



Prevalence and therapeutic relevance of medicinal plants in Algerian ethnomedical practices targeting thyroid disorders

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Ethnobotany Research and Applications 33:74 (2026) - <http://dx.doi.org/10.32859/era.33.74.1-16>

Manuscript received: 15/12/2025 - Revised manuscript received: 22/03/2026 - Published: 23/03/2026

Research

Abstract

Background: Herbal medicine plays a significant role in managing endocrine disorders in Algeria, particularly thyroid diseases, which are more common among women. Although traditional remedies are widely used, systematic documentation of medicinal plants employed for thyroid conditions remains limited. Recording this knowledge is essential for preserving ethnomedical practices and supporting future therapeutic research.

Methods: A cross-sectional ethnobotanical survey was conducted in the Setif region of Algeria using semi-structured questionnaires administered to 70 respondents. Participants included 81.43% women and 18.57% men, with 57.3% aged 20-31 years. Information collected covered plant species used, preparation methods, plant parts utilized, and routes of administration.

Results: The study documented 19 plant species traditionally used for thyroid disorders. *Bunium mauritanicum*, (Talghoda) was the most frequently cited species (33.33%), demonstrating its central role in local ethnomedical practices. It was followed by *Saussurea costus* (14.67%), *Atriplex halimus* (10.67%), and Brazil nut (8%). Most respondents (74.7%) used single-plant preparations, whereas 25.3% used mixtures. The whole plant was most commonly employed (38.7%), followed by roots and leaves (14.7%), seeds (13.3%), fruits (10.7%), and stems (6.7%). Fresh plant material predominated (74.7%), and all remedies were administered orally.

Conclusions: The findings highlight the prevalence and therapeutic relevance of *Bunium mauritanicum*, in traditional thyroid disorder management in Sétif. The strong reliance on herbal remedies reflects both accessibility and the depth of indigenous knowledge. This documentation supports the preservation of ethnomedical practices and offers a basis for future pharmacological investigations.

Keywords: Ethnobotany; medicinal plants, phytotherapy, *Bunium mauritanicum*, thyroid diseases, Herbal medicine.

Background

The thyroid gland plays a central role in regulating metabolism, growth, and overall physiological homeostasis through the secretion of thyroid hormones (Tripathi *et al.* 2021). Thyroid disorders constitute a growing global public health concern, particularly among women, and include hypothyroidism, hyperthyroidism, goiter, thyroid nodules, and thyroid cancer. These conditions arise from complex and multifactorial interactions involving genetic predisposition, nutritional status, environmental exposure, hormonal regulation, and psychosocial factors (Okosieme *et al.* 2016; Vanderpump, 2011). If inadequately managed, thyroid disorders may adversely affect physical health, daily functioning, and quality of life.

Conventional medical management of thyroid disorders includes hormone replacement therapy, antithyroid drugs, radioactive iodine, and surgical interventions. Although these biomedical approaches are generally effective, they may be associated with adverse effects, long-term treatment dependence, financial burden, or limited accessibility, particularly in rural and resource-limited settings (Bauer *et al.* 2014). As a result, many individuals rely on complementary and alternative practices, including traditional and herbal medicine, either alongside or in place of conventional treatments.

Medicinal plants have long been integral to traditional healthcare systems and are used on the basis of accumulated empirical knowledge and cultural transmission rather than formal clinical validation. From a mechanistic perspective, plants traditionally used for thyroid-related conditions are often reported to exert antioxidant, anti-inflammatory, and metabolic-regulatory effects, which may indirectly influence thyroid function or alleviate associated symptoms. Oxidative stress and chronic inflammation are recognized contributors to thyroid dysfunction and autoimmune thyroid diseases; therefore, plant-derived secondary metabolites such as phenolic compounds, flavonoids, terpenoids, and alkaloids are frequently cited for their potential to modulate inflammatory pathways, redox balance, and endocrine signaling. These mechanisms provide pharmacological plausibility but do not constitute evidence of clinical efficacy.

Many plants are traditionally employed due to the presence of bioactive secondary metabolites, which provide biological plausibility rather than therapeutic confirmation (Fabricant & Farnsworth, 2001; Heinrich *et al.* 2004). From a scientific perspective, documenting such practices primarily reflects ethnomedical salience and cultural importance, while also identifying knowledge gaps that warrant further phytochemical, pharmacological, and clinical investigation.

In Algeria, medicinal plants remain an important component of primary healthcare, particularly in rural communities. In Setif province, traditional remedies are commonly reported for thyroid-related conditions; however, systematic documentation of the plant species used, preparation methods, plant parts, and associated traditional knowledge remains limited (Bendimerad *et al.* 2018). The present study is designed as a cross-sectional ethnobotanical survey aimed at documenting plants traditionally used for thyroid-related conditions, recording local knowledge and practices, and assessing their ethnomedical relevance using citation-based indices. This study does not assess clinical efficacy or safety, but instead provides a descriptive foundation for future phytochemical, pharmacological, and clinical research while contributing to the preservation of local ethnobotanical knowledge.

Materials and Methods

Study area

Setif Province, located in northeastern Algeria, lies at an altitude ranging from approximately 600 to 1,100 m above sea level. The ethnobotanical survey was conducted primarily in Setif Province, with additional participants recruited from Constantine Province, Boumerdes Province, Oran Province, Algiers Province, Bordj Bou Arreridj Province, Mostaganem Province, Laghouat Province, Annaba Province, Adrar Province, El Oued Province, Biskra Province, and Djelfa Province (Figure 1).

The study area map was produced using QGIS version 3.36.2. Administrative boundary data were obtained from the GADM 2024 database. All spatial datasets were processed and validated to ensure mapping accuracy.

