



Ethnobotanical survey of medicinal plants used to treat inflammatory conditions in the Sétif Region (Algeria)

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Research

Abstract

Background: Despite significant advances in the pharmaceutical industry, traditional herbal medicine remains a major therapeutic resource in many regions. In Algeria's Sétif province, medicinal plants are widely used to treat inflammatory diseases. However, specific ethnobotanical knowledge regarding inflammatory conditions in this high-plateau region remains under-documented.

Methods: An ethnobotanical survey was conducted using a structured questionnaire administered to 107 informants, including herbalists, patients, and regular users of medicinal plants. Data were collected on sociodemographic characteristics, plant species, plant parts used, preparation methods, and treated diseases. Ethnobotanical indices (Relative Frequency of Citation, Family Importance Value, and Informant Consensus Factor) were calculated, and Correspondence Analysis was performed.

Results: A total of 26 medicinal plants from 14 families were documented. Women comprised most users (68.22 %), with the 20-30 years age group most represented (43.9%). Leaves were the most used plant part (34.2%), infusion the predominant preparation method (56.41%), and oral administration the most common route (62.94%). Respiratory disorders were the most frequently treated (24.29%). *Origanum vulgare* L. ssp. *glandulosum* had the highest RFC (0.224), while Zingiberaceae exhibited the highest Family Importance Value (FIV = 0.175). The highest ICF was recorded for musculoskeletal conditions (0.878), followed by neurological (0.857) and infectious (0.821) disorders.

Conclusions: This study highlights the enduring importance of herbal medicine in the Sétif region and reveals a rich diversity of plants used for inflammatory conditions. High consensus for musculoskeletal and neurological disorders reflects well-established ethnomedical knowledge. Highly cited species warrant phytochemical and pharmacological validation, providing a baseline for future research and underscoring the need for sustainable harvesting.

Keywords: Ethnobotanical survey, inflammatory diseases, Medicinal plants, Sétif region, Algeria.

Background

Inflammation is a fundamental immune response triggered by infections, physical injury, or chemical and environmental insults. Clinically, it manifests as redness, heat, pain and swelling (Karbab *et al.* 2021). When tightly regulated, inflammatory responses play a crucial role in eliminating pathogens and promoting tissue repair. However, chronic or dysregulated inflammation is implicated in the pathogenesis of numerous diseases, including atherosclerosis, type 2 diabetes, neurodegenerative disorders and cancer, largely mediated through persistent production of pro-inflammatory cytokines and oxidative stress (Medzhitov 2008, Biswas 2016).

Despite the availability of conventional anti-inflammatory drugs, access remains limited for many populations due to high costs, adverse effects, and limited availability, especially in low-resource or rural areas (Smith-Hall *et al.* 2012, Wright *et al.* 2025). Consequently, medicinal plants continue to play a central role in traditional healthcare systems and are increasingly recognized as valuable complementary or alternative approaches for managing inflammatory disorders (Hadj-Said & Bouazza 2023, Tasneem *et al.* 2019). Phytotherapy represents a promising and accessible therapeutic strategy. Numerous plant species exhibit significant anti-inflammatory potential; for example, curcumin from *Curcuma longa* has well-documented anti-inflammatory and antioxidant properties (Peng *et al.* 2021), while ginger (*Zingiber officinale*) exerts anti-inflammatory effects by inhibiting prostaglandin and leukotriene biosynthesis (Zhou *et al.* 2022).

Algeria, Africa's largest country, spans approximately 2.4 million km² with remarkable geographic and climatic diversity. This fosters a rich floristic diversity, comprising more than 4,000 taxa distributed across 917 genera and 131 families (Belhouala & Benarba 2021). Its long history has shaped diverse cultural traditions, particularly in medicinal plant use, with phytotherapy remaining an integral part of local culture, especially in rural and semi-arid regions (Miara *et al.* 2018). Recent ethnobotanical studies have documented medicinal plant use across various Algerian regions, including the Sahara (Kedaid *et al.* 2026, Mechaala *et al.* 2022), northern Algeria (Hadj-Said & Bouazza 2023, Maamri *et al.* 2025), northwestern Algeria (Hantour *et al.* 2026, Meliani *et al.* 2023, Soltani *et al.* 2025), and northeastern Algeria (Gherairia *et al.* 2025, Souilah *et al.* 2022). These studies consistently report the dominance of Lamiaceae, Asteraceae, and Apiaceae families, reflecting their ecological abundance and rich content of phenolic and flavonoid compounds with antioxidant and anti-inflammatory activities (Boudjelal *et al.* 2013, Chermat & Gharzouli 2015).

