** = Fumigation; **Dose used: H** = Handle **Pi** = Pinch **Sp** = Spoonful; ***:** two vernaculars; [a]: more than two vernaculars; [b]: shared vernaculars. ; **[1] :** Pre-Rif of Taza **[2] :** Rif of Al Hoceima **[1 2] :** Pre-Rif of Taza and Rif of Al Hoceima ; **ḍ**=th", **ġ** = **gh**= rh, **ḫ**= kh, **š** = ch =sh, **u** = ou.

Table 4. Similarity of species reported in both provinces

Provinces	Indices	Jaccard Index (JI)
Pre-Rif of Taza / Rif of Al-Hoceima	A^1= 93 B^2= 63 C^3= 32	0.25

[1]Number of taxa recorded in the Pre-Rif of Taza; [2]Number of taxa recorded in the Rif of Al-Hoceima; [3]Number of taxa similar between two provinces.

The analysis highlights a relatively low similarity between the Pre-Rif of Taza and the Rif of Al-Hoceima, with a Jaccard index of 0.25 (Table 4). This points to notable differences both culturally and environmentally between these areas, as well as linguistic variations between Arabic and Berber dialects. Nevertheless, the presence of shared taxa suggests exchanges and interactions between these provinces, thus contributing to this level of similarity despite their distinctions (Figure 4).

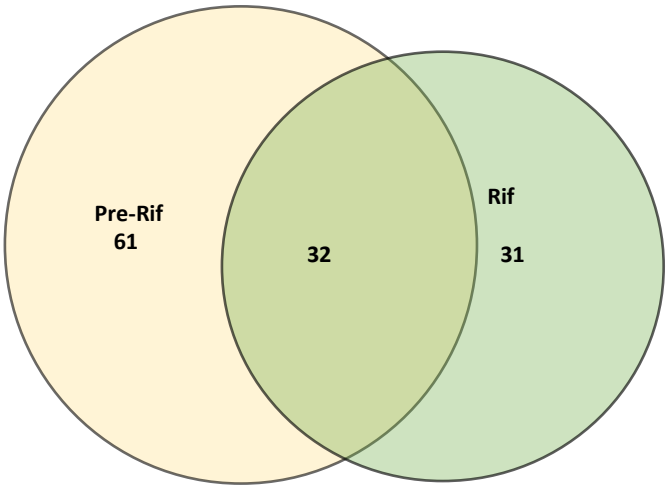

Figure 4. Common names shared among species across the two provinces.

These findings indicate a combination of similarities and marked differences among taxa reported in the two provinces. This highlights that each province has a distinct body of ethnobotanical knowledge, thereby enriching the overall diversity of local knowledge in the region.

Table 5. Ethnotaxonomy: Inclusive and Exclusive Classifications.

	Ethnotaxon	Ethnotaxon Exclusive	Ethnotaxon No Exclusive	Species
Our study	44	44	0	
A / Taza (Khabbach *et al.* 2011)	69	66	3	**Kalitous** *(Eucalyptus camaldulensis Dehnh. - Eucalyptus globulus Labill).* **Tayda** *(Pinus halepensis Mill.* *Pinus pinaster subsp. escarena (Risso) K.Richt).* **Achih** *(Artemisia herba-alba Asso- pectinata (Lam.) Briq. & Cavill).*
B / Taza (Khabbach *et al.* 2012)	36	36	0	-
C / Taza (Boulfia *et al.* 2018)	38	36	2	**Zaâtar** *(Origanum* spp */ Origanum Elongatum).* **Rbiâssam** *(Centaurium maritimum* (L.) *Fritsch / Centaurium Erythraea Rafn).*
D / Taza (El Haouari *et al.* 2018)	92	92	0	-