Data Collection Instrument

Ethnobotanical data were collected using a structured online questionnaire administered to patients and selected herbal practitioners knowledgeable in the traditional use of medicinal plants for thyroid disorders. The questionnaire was designed to document both respondent characteristics and traditional therapeutic practices. It was conducted for Four months (February to May 2024) online at this link: https://docs.google.com/forms/d/e/1FAIpQLScr88a1mmvseU0bc_Ch2G0pCLtNGeddrmqQpxJdeDj4jv_MA/viewform?usp=sharing. It consisted of four main sections:

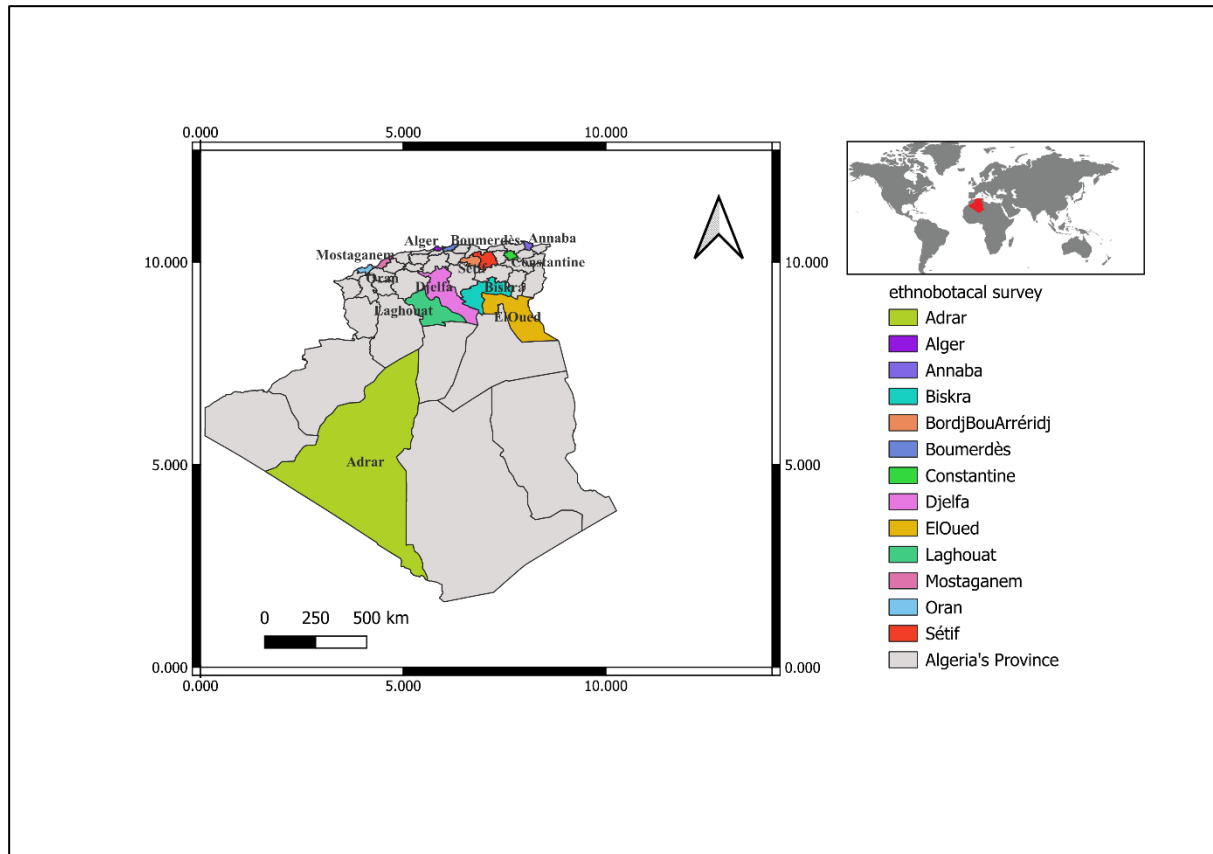


Figure 1. Map of Algeria, showing the study area.

General information of patients

This section recorded:

- Region of residence
- Sex
- Age
- Educational level
- Family status
- Type of thyroid disorder (diagnosed or self-reported)
-

Use of Medicinal Plants

Participants were asked to provide details regarding:

- Name of the medicinal plant used
- Plant part utilized
- Plant condition (fresh, dried, powdered, etc.)
- Form of use (infusion, decoction, powder, etc.)
-

Preparation and Administration

Traditional treatment practices were documented through:

- Preparation method
- Mode of application
- Dosage
- Duration of treatment
-

Perceived Effects of Herbal Therapy

Respondents were also asked to report:

- Reasons for use
- Perceived effectiveness in relieving symptoms
- Any observed side effects
- Overall perception of traditional herbal therapy

Sampling and Recruitment

A total of 70 respondents were included in the study. Participants were recruited through purposive sampling from:

- Local herbal markets
- Households
- Traditional knowledge holders
-

Inclusion criteria:

- Adults aged ≥ 18 years
- Individuals reporting personal use of medicinal plants for thyroid-related conditions
- Individuals possessing household or community knowledge of such use
-

Exclusion criteria:

- Inability to provide reliable responses
- Plant use unrelated to endocrine or thyroid conditions

Eligibility was confirmed through screening questions addressing plant use specifically for thyroid-related symptoms or conditions.

Thyroid Disorder Ascertainment

Respondents were asked to specify whether plant use was related to:

- A medically diagnosed thyroid disorder
- Self-reported symptoms suggestive of thyroid dysfunction
- Household or community-based traditional knowledge

This allowed differentiation between therapeutic use and transmitted ethnobotanical knowledge.

Data Analysis

The ethnobotanical data collected during the survey were recorded and organized using Microsoft Excel (version 2016). A structured database was developed to classify the recorded information, including plant species, local names, plant parts used, preparation methods, and routes of administration.

The organized dataset was used to generate tables and graphical representations to facilitate visualization of medicinal plant use patterns in the management of thyroid disorders among the surveyed population.

Data analysis was performed using:

- Descriptive statistics
- Relative Frequency of Citation (RFC)

Relative Frequency citation

The ethnomedicinal importance of each plant species was evaluated using the Relative Frequency of Citation (RFC) index, following the method described by Vitalini S et al. (2013). The RFC was calculated using the formula:

$$RFC = FC/N$$

Where:

FC = Number of respondents mentioning the use of a given plant species

N = Total number of respondents participating in the survey

RFC values range from 0 to 1. A higher RFC value indicates greater local importance and wider recognition of a species in the traditional management of thyroid disorders.

Results

Geographic Distribution of Patients

The majority of respondents were from the Wilaya of Setif, comprising 75.71% (53/70) of the study population, while the remaining 24.29% were distributed across other provinces. This indicates higher engagement and awareness among individuals in Setif, though inclusion of participants from other provinces provides broader regional representation and enhances the generalizability of the findings (Figure. 2).