Despite this growing body of research, knowledge of plant-based remedies for inflammatory disorders remains under-documented, particularly for the high plateaus of Sétif. While Chermat and Gharzouli (2015) conducted an ethnobotanical study in Djebel Zdimm (Sétif), their work focused on general medicinal flora rather than inflammation-specific uses. This geographical and thematic gap is significant, as local ethnobotanical knowledge in this region is at risk of being lost before being systematically documented, particularly among younger generations (Miara *et al.* 2018, Milani *et al.* 2025). Ethnobotanical surveys are therefore essential for preserving indigenous knowledge and fueling pharmacological research and drug discovery (Domingo-Fernández *et al.* 2023, Süntar 2020).

Furthermore, sociodemographic factors significantly influence medicinal plant use patterns in Algeria. Studies consistently show that women, older adults (≥50 years), and individuals with lower formal education levels possess and transmit more ethnobotanical knowledge (Mechaala *et al.* 2022, Meliani *et al.* 2023, Miara *et al.* 2018). However, recent trends indicate increasing use among educated, younger populations in semi-urban areas like Sétif, suggesting a dynamic shift in traditional knowledge transmission (Chelghoum *et al.* 2021). Understanding these patterns is crucial for developing targeted conservation and public health strategies.

The present study aims to: (1) document and quantify the local communities' reliance on medicinal plants for inflammatory conditions in the Sétif region; (2) identify the plant species deemed most effective by local practitioners based on citation frequencies and ethnobotanical indices (RFC, FIV, ICF); and (3) analyze usage patterns in relation to sociodemographic factors such as gender, age, and education level. By addressing these objectives, this study contributes to the preservation of Algeria's ethnobotanical heritage and provides a foundation for future pharmacological validation of anti-inflammatory medicinal plants.

Materials and Methods

Ethnobotanical survey

An ethnobotanical survey was carried out in Algeria's Sétif region to document the plants used by herbalists and the local community for managing inflammatory conditions.

Study area

The Sétif province, located in eastern Algeria's high plateaus (35°36'58" and 36°35'45" N, 4°43'52" and 6°1'37" E), spanning 6,549.64 km² across 60 communes in 20 districts (Fig. 1A). Situated at an elevation of nearly 1,100 meters, the region experiences a Mediterranean climate characterized by hot, dry summers and mild, wet winters. With a population of approximately 1.5 million inhabitants, Sétif is known for its diverse landscapes, which include mountains, hills, and fertile plains. The communes of Sétif, Bougaa and El Eulma were selected for this study due to their ecological diversity and the prevalence of traditional medicinal practices (Fig. 1B).

Sampling Strategy and Participants

A total of 107 informants were interviewed between February and April 2024. Participants were selected using a purposive and snowball sampling strategy. Initial contacts were made with known local herbalists, who then recommended other knowledgeable individuals.

- **Inclusion Criteria:** Participants had to be permanent residents of the study area, aged 20 years or older, and possess demonstrated knowledge of medicinal plants used for inflammatory conditions.
- **Exclusion Criteria:** Participants were excluded if they: (i) declined to provide informed consent; (ii) were not permanent residents of the Sétif region; or (iii) were under 20 years of age.