E / Taza (El Brahimi *et al.* 2022)	102	102	0	-
F / Hoceima (Smaili *et al.* 2023)	75	73	2	**Ibaouan** *Vicia Faba* L. */ Vicia sativa* L. **L-'ar'ar** *Juniperus phoenicea* L. / *Tetraclinis articulata (Vahl) Mast.*
G / The Rif, Northern Morocco. (Chaachouay *et al.* 2022)	215	206	9	**Sekkom** *Asparagus acutifolius* L. */ Asparagus densiflora Kunth. / Asparagus officinalis* L. */ Asparagus plumosus Baker / Asparagus stipularis Forssk* **Houmida** *Emex spinosa* (L.) *Campd. / Rumex acetosa* L. **Sefsaf** *Populus alba L. / Populus nigra* L. **Kalitûs** *Eucalyptus camaldulensis Dehnh. / Eucalyptus globulus Labill.* **Chih** *Artemisia herba-alba Asso / Artemisia mesatlantica Maire* **Rtem** *Retama monosperma* (L.) *Boiss / Retama raetam (Forssk.) Webb* **Tifaf** *Sonchus asper* (L.) *Hill / Sonchus tenerrimus* L. */ Sonchus fragilis Ball* **Karmous** *Ficus carica* L. */ Ficus carica var. dottato* **Lakhzama** *Lavandula dentata* L. */ Lavandula pedunculata (Mill.) Cav / Lavandula officinalis Chaix*
H/ Taza (Ghabbour *et al.* 2024a)	91	65	0	-

When a single vernacular name is used to designate a plant or a taxon, we speak of an ethnotaxon. It can be exclusive if it is systematically associated with a single plant, or non-exclusive if it is used to designate different plants. The distinction between these two concepts is essential for understanding cultural diversity in the way individuals interact with and understand the biodiversity around them. Our study compared previous research carried out in Taza and Al-Hoceima. First, we identified the ethnotaxa present in each study, then distinguished exclusive from non-exclusive ethnotaxa. The results indicate that in four studies only exclusive ethnotaxa were present, while another four studies included both exclusive and non-exclusive ethnotaxa. The non-exclusive ethnotaxa were mainly associated with species with the following vernacular names: "Rbiâssam / Zaâtar / Achiḥ / Tayda / Kalitous Ibaouan / L- 'ar'ar / Sekkom / Houmida / Sefsaf / Kalitûs / Chih / Rtem / Tifaf / Karmous / Lakhzama ", as illustrated in (Table 5).

This analysis highlights the fact that the same vernacular name can designate several plant species, emphasizing that vernacular names do not allow precise identification of plant species nor a distinction between species and subspecies. This underscores the importance of scientific identification for a more precise classification of plant species; the use of scientific names ensures clear and precise communication in the field of preservation and study of biodiversity. The results obtained seem consistent with a previous study (Najem *et al.* 2021) that looked further into the question of vernacular names. This study highlighted that a species with a single vernacular name can correspond to several distinct species. This situation can lead to confusion when identifying plants, which could potentially influence the risk of poisoning.

Ecological distribution

Harvest period and Type of medicinal and aromatic plants in the study areas.

The harvesting period depends on several factors, such as climatic conditions, plant maturity and traditional practices. It represents an essential step to ensure the quality of the plants and optimize their use. The results concerning the harvest periods reveal a marked similarity between the two study areas, where the collection of plants is mainly carried out throughout the year, in summer and spring, representing respectively 50.4 %, 29.5 % and 13.6 % for the Pre-Rif, against 47.8 %, 32.5 % and 12.4 % for the Rif. A difference was reported at the level of the following periods where the Pre-Rif is followed by autumn with 4.8 % and winter with 1.7 % While the Rif is followed by winter with 4.7 % while autumn represents only 1.3 %. This is relatively consistent with a previous study (Chaachouay *et al.* 2020) and not consistent with another study (Adouane 2016).

Furthermore, the populations of the two study areas show a notable preference for spontaneous plants, representing 67 % and 71 % in the Pre-Rif and the Rif, respectively, a result in agreement with a previous study 55.9 % (Ghabbour *et al.* 2024a, El Aboui *et al.* 2024). Cultivated plants occupy a secondary place with 22 % in the Pre-Rif and 21 % in the Rif, while the use of imported plants remains marginal, not exceeding 12 % in both regions. The high use of spontaneous plants is explained by their availability throughout the year, highlighting the importance of local natural resources. These observations confirm the wealth of traditional knowledge and sustainable practices associated with the use of medicinal plants, in agreement with other similar studies (Khabbach *et al.* 2011, Ndjouondo *et al.* 2015, Smaili *et al.* 2023, Ghabbour *et al.* 2024b).