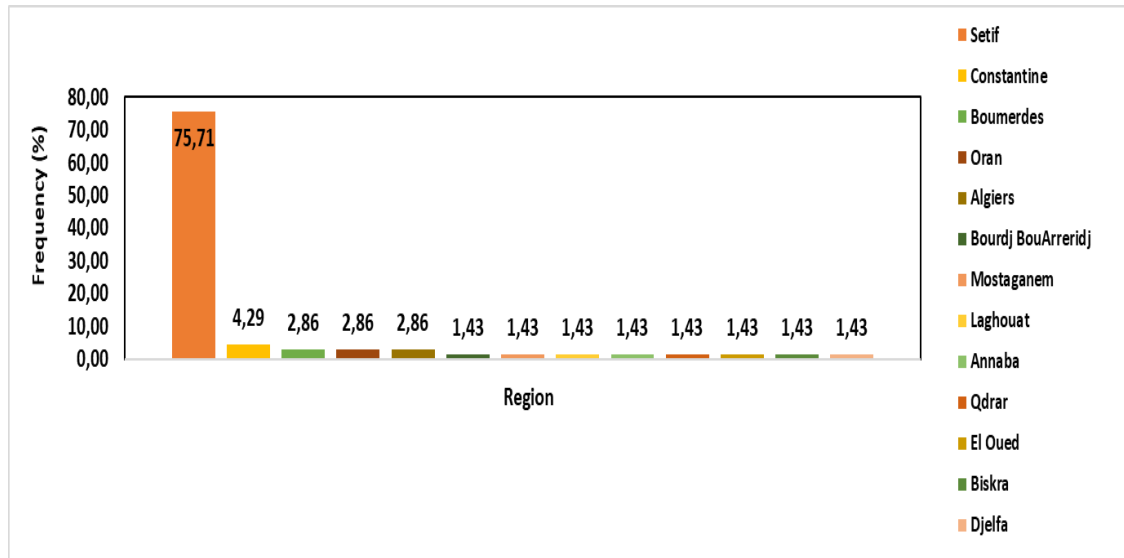


Figure 2. Distribution of patients according to the region.

Distribution of Patients by Sex

Female participants predominated in this study, representing 81.43% (57/70) of respondents, compared to 18.57% male participants (13/70). This notable gender disparity may reflect differences in healthcare-seeking behavior, the prominent role of women in traditional medicine within households, and cultural factors influencing the use of herbal remedies (Figure. 3).

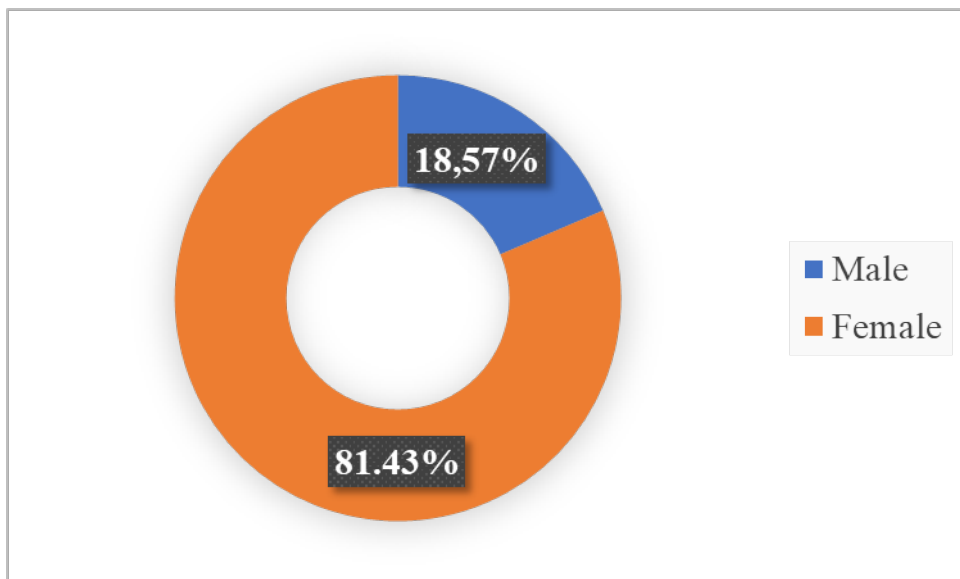


Figure 3. Distribution of patients according to sex.

Distribution of Patients by Age

Analysis of age groups revealed that the majority of participants (57.3%) were between 21 and 31 years, followed by 31-45 years (17.3%), 15-20 years (16%), and over 45 years (10%). These results suggest that young adults are the most frequent users of medicinal plants in the surveyed region, contrasting with studies that report higher herbal medicine use among older populations (Figure. 4).

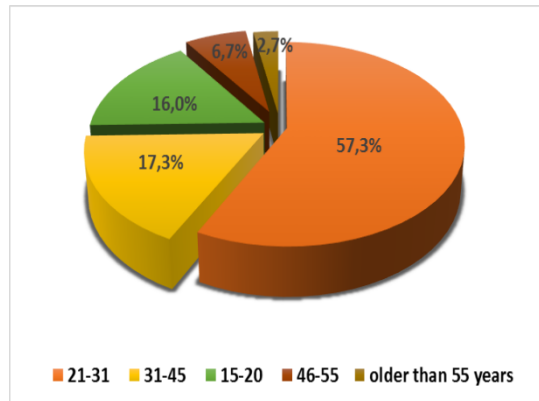


Figure 4. Distribution of patients according to the age.

Distribution of Patients by Level of Education

Educational backgrounds varied among respondents. The most common level was a bachelor’s degree (30.7%), followed by a master’s degree (28%), high school diploma (16%), below high school (14.7%), doctoral degree (8%), and uneducated (2.7%). This distribution indicates that individuals with higher education levels are actively engaged in traditional medicine practices, possibly due to increased health awareness or interest in complementary therapies (Figure. 5).

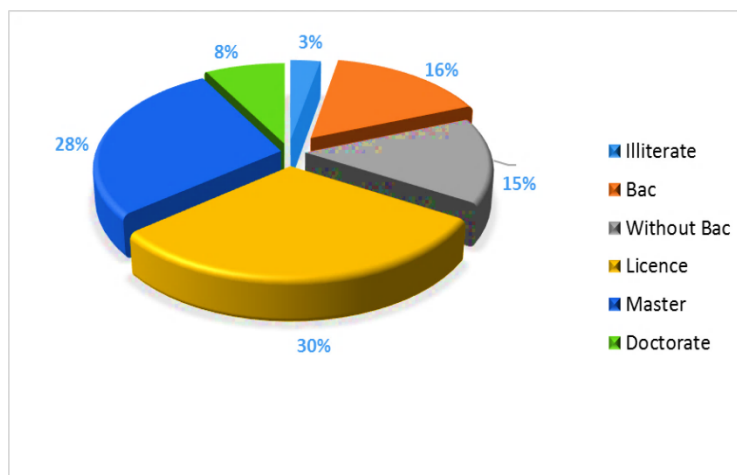


Figure 5. Distribution of patients by level of education.

Distribution of Patients by Family Status

Among the respondents, 64% were married, while 36% were single. This demographic detail provides context for social factors that may influence the use and transmission of traditional knowledge on medicinal plants (Figure. 6).