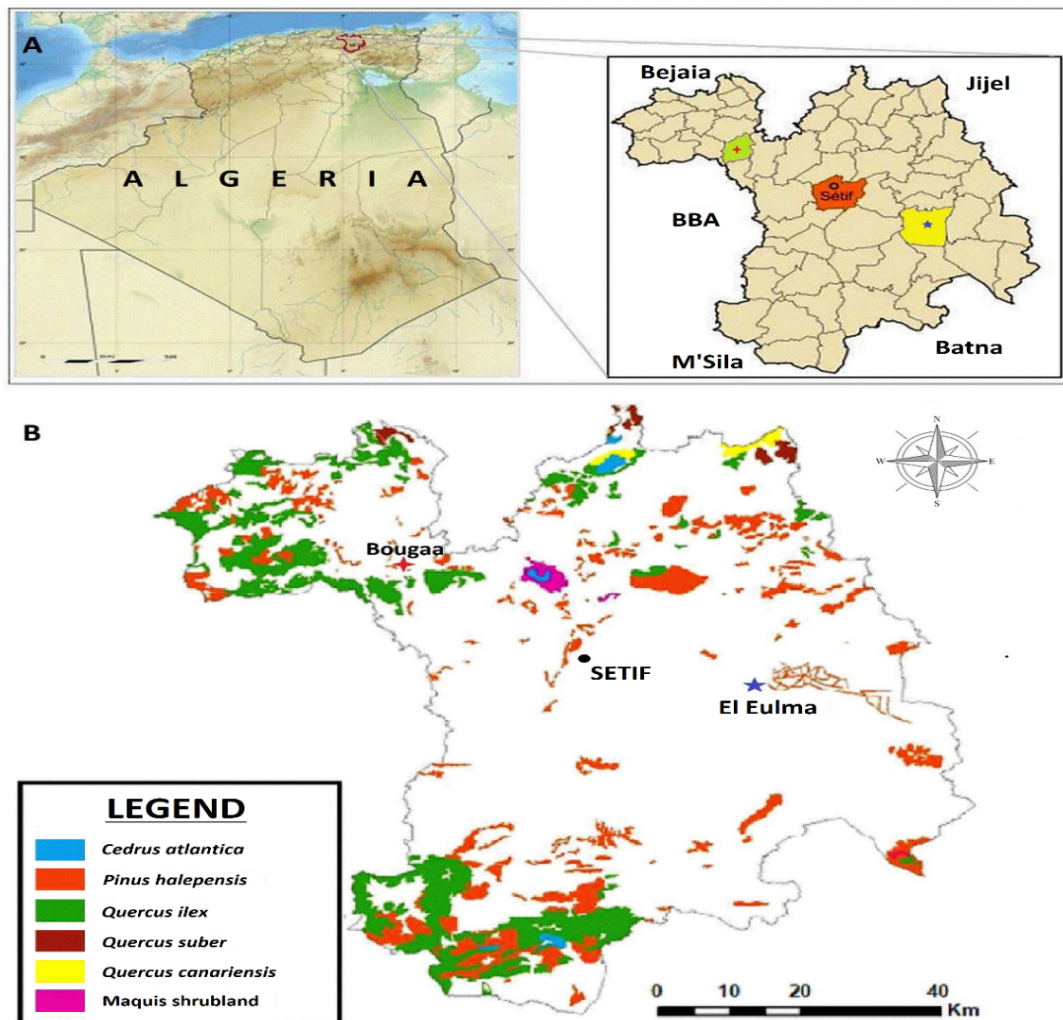


Figure 1. (A) Map showing the geographical location of the study area. (B) Geographical distribution of plant species in the forests of Sétif province.

Data Collection and Questionnaire Validation

A structured questionnaire comprising 21 items was designed to guide interviews. The questionnaire covered sociodemographic characteristics (age, gender, education and marital status), plant species (vernacular names), plant parts used, modes of preparation, routes of administration, and the diseases and conditions treated. Prior to the main survey, the

questionnaire was pilot-tested with 10 individuals to ensure clarity, cultural appropriateness and relevance. Minor adjustments were made based on feedback regarding local terminology and question phrasing. Interviews were conducted face-to-face in the local language (Arabic/Tamazight), and responses were translated into English for analysis.

Botanical Identification

Plant identification was carried out based on vernacular names collected during the survey. These names were subsequently verified by Dr. Wafa Nouioua (Laboratory of Phytotherapy Applied to Chronic Disease, University Ferhat Abbas Sétif 1), a specialist in plant taxonomy. Scientific identification was further confirmed using authoritative Algerian floras, including Flore de l'Algérie, and through comparison with published ethnobotanical studies. Accepted scientific names were verified against the international botanical database World Flora Online (WFO) Plant List (<https://wfoplantlist.org/>) and the corresponding WFO IDs were assigned.