Plant use

The analysis of the data collected reveals that the majority of the populations of Pre-Rif (58.1 %) and Rif (81 %) use medicinal plants for therapeutic purposes, and respectively 10.5 % and 30.1 % of this population primarily utilize them for culinary purposes (Figure5). On the other hand, a smaller share, respectively 2.6 % and 5.3 %, is attributed to their decorative use. Only 5 % and 3 %, respectively, are associated with magical practices and religious or spiritual beliefs, while a small proportion, which does not exceed 4 % in the areas, is intended for insect repelling, which is consistent with previous studies (El-Assri *et al.* 2021). These results illustrate the versatility of medicinal plants and their ability to meet a wide range of needs within communities. Their diverse use reflects the richness of traditional knowledge and its importance in several aspects of daily life, ranging from physical health to nutrition, including aesthetics and spirituality.

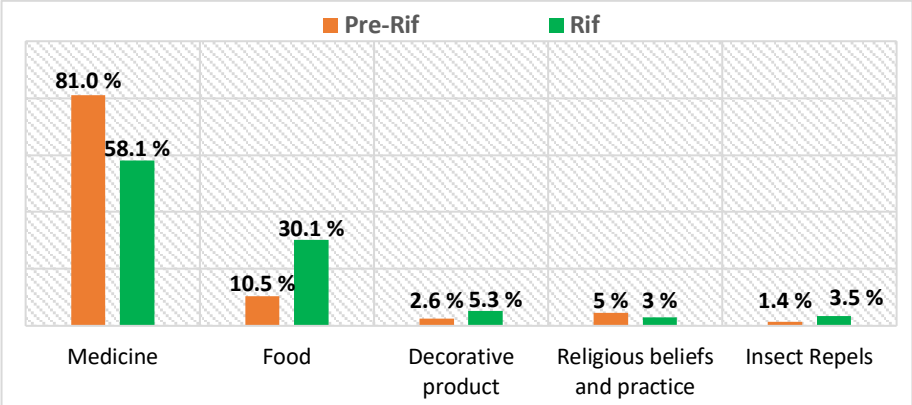

Figure 5. Uses of plants inventoried in the study area.

Gathering strategy, period and conditions, and drying method.

The results showed that at the level of the two study areas, all the plants were collected manually using secateurs, knives, chisels, or sickles, which can confirm their richness in medicinal and aromatic plants (MAPs) and therefore easy accessibility. Almost all of these plants, 62 % at the Pre-Rif level and 61 % at the Rif level, respectively, were used dry, where the drying is done essentially away from light with 50% and 36 %, respectively, while drying by exposure to light is only 12 % and 25 %, respectively (Figure 6). This is in line with previous studies (Ndjouondo *et al.* 2015, Slimani *et al.* 2016).

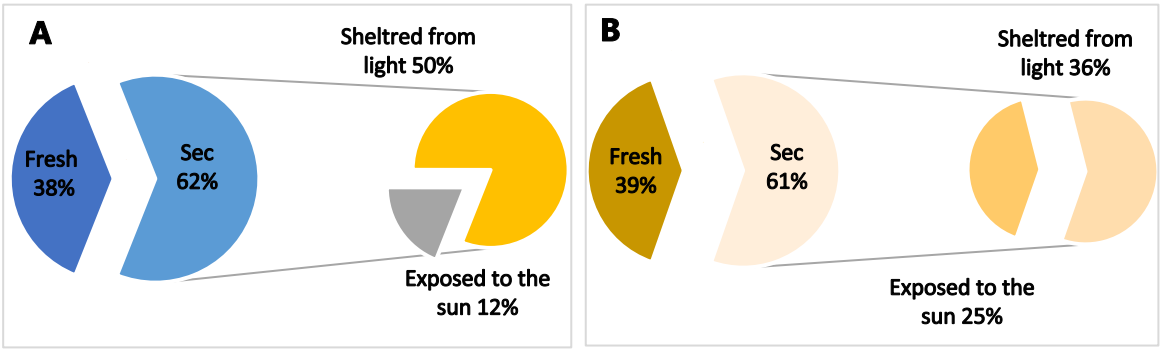

Figure 6. Harvest state and drying method in the Pre-Rif of Taza (A). Harvest state and drying method in the Rif of Al-Hoceima (B).