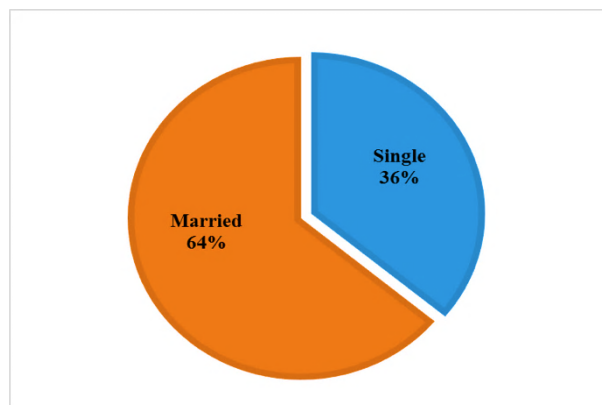


Figure 6. Distribution of patients according to family situation.

Types of Thyroid Disorders

Patients reported various thyroid disorders: hyperthyroidism (32%), hypothyroidism (28%), thyroiditis (24%), goiter (14.7%), and thyroid cancer (1.3%). This diverse spectrum reflects the heterogeneity of thyroid conditions in the population and supports the relevance of traditional remedies in managing multiple thyroid-related pathologies (Figure. 7).

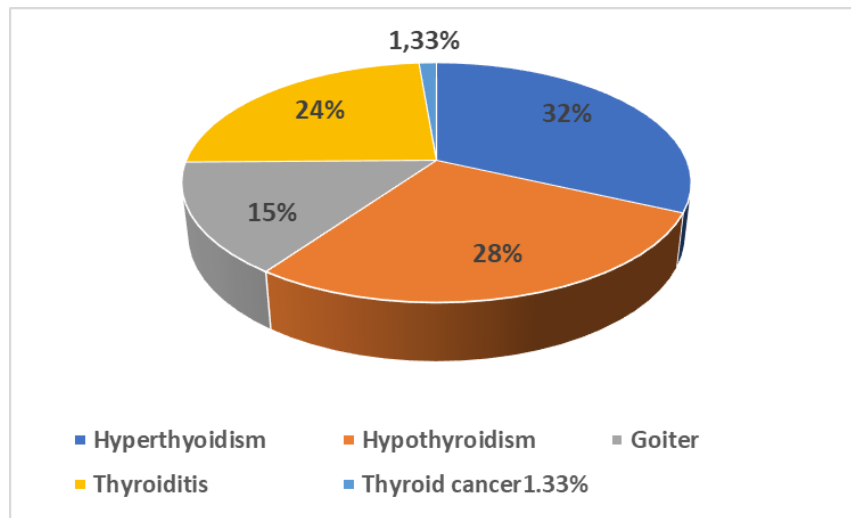


Figure 7. Distribution of patients by the Type of thyroid disorders.

Use of Traditional Remedies

A high prevalence of herbal medicine use was observed, with 92% of respondents reporting the use of medicinal plants to manage thyroid disorders. Only 8% did not use traditional remedies, highlighting the cultural significance and perceived efficacy of herbal medicine in the study area (Figure. 8).

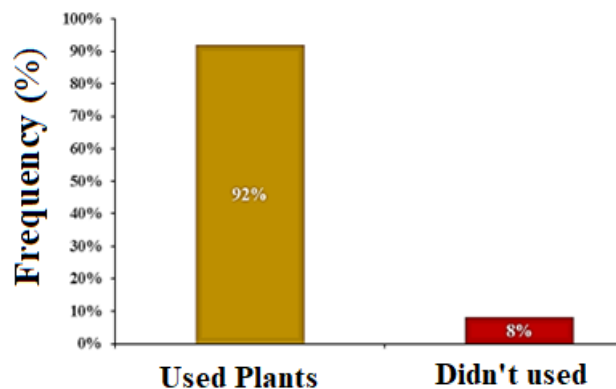


Figure 8. Distribution of patients by traditional remedy.

Form of Traditional Remedies

Among users of herbal medicine, 74.7% reported using a single plant species, while 25.3% employed mixtures of two or more plants. This indicates a preference for simple remedies, although complex combinations are also used in specific contexts (Figure. 9).

Medicinal Plants Identified

The survey identified nineteen medicinal plants used by patients in the management of thyroid disorders. The plant species reported by survey respondents for the management of thyroid disorders were taxonomically verified by Pr. Wafa Nouioua (Department of Plant Ecology and Biology, Faculty of Natural and Life Sciences, Ferhat Abbas University, Setif 1, Algeria). Identification was based on macromorphological descriptions from authoritative references, including *Nouvelle flore de l'Algérie et des régions désertiques méridionales* (Quézel & Santa, 1962-1963) and *Flore de l'Afrique du Nord* (Maire, 1958-1959), as well as expert knowledge to ensure accurate taxonomic classification. This approach allowed confirmation of species cited by participants while preserving the ethnobotanical context of the study, without the need for physical plant collection (Table 1).

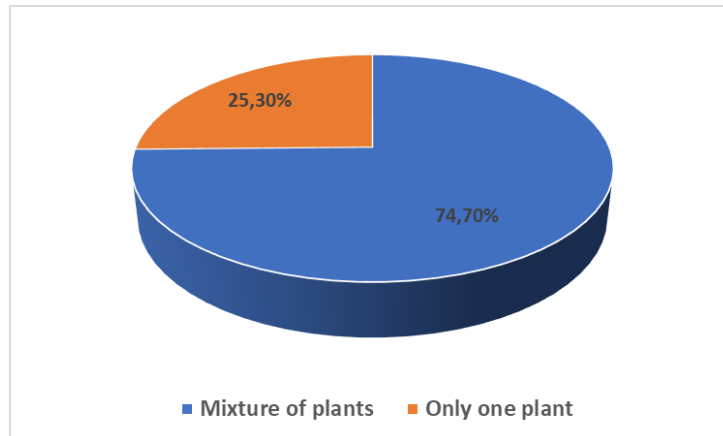


Figure 9. Distribution of patients according to traditional treatment form.

Bunium mauritanicum was the most commonly cited species, reported by 32.86% of patients. This plant was primarily used for curative purposes, with 28% of these patients preparing it by mixing with honey, 24% by infusion, 12% by maceration, 8% by decoction mixed with fresh yogurt, and 4% by mixing with milk.

Brazilian Chestnut (*Bertholletia excelsa*) was used by 8.57% of patients, with preparation methods including maceration, decoction, and infusion (16.7% each), while 50% of patients used it in fresh form. *Atriplex halimus* was reported by 10% of patients, primarily via maceration and decoction (50% each). *Saussurea costus* was used by 14.28% of patients, with 36.4% preparing it with honey, 27.3% by infusion, 18.2% by maceration, and 9.1% each by powder or mixing with honey.