Ethnobotanical Indices

To quantitatively assess the ethnobotanical data, three indices were employed:

Frequency of Citation (FC)

The frequency of citation is defined as the number of informants who cited a given species, following the approach of Phillips & Gentry (1993).

$$FC=n$$

where, n is the number of informants citing the species.

Relative Frequency of Citation (RFC)

The Relative Frequency of Citation measures a species' local importance as the number of informants citing it (FC) divided by total informants (N), without considering the use-categories (Tardi'o & Pardo-de-Santayana, 2008).

$$RFC = FC/N \quad (0 \leq RFC \leq 1).$$

Family Importance Value (FIV)

Family Importance Value (FIV) indicates the level of significance of plant families and attempts to evaluate the biological taxonomic value of plants (Sreekeesoon & Mahomoodally 2014).

It is calculated as:

$$FIV = FC_{\text{family}}/N_s$$

where FC_{family} is the number of informants mentioning the family and N_s is the number of species in that family.

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) was determined to evaluate the consensus among traditional healers as follows:

$$ICF = (Nur - nt)/(Nur - 1)$$

where, Nur is the number of uses reported by respondents for a particular disease and nt the number of plants species in each botanical family reported to be used to treat this particular disease (Gazzaneo *et al.* 2005, Heinrich *et al.* 1998).

In this study, therapeutic categories were defined by grouping related ailments based on body systems and pathological conditions (e.g., respiratory disorders, digestive disorders, musculoskeletal conditions) to ensure a robust and meaningful analysis (Canales *et al.* 2005).

Data Analysis

Data entry and processing were performed using Microsoft Excel 2024 and OriginPro 2024 (OriginLab 2024). Descriptive statistics (frequencies and percentages) were applied to sociodemographic and usage data. Correspondence Analysis (CA) was carried out using R software (v. 4.5.0) with the FactoMineR and factoextra packages to explore relationships among botanical families, plant parts, and preparation methods.

Results and Discussion

Sociodemographic characteristics of medicinal plant users

The survey results indicate that women constituted the majority of medicinal plant users (68.22%), whereas men accounted for 31.77% (Table 1). This predominance of female participants may be attributed to their traditional role as primary caregivers within the household, where they are typically responsible for managing the health of children and other family

members. Consequently, women often represent the principal holders and transmitters of ethnobotanical knowledge (Mantuan & Sannomiya 2024). Similar patterns have been reported across the Mediterranean region, including Algeria (Miara *et al.* 2018), Morocco (Alaoui & Laaribya 2017) and Portugal (Camejo-Rodrigues *et al.* 2003), underscoring the persistent influence of gender on traditional healthcare practices (Alqethami *et al.* 2020). Married individuals also represented a higher proportion of users (53.28%), consistent with findings from western Algeria (Meliani *et al.* 2023), likely due to increased familial responsibilities encouraging reliance on accessible home remedies.

Regarding age, the 20-30 years group was most represented (43.9%), followed by 30-40 years (23.36%), with usage declining in older age groups (≥ 60 years: 4.67%). This contrasts with traditional ethnobotanical surveys in rural and nomadic Algerian communities, which typically report higher knowledge retention among older adults (Chermat & Gharzouli 2015, Mechaala *et al.* 2022, Miara *et al.* 2018). The younger demographic profile here likely reflects the semi-urban context of the Sétif region and the high educational attainment of the sample, suggesting phytotherapy is increasingly integrated into contemporary lifestyles. Older participants in this study often expressed a preference for modern medicine, citing perceived rapid effectiveness and concerns about herb-drug interactions.

In terms of educational attainment, the majority of participants held a university degree (71.96%), No participants without formal education were identified in this study, as all respondents reported having at least a middle school level of education, diverging from rural studies reporting higher illiteracy rates (Mechaala *et al.* 2022, Miara *et al.* 2018, Lefrioui *et al.* 2024), but aligning with recent clinical ethnobotanical studies in western Algeria (Bentabet *et al.* 2022, Chelghoum *et al.* 2021). This may reflect greater awareness of therapeutic properties and an enhanced ability to access and evaluate information on safe herbal use in urbanized settings.