Plant's part used

Different parts of the plants are used for the treatment of diseases in the study area. The leaves are the most used part, with 55.6 % and 54.2 % in both the Pre-Rif of Taza and the Rif of Al Hoceima respectively (Table 6), which is in line with other studies (Ghabbour *et al.* 2024b, El Aboui *et al.* 2024, Benali *et al.* 2017, Boulfia *et al.* 2018, El Brahimi *et al.* 2022, El Mansouri *et al.* 2011, Ennabili *et al.* 2000, Khabbach *et al.* 2011, Mehdioui & Kahouadji 2007, Salhi *et al.* 2010,). However, significant differences are observed in the use of other parts of the plant between these two zones. In the Pre-Rif, the aerial part is 12.7 %, the seeds 9.2 % and the roots 7.5 % are more used, while in the Rif, the stem 12.7 %, the aerial plant 8.7 % and the seeds 7.3 % are more exploited.

Table. 6. Most parts are used in the Pre-Rif of Taza and the Rif of Al Hoceima.

Plant parts used	The Pre-Rif of Taza	Rif of Al Hoceima
Leaves	55.6 %	54.2 %
Stem	2 %	12.7 %
Aerial part	12.7 %	8.7 %
Seeds	9.2 %	7.3 %
Fruits	4.5 %	5.2 %
Flowers	5.7 %	4.1 %
Rhizomes	0.4 %	2.2 %
Roots	7.5 %	1.5 %
Bulb	0.7 %	1.2 %
Pericarp	1 %	1.2 %
Bark	0.4 %	1 %
Whole plant	0.1 %	0.9 %

Preparation method

Methods of preparation, dose, duration and result of treatment

According to our field survey results, infusion, decoction and grinding are the main methods of preparation used in the two study areas with different rates where they are respectively represented in Pre-Rif by 36.1 %, 29.6 %, and 23.3 %, while in Rif they are represented by 35.7 %, 45.1 %, and 6.9 %. Other methods such as boiling, maceration, essential oil, cataplasm and juice are used but with rates that do not exceed 4 %. These results reveal a great convergence in the way the recipes are prepared for both populations from the two study regions, which may be because the decoction makes it possible to capture the most active principles and cancels the toxic effect of certain recipes. The result is consistent with several previous studies emphasizing that decoction, infusion and grinding are the predominant methods of plant preparation. This highlights the importance of processes that extract beneficial properties from plants for various uses (Ghabbour *et al.* 2024b, El Aboui *et al.* 2024, Benali *et al* .2017, Chaachouay *et al.* 2020, El Brahimi *et al.* 2022, Khabbach *et al.* 2012, Salhi *et al.* 2010).

Several factors come into play to ensure the effectiveness and safety of medicinal plants. Determining the appropriate dose of use, duration of treatment and observed results is of paramount importance. These elements often define the success and effectiveness of herbal remedies, as well as influence the perception of their use within communities.

The majority of Pre-Rif and Rif interviewed respectively use spoons as the basic dose for the preparation of different remedies at 62.1 % and 51.8 % respectively, handfuls at 30.1 % and 36.9 % respectively and pinch at 7.8 % and 9.8 % respectively. These remedies are generally taken at the Pre-Rif level for a short duration at 40.5 % or medium duration at 40.1 % and rarely over a long period at 19.4 % while the Rif are taken mainly for a medium period at 50.6 % followed by a short period 35.5 % and just 12.4 % who take them for a long duration. Regarding beliefs about the effectiveness of these remedies, 49.2% of the population of the Pre-Rif and 44.4 % of the Rif believe in their power to improve health as well as 26.6 % and 22.7 % of the Pre-Rif and Rif respectively believe in their curative power, while 22.5 % and 27.5 % of Pre-Rif and Rif respectively consider them ineffective.

The results show that the majority of Pre-Rif and Rif respectively use spoons as the basic dose for the preparation of different remedies at 62.1 % and 51.8 % respectively followed by handfuls at 30.1 % and 36.9 % respectively and pinch at 7.8 % and 9.8 % respectively. This appears to be consistent to some extent with previous results (El-Assri *et al.* 2021).

These remedies are generally taken at the Pre-Rif level for a short duration at 40.5 % or medium duration at 40.1 % and rarely over a long period at 19.4 % while the Rif are taken mainly for a medium period at 50.6 % followed by a short period 35.5 % and just 12.4 % who take them for a long duration. Regarding beliefs about the effectiveness of these remedies, 49.2 % of the population of the Pre-Rif and 44.4 % of the Rif believe in their power to improve health as well as 26.6 % and 22.7 % of the Pre-Rif and Rif respectively believe in their curative power, while 22.5 % and 27.5 % of Pre-Rif and Rif respectively consider them ineffective.