Melissa officinalis L. was used by 5.71% of patients, with 50% using maceration and 25% each for infusion and decoction. *Zingiber officinale* was used by 4.29% of patients, with equal use of powder, maceration, and infusion methods (33.3% each). *Matricaria recutita* was reported by 5.71% of patients, prepared via maceration (50%) or mixing with honey and decoction (25% each). *Avena sativa* was used by 2.86% of patients, exclusively prepared by mixing with milk.

Other species, including *Glycyrrhiza glabra* L., *Porphyra yezoensis*, *Mentha spicata*, *Rubus ulmifolius*, *Syzygium aromaticum*, *Curcuma longa*, *Haloxylon salicornicum*, *Ajuga reptans*, *Juglans nigra*, and *Laminaria japonica*, were reported at a frequency of 1.43% each, mainly prepared using maceration or decoction methods (Figure. 10, Table 1).

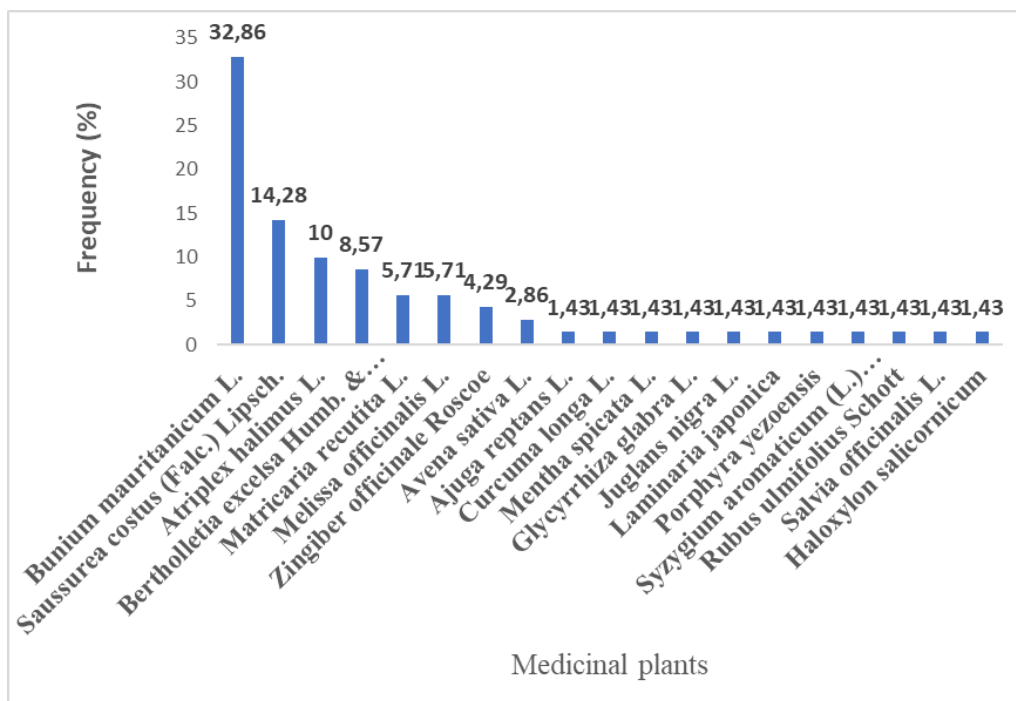


Figure 10. Citation frequencies of medicinal plants used.

Table 1. Ethnobotanical survey of medicinal plants used by patients with thyroid disorders.

Family	Species	Vernacular Name	Vouche ID	Part Used	Ethnobotanical Uses	Frequency of use (%)
Apiaceae	<i>Bunium mauritanicum</i> L.	Talghouda	UFS- -2024-01	roots	Curative treatment of thyroid disorders	32.86
Asteraceae	<i>Saussurea costus</i> (Falc.) Lipsch.	Qost Hindi	UFS- -2024-02	Roots	Regulation of thyroid hormones, antioxidant	14.28
Amaranthaceae	<i>Atriplex halimus</i> L.	Gtaf	UFS- -2024-03	Leaves, stems	Anti-hyperthyroid activity, maceration/decoction	10
Lecythidaceae	<i>Bertholletia excelsa</i> Humb. & Bonpl.	Jawz el-Brazil	UFS- -2024-04	Seeds	Thyroid support, prepared fresh or decoction	8.57
Asteraceae	<i>Matricaria recutita</i> L.	Babounj	UFS- -2024-05	Leaves, flowers	Relief of thyroid-related fatigue, insomnia, palpitations	5.71
Lamiaceae	<i>Melissa officinalis</i> L.	Toranjan	UFS- -2024-06	Leaves	Maceration/infusion for thyroid health	5.71
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Zanjabil	UFS- -2024-07	Rhizome	Support thyroid health, antioxidant	4.29
Poaceae	<i>Avena sativa</i> L.	Chofan	UFS- -2024-08	Seeds	Support thyroid, mixed with milk	2.86
Zingiberaceae	<i>Curcuma longa</i> L.	Korkom	UFS- -2024-09	Rhizome	Anti-inflammatory, thyroid protective	1.43
Lamiaceae	<i>Mentha spicata</i> L.	Na'na'	UFS- -2024-10	Leaves	Thyroid support, mild antioxidant	1.43
Fabaceae	<i>Glycyrrhiza glabra</i> L.	'Arq sous	UFS- -2024-11	Roots	Thyroid hormone regulation	1.43
Juglandaceae	<i>Juglans nigra</i> L.	Jawz aswad	UFS- -2024-12	Leaves, bark	Support thyroid health	1.43
Lamiaceae	<i>Ajuga reptans</i> L.	'Ajram (local/rare)	UFS- 2024-13	Leaves	Traditional thyroid support	1.43
Porphyraeae (Rhodophyta)	<i>Porphyra yezoensis</i>	Nori	UFS- -2024-14	Whole plant	Supplement for thyroid health	1.43
Myrtaceae	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Qoronfol	UFS- -2024-15	Flower buds	Thyroid support, antioxidant	1.43
Rosaceae	<i>Rubus ulmifolius</i> Schott	'Aliq	UFS- -2024-16	Leaves, fruits	Support thyroid health	1.43
Lamiaceae	<i>Salvia officinalis</i> L.	Salmiya	UFS- -2024-17	Leaves	Support thyroid health	1.43
Amaranthaceae	<i>Haloxylon salicornicum</i>	Rmath	UFS- -2024-18	Whole plant	Thyroid support, antioxidant	1.43
Laminariaceae	<i>Laminaria japonica</i>	Laminaria	UFS- -2024-19	Whole plant	Thyroid support, antioxidant	1.43

Plant Parts Used

The most commonly used plant part was the whole plant (38.7%), followed by roots (14.7%), leaves (14.7%), seeds (13.3%), fruits (10.7%), and stems (6.7%). This suggests a holistic approach in traditional medicine, aiming to utilize the full spectrum of bioactive compounds present in different plant parts (Figure. 11).