Table 1. Sociodemographic profile of informants interviewed (n = 107)

Characteristic	n	%
Gender		
Women	73	68.22
Men	34	31.77
Age groups (years)		
20-30	47	43.9
30-40	25	23.36
40-50	16	14.95
50-60	14	13.08
> 60	5	4.67
Educational level		
Intermediary	10	9.34
Secondary	20	18.69
University	77	71.96
Marital status		
Married	57	53.28
Single	50	46.72
Total	107	100

Phytotherapy practices in daily life: Focus on plant-based remedies

Reasons for using medicinal plants

According to our results, perceived safety (34.1%) and efficacy (30.2%) were the primary motivations for using medicinal plants, outweighing low cost (18.1%) and habit (17.6%) (Fig. 2). This suggests phytotherapy in the study area is driven by cultural beliefs and experience rather than solely economic constraints, contrasting with North African studies where cost dominated (Boudjelal *et al.* 2013, Lefrioui *et al.* 2024, Ranjarisoa *et al.* 2016). This discrepancy likely reflects our respondents' distinct sociodemographic profile: predominantly university-educated (71.96%) and young (43.9% aged 20-30), unlike typical surveys reporting high illiteracy (Mechaala *et al.* 2022; Miara *et al.* 2018). This indicates a shifting paradigm among educated, semi-urban populations in Sétif, where phytotherapy is viewed as a safer complementary alternative (Chelghoum *et al.* 2021). Consequently, public health strategies must address risks associated with the perception of "natural safety," including toxicities and herb-drug interactions.

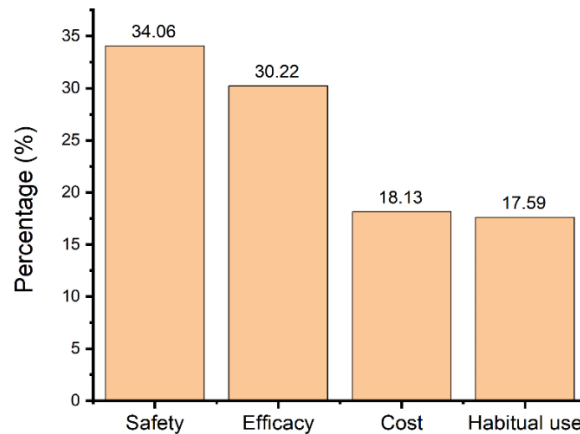


Figure 2. Distribution of the studied population according to the reasons for using medicinal plants.

Origin of medicinal plants

The present ethnobotanical survey revealed that wild medicinal plants constitute the predominant source of herbal remedies, accounting for 61.9% of reported usage. Cultivated species represent a substantial proportion (33.3%), whereas adventitious (weed-type) plants are used only marginally (4.8%) (Fig. 3). This marked preference for wild species aligns with recent ethnobotanical findings in neighboring regions of the Sétif high plateaus, where Aouir *et al.* (2025) documented a 60% reliance on wild flora in the El-Hamma region (Sétif). Similarly, studies in the Algerian steppe and Sahara gate regions report comparable dependencies on wild-harvested taxa, with wild species comprising 60% of used flora among nomadic communities (Miara *et al.* 2018), a trend also observed in the El Kantara area where medicinal use focuses heavily on wild steppe species (Mechaala *et al.* 2022). This consistent pattern across diverse Algerian ecosystems suggests that wild plants are preferred due to their accessibility, perceived therapeutic potency, and deep integration into local ethnomedical knowledge systems. However, the heavy reliance on wild harvesting raises concerns regarding the sustainability of high-demand species, such as *Artemisia herba-alba* and *Origanum vulgare*, and underscores the need for conservation strategies including domestication and sustainable harvesting protocols.