Preparation and Administration

Most remedies were administered orally, with 73.7 % and 82.7 % for Pre-Rif and Rif, respectively, mainly in the form of herbal tea with 60.1 % and 68.3 %. Then in powder form, 19.2 % and 12.9 % are for external use, with 18.6 % and 16.9 % respectively, while inhalation and fumigation and other forms, such as raw, extraction and essential oil, do not exceed 7 % (Figure 7). Similar results have been obtained in other studies (Ghabbour *et al.* 2024b, Bouyahya *et al.* 2017, Djouamaa *et al.* 2022, El Abbouyi *et al.* 2014, EL Alami & Chait 2017, El Haouari *et al.* 2018, Idm'hand *et al.* 2020, Kachmar *et al.* 2021, Khabbach *et al.* 2012, Youbi *et al.* 2016).

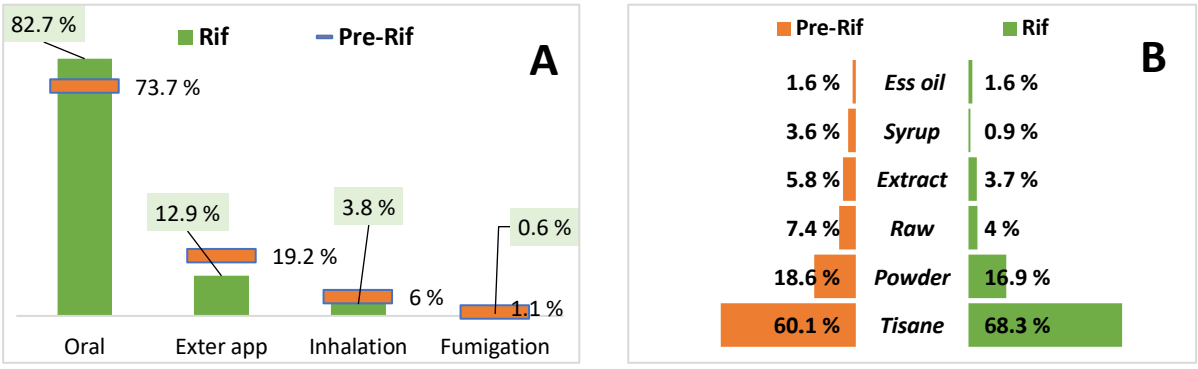

Figure 7. Administration method of medicinal plants used in the study area (A). Form of employment of medicinal plants used in the study area (B).

Commonly treated diseases and diagnostic

The medicinal plants inventoried are used to treat various diseases; digestive disorders have the highest frequency in both areas, while a difference is noted for the rest of diseases, with diabetes, cancer, and colds being the most targeted by these remedies in the Pre-Rif, while it is not the case in the Rif, where colds, influenzas, and tiredness are the most cited (Figure 8). The results mentioned are consistent with those of other studies (Ghabbour *et al.* 2023, Belhaj *et al.* 2020, Boulfia *et al.* 2018, Bouyahya *et al.* 2017, El Alami & Chait 2017, El Brahimi *et al.* 2022, El Haouari *et al.* 2018, Es-Safi *et al.* 2020, Idm'hand *et al.* 2020, Fakchich & Elachouri 2014, Khabbach *et al.* 2012, Mehdioui & Kahouadji 2007, Slimani *et al.* 2016, Ullah *et al.* 2013) carried out in various regions of Morocco and outside Morocco, particularly with regard to predominant pathologies such as those affecting the digestive system.