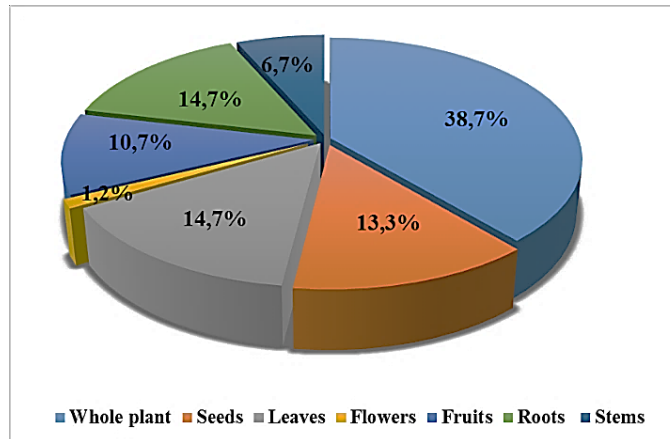


Figure 11. Distribution the part of the used plants.

State of the Plant Material

Dried plants were the most commonly used form (74.7%), while fresh plants accounted for 25.3% of usage. Preference for dried material may be attributed to ease of storage and preservation of bioactive components, whereas fresh plants are likely used when available for immediate consumption (Figure. 12).

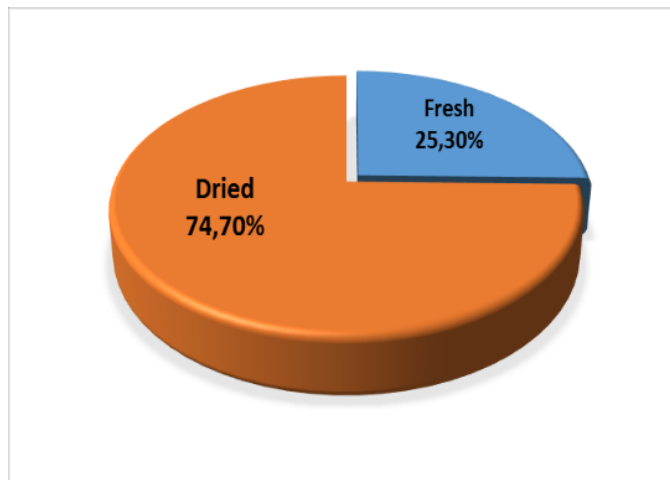


Figure 12. Distribution of patients according to the state of the used plant.

Form of Medicinal Used plants

The medicinal plants were predominantly used either as entire plants (49.3%) or as powders (49.3%), with oil preparations being rare (1.3%). This reflects traditional practices emphasizing both simplicity and versatility in preparation methods (Figure. 13).

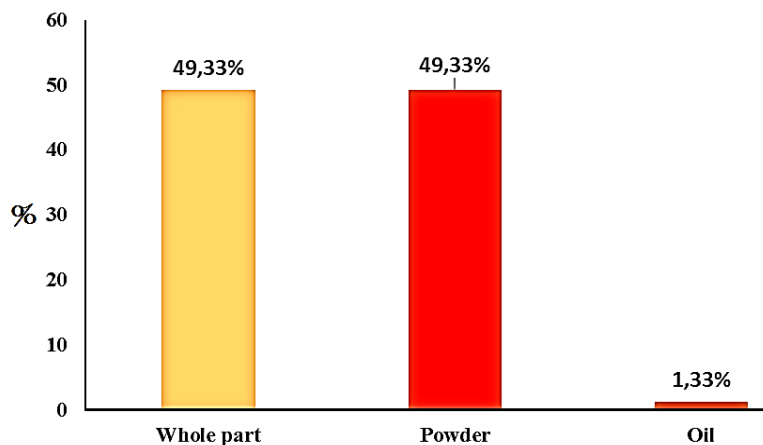


Figure 13. Distribution by the used medicinal plant form.

Preparation Methods

The primary preparation methods were decoction (22.7%), maceration (18.7%), and infusion (17.3%). Additional methods included mixing with honey (17.3%), yogurt (6.7%), or milk (2.7%). These diverse methods highlight the adaptability of traditional remedies to local resources and patient preferences (Figure. 14).

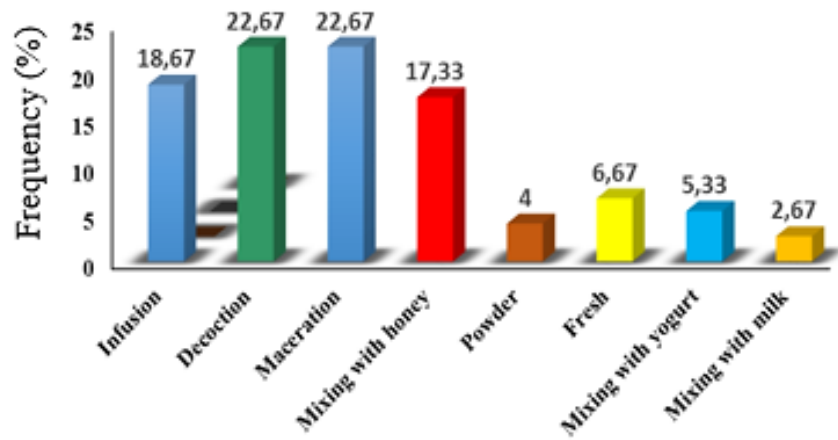


Figure 14. Distribution of preparation method of the remedy.

Dosage and Duration of Herbal Treatment

Patients reported varying dosage schedules, with once-daily administration most common (64%), followed by twice daily (32%), three times daily (1.3%), and once or twice per week (1.3% each). Treatment duration ranged from one month (38.67%) to three months (21.42%), six months (26.67%), and one year (13.33%) (Figure. 15).