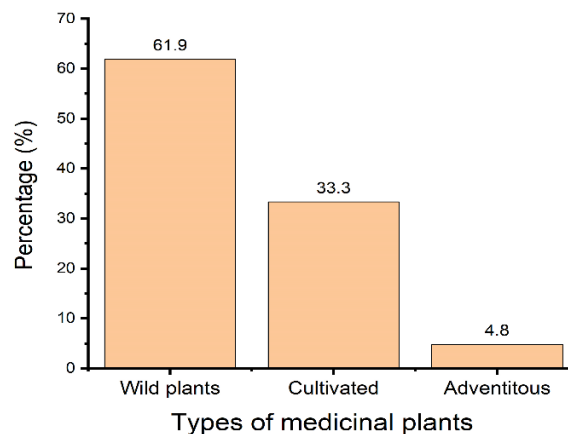


Figure 3. Distribution of types of medicinal plants used by the studied population.

Harvesting techniques

This ethnobotanical survey indicated that the overwhelming majority of respondents harvest medicinal plants manually (98%), whereas mechanical methods are rarely employed (2%) (Fig. 4). This marked preference for manual collection aligns with findings from other Algerian ethnobotanical studies. For instance, Miara *et al.* (2018) reported that nomadic communities in the Algerian steppe rely heavily on wild collection (60% of species) during seasonal displacements, utilizing traditional gathering methods without industrial intervention. Similarly, Chermat and Gharzouli (2015) documented traditional harvesting practices in the Sétif region, emphasizing the reliance on spontaneous flora gathered during specific picking periods. These convergent patterns underscore the persistence of artisanal harvesting techniques across diverse Algerian ecosystems, reflecting both practical constraints and the preservation of ethnomedical heritage. However, the lack of phenological consideration during collection may compromise plant regeneration, a concern raised in conservation-oriented ethnobotanical frameworks (Smith-Hall *et al.* 2012), while the reliance on wild species highlights the need for sustainable management to prevent biodiversity loss (Miara *et al.* 2018).

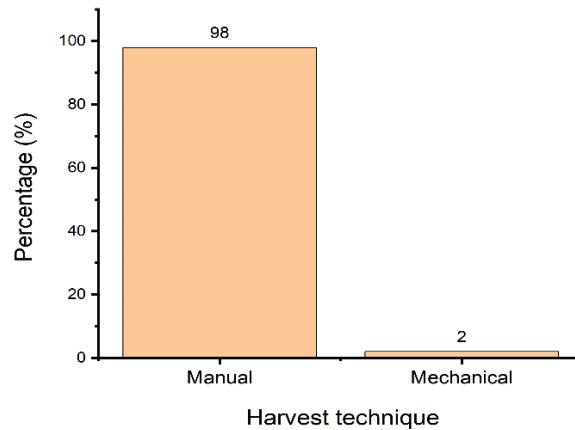


Figure 4. Distribution of the study population by harvest technique.

Status and condition of medicinal plants

Medicinal plants are utilized in various forms depending on user preferences and intended therapeutic applications. The ethnobotanical survey revealed that the majority of respondents prefer using plants in their dried form (61%), which commonly serves as the basis for preparations such as infusions, powders, and extracts. In contrast, a smaller proportion of participants reported using plants in their fresh state (39%), particularly for the treatment of inflammatory conditions (Fig. 5). The choice between fresh and dried plant material appears to be influenced by several factors, including seasonal availability, ease of storage, preparation methods, and individual preferences. Dried forms offer advantages in terms of preservation and year-round accessibility, whereas fresh plants are often perceived as more potent for certain therapeutic applications. These findings align with previous ethnobotanical studies conducted across Algeria. For instance, Meliani *et al.* (2023) documented a comparable predominance of dried plant material (56%) in western Algeria (El Bayadh), suggesting that drying is a widespread preservation strategy within the national ethnomedical heritage. Similarly, Chermat and Gharzouli (2015) reported consistent patterns in the Djebel Zdimm (Sétif) region, where preparation methods such as decoctions (45%) and infusions (30%) typically imply the use of dried plant parts.