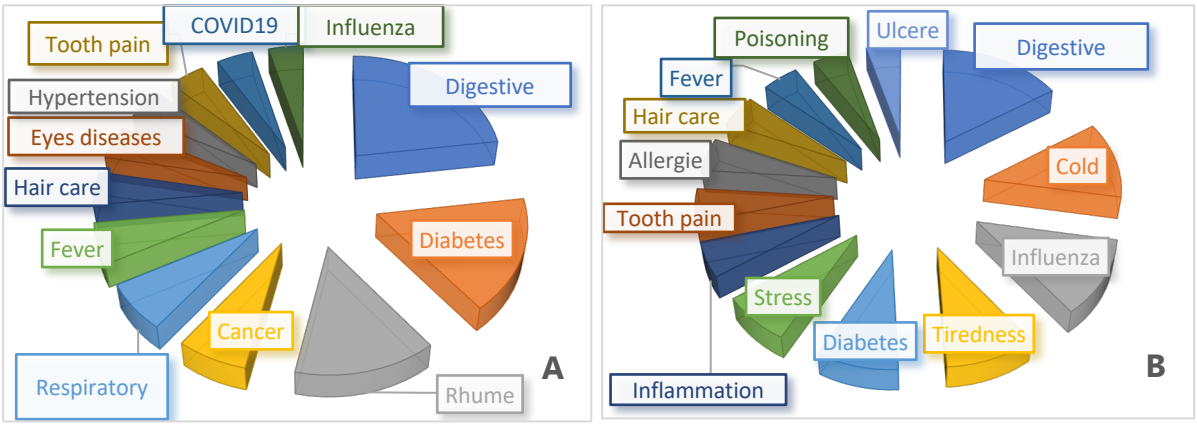

Figure 8. Illustration of Commonly Treated Diseases by the Pre-Rif population (A) and by the Rif population (B).

The comparison displayed in Table 7 highlights the medicinal properties of the plant species most commonly utilized in our research, in contrast to their applications found in earlier studies conducted in Taza and Al-Hoceima. The results underline a

consistency between our study and previous studies concerning the main pathologies treated by the majority of species studied (Smaili *et al.* 2023, Chaachouay *et al*., 2022, Ghabbour *et al*., 2023). Each plant has the same set of diseases that have been studied before, except for *Lycium barbarum* L., which is only found in our study and only in the Pre-Rif and not the Rif.

***Rosmarinus officinalis* L.*, Artemisia herba-alba* Asso.*, Lavandula* spp. *and Origanum* spp.** are among the most frequently used medicinal plants, sharing a high number of diseases treated. The most frequently targeted conditions are digestive and respiratory disorders, colds and coughs. Previous studies have confirmed their antioxidant, anti-inflammatory and antimicrobial properties (Amor *et al.* 2019, Diass *et al.* 2023), confirming their effectiveness in traditional medicine. The recurrent use of these species for similar diseases highlights the intergenerational transmission of ethnobotanical knowledge, ensuring the continuity of their therapeutic applications. Over time, this knowledge has facilitated the constant use of these plants to treat specific health problems.

Conclusion

Our comparative ethnobotanical study highlights the richness of traditional knowledge linked to medicinal plants in the Rif and Pre-Rif of Morocco. The results highlight a preference for traditional medicine among those surveyed. The study included 820 participants, providing information on 51 families across 96 plant species. Lamiaceae and Asteraceae families are the most often mentioned ones. In the Pre-Rif period, the most common species were *Origanum* spp. and *Eucalyptus globulus* Labill., whereas in the Rif period, the most common species were *Origanum* spp. and *Rosmarinus officinalis* L. It is noteworthy to note that the two provinces share striking similarities in the plant parts used, preparation processes, and administration methods. Furthermore, the results showed that, despite geographical and cultural differences, there are striking similarities in the use of certain plants to treat specific pathologies. This suggests a common base of ethnobotanical knowledge shared between these groups. This highlights the importance of preserving and promoting this ancestral knowledge, not only for its cultural value but also for its potential in terms of traditional medicine and biodiversity conservation. This necessitates maintaining this line of inquiry in order to promote novel methods of traditional medicine and spontaneous flora preservation, all the while protecting cultural diversity and plant ecosystem conservation.

Table 7. Comparative study of the therapeutic uses for the plants with a higher frequency of Citation and their number.