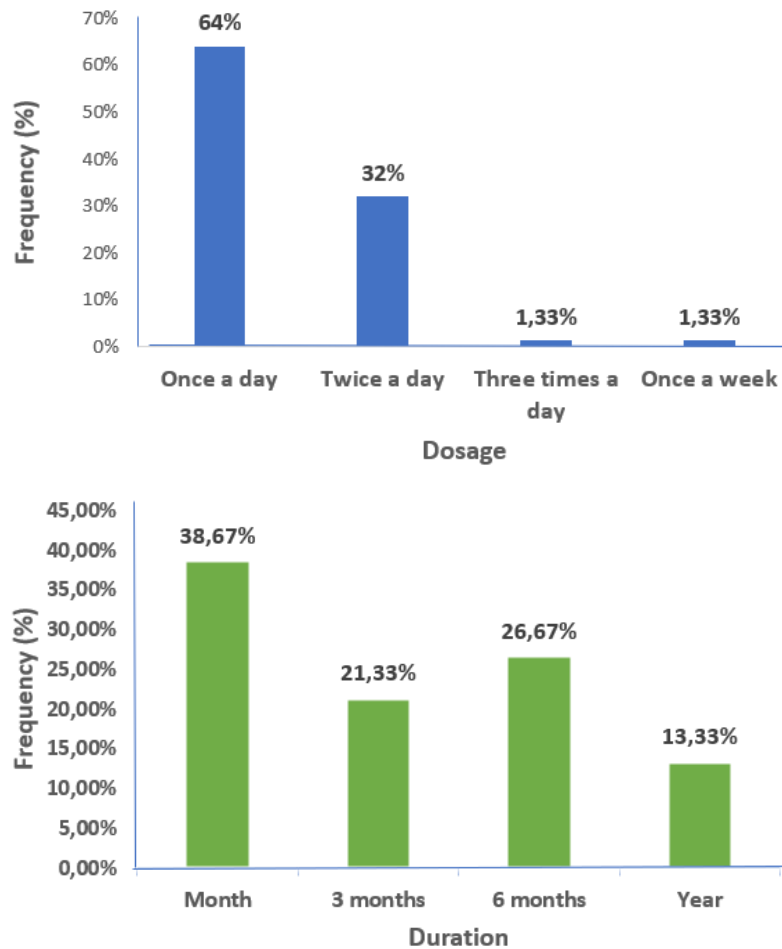


Figure 15. Dosage and period of herbal treatment.

Purpose of Treatment

Herbal remedies were primarily used for curative purposes (78.7%), whereas 21.3% of patients employed them preventively. This suggests a stronger emphasis on symptom management rather than prophylactic use in the surveyed population (Figure. 16).

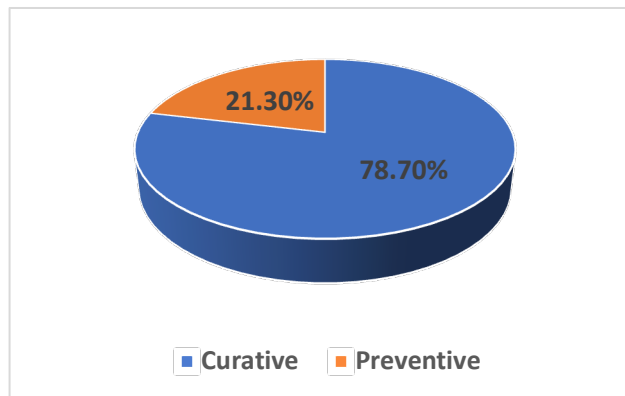


Figure 16. Distribution by consideration used.

Symptom Relief

Most patients (88%) reported noticeable improvement in thyroid-related symptoms, including reduced palpitations, decreased fatigue, improved sleep, and moderate weight regulation, while 12% reported no relief (Figure. 17).

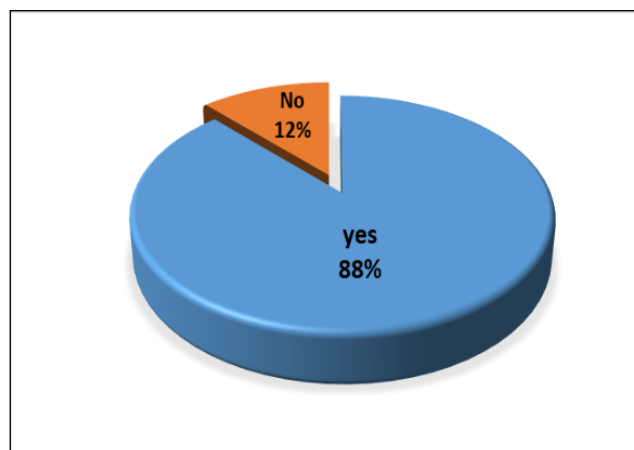


Figure 17. Distribution by Relieving symptoms.

Side Effects

The majority of participants (89.3%) did not experience any adverse effects from herbal remedies. A minority (10.7%) reported mild side effects, such as stomach discomfort, diarrhea, or nausea, indicating a generally perceived tolerability for these traditional treatments (Figure. 18).

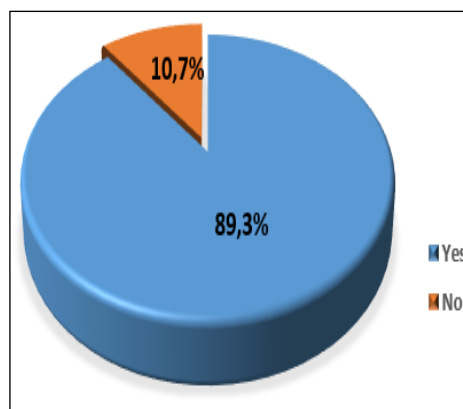


Figure 18. Distribution by side effects.

Recommendation of Traditional Therapy

A high proportion of patients (82.7%) recommended traditional remedies to others, reflecting widespread confidence in their efficacy, while 17.3% did not provide recommendations, possibly due to personal experiences or preference for alternative treatments (Figure. 19).

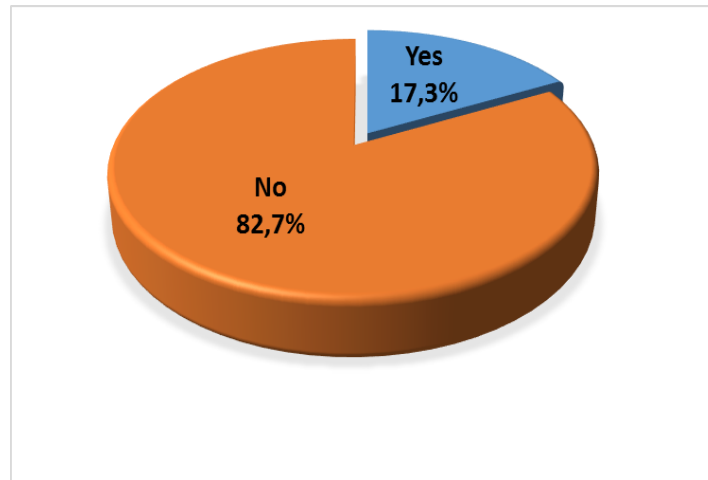


Figure 19. Distribution according to the opinion on traditional therapy.