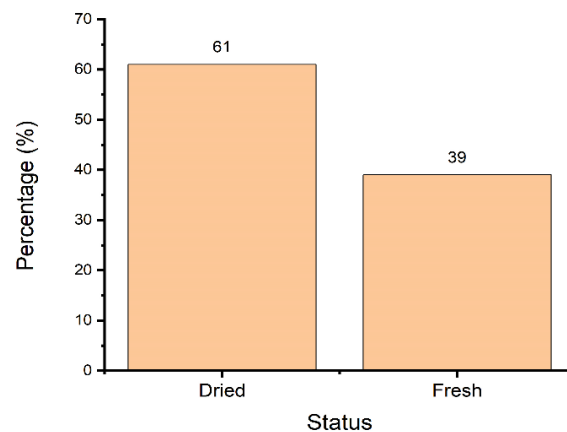


Figure 5. Distribution of respondents according to the form of medicinal plant used (fresh vs. dried)

Harvesting time

Respondents primarily collected medicinal plants year-round (34.6%) or during spring (30%), with fewer harvesting in autumn (19.1%) or summer (16.4%) (Fig. 6). While year-round collection likely reflects immediate healthcare needs and accessibility, harvest timing critically influences therapeutic efficacy due to variations in bioactive compounds across phenological stages (Taylor, 2004). Spring harvesting preferences align with findings from northeastern Algeria, where Souilah *et al.* (2022) documented peak collection in the Central Russikada region during vegetative growth. Similarly, Miara *et al.* (2018) reported comparable patterns among nomadic steppe communities, associating spring harvesting with maximal aerial parts availability. However, extensive year-round harvesting may indicate storage constraints or reliance on fresh material. Unsystematic collection disregarding phenology risks compromising phytochemical quality and exerting pressure on wild populations. Future research should integrate phenological monitoring with phytochemical analyses to define species-specific optimal harvesting windows for sustainable management.

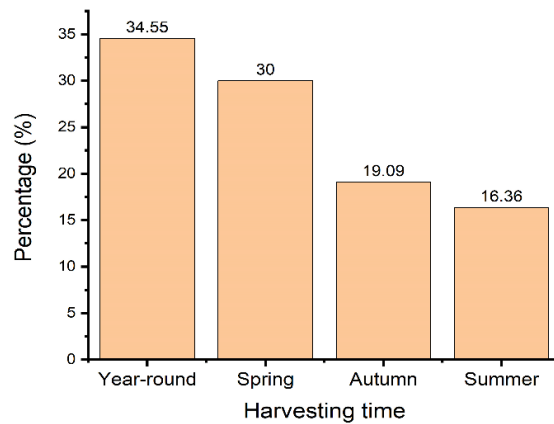


Figure 6. Distribution of the studied population according to the harvest season.

Diversity of medicinal plants

The ethnobotanical survey documented a total of 26 medicinal species belonging to 14 botanical families. The family Lamiaceae was the most represented, with nine species (34.6%), highlighting its dominant contribution to the local pharmacopeia. This finding aligns with broader ethnobotanical patterns across Algeria, where Lamiaceae and Asteraceae consistently dominate medicinal floras due to their rich content of phenolic compounds and essential oils (Aouir *et al.* 2025, Mechaala *et al.* 2022, Miara *et al.* 2018). Lamiaceae was followed by Asteraceae, Zingiberaceae, Myrtaceae, and Verbenaceae, each represented by two species (7.7%). The remaining nine families were represented by a single species each (3.8%) (Fig. 7).

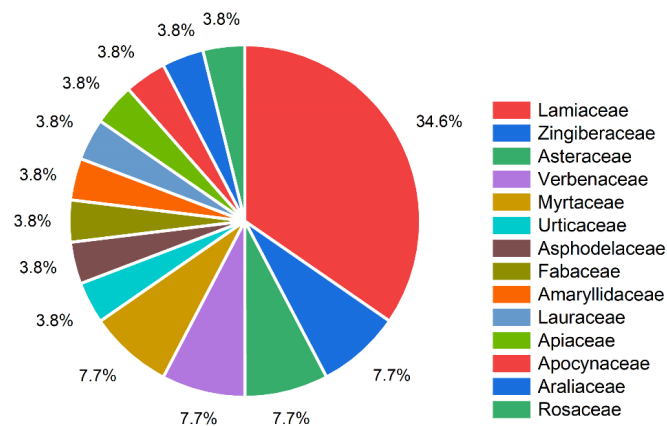


Figure 7. Distribution of reported species among the botanical families.