Nom scientifique	Our study	[1]	[2]	[3]	[4]	[5]	[6]	[7]	CD
***Origanum* spp.**	Diabetes, Digestive System, Cold, Cough Microbial Infection, Fever, Respiratory System, Dental Pain, Tiredness, Hair Treatment, Influenza, Hepatitis, Poisoning, Aperitif, Headache, Antiseptic	-	-	-	-	Diabetes, Digestive System, Cold, Cough, Microbial Infection (Covid 19), Fever,Respiratory System, Cancer, Stomach Pain, Tiredness Nervousness, Flu Mouth and Diseases Cardiac	-	Digestive System	8
***Eucalyptus* spp.**	Cold, Microbial Infection, Analgesic, Influenza, Antiseptic, COVID19	Anti-Rheum, Anti-Rheumatic, Anti-Flu	Influenza, Antiseptic, Diabetes	Affection Respiratory	Respiratory Disease, Diabetes	Diabetes, Hypertension, Digestive System, Asthma, Fever, Immune Deficiency, Lung Inflammation, Respiratory System, Flu, Yellowing, Cardiac	Common Cold	Symptoms Of Respiratory Disease (Bronchitis, Rhinitis)	6
***Rosmarinus officinalis* L.**	Diabetes, Hypertension, Digestive System, Cold, Cough, Microbial Infection, Immune Deficiency, Blood Circulation, Hair Treatment Influenza, Sexual Diseases	Purgative, Sedative (Aorta Palpitations, Called Locally "Boumzoui"), Anti-Rheum, Anti-Rheumatic, Liver, Protection	Digestive System, Internal Bleeding, Burns, Poison Antidote, Sedative, Anti-Inflammatory, Cold, Stimulate Blood Circulation, Hair Cair	Diarrhea, Affection Respiratory	Digestive Problems, Burn Treatment, Sedative, Blood Circulation Stimulation, Anti-Inflammatory, Cold Problems, Hair Care	Diabetes, Headaches, Digestive System, Intestinal Pain, Cold Cough, Fever, Respiratory System, Renal System, Dental Pain, Stomach Pain, Tiredness, Diarrhea, Dizziness, Sexual Impotence Nervous System, Nervousness, Flu, Sexual Diseases,	-	Metabolic Diseases	12

					Mouth Diseases, Circulatory Diseases, Cardiac, Stomach Ulcer				
***Lavandula* spp.**	Digestive System, Cold, Microbial Infection, Fever, Respiratory System, Cancer, Hair Treatment, Sexual Diseases, Bone Diseases, Urinary Diseases, Rheumatism	-	Cold Problems, Burns, Mycoses, Digestive System, Respiratory System Disorders, Sedative, Menstrual, Disorders, Diuretic, Rheumatism, Hair Cair	-	Cold Problem, Burn Treatment, Digestive Disease, Sedative, Kidney Disease Rheumatological Disease, Hair Care	-	-	-	9
***Calamintha officinalis* Moench**	Digestive System, Cold, Cough, Fever, Dental Pain, Sexual Diseases, Inflammation, Headache	-	Digestive System, Cold, Dizziness, Poison Antidote, Headache, Sedative, Anti-Inflammatory, Cough, Fever	-	-	-	-	-	4
***Aristolochia longa* L.**	Digestive System, Kidney Problems, Cancer, Scar, Mouth Sores, Influenza, Poisoning, Infection	-	Digestive System, Cancer, Kidney Problems, Infections	-	Cancer, Digestive Problems, Kidney Disease, Skin Disease	-	Scorpion Stings	-	4

***Lycium barbarum* L.**	Eye Disease	-	-	-	-	-	-	-	-
***Artemisia herba-alba* Asso.**	Diabetes, Digestive System, Cold, Cough Microbial Infection, Fever, Tiredness, Inflammation, Abortive	Anti-Rheumatic, Anti-Rheum, Stomachic, Sedative (Against The Aorta Palpitations), Antidiabetes, Depurative, Vulnerary	Diabetes, Anthelmintic, Antiinflammatory, Sedative, Against Gases, Cold	Affection Neurological , Diabetes, Pain Abdominal, Sedative	Diabetes, Anti-Inflammatory, Sedative, Stomach Pain, Cold Problems	Diabetes, Digestive System, Intestinal Pain, Cold, Cough, Microbial Infection (Covid 19), Fever Immune Deficiency, Depression, Stomach Pain, Tiredness Dizziness, Nervousness, Flu	Abdominal Pain, Coldness	Neurological Diseases	12
***Mentha suaveolens* Ehrh.**	Digestive System, Cold, Tiredness Sexual Diseases, O.Diseases, Headache, Goitre Poisoning, Influenza, Fever, Respiratory System	Carminative, Favoring Conception And Fertility	Influenza, Respiratory System	Affection Neurological , Fertility	-	-	Common Cold, Urinary, Calculus, Coldness, Sleep-Disturbance	Respiratory Diseases	4
***Mentha pulegium* L.**	Cold, Respiratory System, Scar, Urinary Diseases	Against Angina, Anti-Rheum, Anti-Flu	Influenza, Against Chill, Poison Antidote, Respiratory and Urinary Systems Problems	Affection Respiratory	Respiratory Disease, Cough, Face Care	Diabetes, Headaches, Digestive System, Cold, Cough, Fever, Respiratory System, Stomach Pain, Tiredness, Diarrhea, Flu, Throat Inflammation Yellowing, Cardiac	Common Cold, Coldness, Vertigo	Neurological Diseases	5