Discussion

This study highlights the extensive use of traditional medicinal plants for managing thyroid disorders in the Setif region of Algeria, providing important insights into community-based healthcare practices. The predominance of female participants (81.3%) aligns with previous research (Bouallala *et al.* 2014; Taibi *et al.* 2021) and likely reflects women's central role in family health management, greater engagement in traditional medicine knowledge, and higher likelihood of seeking remedies for chronic conditions. The age distribution, with the majority of users aged 21-31, contrasts with studies suggesting greater reliance on herbal remedies among older adults (Benkhniqne *et al.* 2011; Daoudi *et al.* 2015; Taibi *et al.* 2021) and may indicate growing interest in traditional remedies among younger populations, potentially driven by cultural transmission, accessibility, and awareness of therapeutic potential.

The survey documented a diverse array of medicinal plants, preparation methods, and plant parts used. Whole-plant use (38.7%) and dried material (74.7%) were predominant, reflecting practices intended to preserve plant material for repeated use. Decoction, maceration, and infusion were the most common preparation methods, often supplemented with honey, yogurt, or milk, which may enhance palatability or perceived efficacy. High citation frequency of species such as *Bunium mauritanicum*, *Saussurea costus*, *Atriplex halimus*, Brazilian chestnut, *Melissa officinalis*, *Matricaria recutita*, and *Zingiber officinale* indicates their ethnomedical salience—that is, their cultural prominence and importance in traditional thyroid care—rather than confirmed therapeutic effectiveness.

Respondents frequently reported perceived symptom relief (88%) and recommended these remedies to others (82.7%). These self-reported outcomes highlight community perceptions but should not be interpreted as clinical validation. Some cited species have compounds with potential pharmacological relevance. For example, *Bunium mauritanicum* and flavonoid-rich species may modulate thyroid hormone synthesis through thyroperoxidase inhibition; *Saussurea costus* exhibits antioxidant activity; *Atriplex halimus* contains phenolic compounds and flavonoid glycosides with potential thyroid-modulating properties; and *Zingiber officinale* and curcumin-containing plants provide antioxidant and anti-inflammatory effects. While these findings suggest pharmacological plausibility, they do not confirm efficacy or safety at doses or preparations used traditionally.

The predominance of whole-plant uses, particularly for high-demand species, raises sustainability concerns. Overharvesting could threaten local populations and biodiversity. Promoting selective harvesting of aerial parts, cultivation initiatives, and community-based conservation programs may help preserve these resources while maintaining access to culturally significant medicinal plants.

This study has several limitations. Data were collected through self-reported online questionnaires, which may be subject to recall bias and differences in interpretation of thyroid-related conditions. The sample size may not capture the full diversity of traditional practices across Algeria. Importantly, citation frequency and self-reported effects do not equate to verified clinical efficacy or safety. Future studies combining field-based ethnobotanical surveys with pharmacological validation, dosage assessment, and conservation evaluation are recommended to address these evidence gaps.

Overall, this study documents the rich ethnobotanical heritage of the Setif region and emphasizes the cultural prominence of certain medicinal plants in thyroid disorder management. The systematic recording of traditional practices provides a foundation for future pharmacological research, conservation strategies, and potential evidence-informed integration of culturally important remedies into broader healthcare systems, thereby bridging traditional knowledge with scientific investigation while respecting local biodiversity.

Conclusion

This study documents the rich traditional knowledge of medicinal plants used for thyroid disorder management in the Setif region of Algeria. High citation frequency of species such as *Bunium mauritanicum*, *Saussurea costus*, *Atriplex halimus*, *Melissa officinalis*, *Matricaria recutita*, and *Zingiber officinale* highlights their cultural prominence and ethnomedical salience within the community. The predominance of whole-plant uses and common preparation methods reflects practices aimed at preserving plant material and ensuring accessibility. While self-reported benefits suggest perceived effectiveness, clinical validation is lacking, and the pharmacological potential of these plants requires further investigation. These findings provide a foundation for future pharmacological studies, sustainable harvesting initiatives, and the potential integration of culturally significant remedies into evidence-informed healthcare systems.

Declarations

List of abbreviations: Not applicable.

Ethics approval and consent to participate: The study was conducted in accordance with ethical and legal guidelines for research involving traditional knowledge and human participants. Participation of patients and traditional healers was entirely voluntary, and informed consent was obtained electronically prior to completion of the online questionnaire. Respondents were assured of the confidentiality of their responses, the anonymity of all collected data, and their right to withdraw from the study at any time without consequence.

Nagoya Protocol / Access and Benefit-Sharing (ABS) Compliance

This study was conducted in accordance with the principles of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. In Algeria, national regulations for ABS apply primarily to the collection and use of genetic resources for commercial purposes. This study did not involve the collection or export of genetic material for commercial use; all data were obtained through surveys of traditional knowledge and the documentation of medicinal plant use. Voucher specimens were collected only for taxonomic verification and deposited in local herbaria, following standard botanical practices.

Prior Informed Consent (PIC) was obtained from all participants, including patients and traditional healers, before participation in the survey. Respondents were informed of the purpose of the research, the voluntary nature of their participation, and the intended use of the data. No Material Transfer Agreements (MAT) or commercial benefit-sharing arrangements were required, as no genetic resources were accessed for commercial development.

To protect traditional knowledge, all information collected is anonymized, and data are reported in aggregate to safeguard the identities of communities and knowledge holders. Copies of the study findings will be shared with local communities and participating traditional healers to ensure transparency and return of knowledge. This approach ensures compliance with ABS principles while respecting community rights and promoting responsible ethnobotanical research.

Consent for publication: All participants provided informed consent for the use of the data collected, and they agreed that the results of this study could be published. The authors confirm that no identifying information of participants is included in the manuscript.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author, Hanane KHITHER, upon reasonable request.

Competing interests: The Authors declare that there is no conflict of interest.

Funding: Not applicable.

Author contributions: H. K. and S. M. contributed to data interpretation, fieldwork, and manuscript revision. W. N. performed plant identification, S. H. drew the study area map and contributed to the theoretical background, A.D. and R.G. collected ethnobotanical data, carried out data analysis, contributed to the theoretical background, and wrote the initial

manuscript, while H. K. and A. M. supervised data collection and analysis, assisted with discussions, and prepared the final version of the manuscript.

Acknowledgements

We would like to thank each healer who contributed to this research and shared their knowledge. We would like to pay tribute to Rodrigo Castro Ramirez, the only male healer, who shared detailed information on the dynamics of blessings within the African-based religion and died a few months after the field research was conducted.

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