***Ajuga iva* L.**	Diabetes, Hypertension, Digestive System, Anemia, Pulmonary Inflammation, Cardiac, Hair Treatment, Influenza, Sexual Diseases	Stomachic, Anti-Diabetic, Vulnerary, Measles Treatment	Digestive System, Cardiovascular Diseases, Poison Antidote, Mouth Hygiene, Lung Disorders	Diabetes, Affection, Digestive	Digestive Disease, Cardiovascular Disease, Mouth Disease, Pulmonary Disorder	Diabetes, Digestive System, Respiratory System	-	-	6
***Salvia officinalis* L.**	Diabetes, Hypertension, Digestive System, Cold, Fever, Liver Diseases, Influenza, Bone Diseases	Anti-Diabetes, Carminative, Purgative	Digestive System, Diabetes, Hypertensive, Cosmetology	Affection Digestive, Menstruate	Digestive Disease, Diabetes, Face Care, Hypertension	Diabetes, Hypotension, Digestive System, Cough, Immune Deficiency, Respiratory System, Renal System, Stomach Pain, Tiredness, Dizziness, Sexual Impotence, Sexual Diseases, Circulatory Diseases, Cardiac	Hyperglycemia	Metabolic Diseases	4
Tetraclinis articulata (Vahl) Mast.	Cancer, Diabetes, Digestive System, Cold, Hair Treatment, Sexual Diseases	Locally Analgesic, Stomachic, Anti-Rheumatic	Digestive System, Hair Caire	Affection Digestive, Pain Abdominal, Rheumatism	Digestive Affection, Hair Care	Diabetes, Digestive System, Intestinal Pain, Cold, Respiratory System, Stomach Pain, Intoxication	-	Neurological Diseases	6

***Thymus zygis* L.**	Hypertension, Digestive System, Cold, Microbial Infection	-	-	-	-	Diabetes, Headaches, Digestive System, Respiratory System, Intestinal Pain, Cold, Flu, Intoxication, Infection	-	-		3

[1] Khabbach *et al*., 2012 ; **[2]** El Haouari *et al*., 2018 ; **[3]** Boulfia *et al*., 2018 ; **[4]** El Brahimi *et al*., 2022 ; **[5]** Ghabbour *et al*., 2023 ; **[6]** Smaili *et al*., 2023 ; **[7]** Chaachouay *et al*., 2022. **CD** : Common disease.

Declarations

List of abbreviations: Ap Areal Plant **B** Bark **Bo** Boiled **Br** Brute **Bu** Bulb **C** Cultivated **Cd** Cooked **Cr** Cream **D** Dry **De** Decoction **Dy** Dyeing **Ex** Extract **Ex.ap** External application F Fresch **Fl** Flowers **Fr** Fruit **Fu** Fumigation **G** Grinding **H** Handle **He** Huile essential **Ht** Herbal tea **I** Infusion **Id** Introduced **In** Inhalation **Ju** Juice **L** Leaves **Lo** Lotion **M** Maceration **O** Oral **P** Peel **Pd** Powder **Pe** Pericarp **Pi** Pinch **Po** Poultice **Rh** Rhizomes **Ro** Roots **S** Spontaneous **Sd** Seeds **Sp** Spoonful **St** Stem **Sy** Syrup **Wp** Whole plant **WHO** World Health Organization

Ethics Approval: The authors confirm that the study was reviewed and approved by an Institutional Review Board of the Laboratory of Natural Resources and Environmental; Polydisciplinary Faculty of Taza; University of Sidi Mohammed Ben Abdellah. The committee further approved that the study will have no direct negative impact on the participants and the biodiversity of the study area. All participants provided oral prior informed consent before the interview

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