Cultural importance and family significance of medicinal plants

The quantitative analysis of ethnobotanical data using the Relative Frequency of Citation (RFC) and Family Importance Value (FIV) indices provides critical insights into the cultural relevance and therapeutic priority of medicinal plants in the study area (Table 2).

Origanum vulgare L. ssp. *glandulosum* was the most cited species (RFC = 0.224), highlighting its prominent role in local traditional medicine, particularly for respiratory and digestive inflammatory conditions. This finding aligns with recent phytochemical analyses confirming that this endemic Algerian subspecies is rich in carvacrol and thymol, compounds known for significant antioxidant and antimicrobial activities (Belhadj *et al.* 2025). It was followed by *Zingiber officinale* (RFC = 0.205) and *Curcuma longa* (RFC = 0.140), both widely recognized for their potent anti-inflammatory and antioxidant properties, as validated in pharmacological models (Amari *et al.* 2023, Lefrioui *et al.* 2024). Other notable species included *Mentha spicata* L. (RFC = 0.121), consistent with its status as a highly cited species in neighboring Sétif areas (Aouir *et al.* 2025), *Anthemis arvensis* (RFC = 0.112), and *Marrubium vulgare* (RFC = 0.093), the latter traditionally used for digestive and respiratory disorders (Boudjelal *et al.* 2013). In contrast, *Origanum majorana*, *Zataria multiflora*, and *Salvia rosmarinus* L. showed the lowest RFC values (0.009), suggesting limited use or lower familiarity among respondents.

At the family level, FIV analysis showed the dominance of Zingiberaceae (FIV = 0.172), followed by Urticaceae and Asteraceae (FIV = 0.065 each). Lamiaceae (FIV = 0.061), Aloeaceae (FIV = 0.037), and Fabaceae (FIV = 0.028) had moderate importance.

Although Lamiaceae had the highest species richness (nine species), its lower FIV indicates that cultural importance depends more on usage frequency per species than on taxonomic diversity. The high value of Zingiberaceae is mainly due to the widespread and intensive use of *Zingiber officinale* and *Curcuma longa*.

Phytochemical Validation and Therapeutic Implications

Among the most frequently cited species, *Origanum vulgare* L. ssp. *glandulosum* (RFC = 0.224) is particularly rich in phenolic monoterpenes, notably carvacrol and thymol, which are well documented for their potent anti-inflammatory, antioxidant, and antimicrobial activities (Lombrea et al. 2020, Belhadj et al. 2025). These compounds exert their effects by inhibiting key pro-inflammatory mediators such as nuclear factor-kappa B (NF- κ B), cyclooxygenase-2 (COX-2) and pro-inflammatory cytokines including tumor necrosis factor-alpha (TNF- α) and interleukin-6 (IL-6), while also scavenging reactive oxygen species implicated in the amplification of inflammatory cascades (Silva et al. 2020).

Similarly, *Zingiber officinale* Roscoe (RFC = 0.205) and *Curcuma longa* L. (RFC = 0.140) are widely recognized for their anti-inflammatory potential. *Z. officinale* contains bioactive gingerols and shogaols, which inhibit COX-2, lipoxygenase (LOX), and NF- κ B signaling pathways, thereby reducing the synthesis of prostaglandins and leukotrienes (Mao et al. 2019, Ballester et al. 2022). *C. longa*, characterized by curcuminoids such as curcumin, modulates multiple inflammatory pathways including NF- κ B, mitogen-activated protein kinases (MAPK) and Janus kinase/signal transducer and activator of transcription (JAK-STAT), leading to the downregulation of a broad spectrum of pro-inflammatory cytokines (Kocaadam & Şanlıer 2017, Pen et al. 2021).

Other notable species, such as *Mentha spicata* L. (RFC = 0.121), *Anthemis arvensis* L. (RFC = 0.112), and *Marrubium vulgare* L. (RFC = 0.093) are rich in phenolic acids, flavonoids and terpenoids that underpin their traditional applications in managing digestive and respiratory inflammatory disorders (Brahmi et al. 2015, Boudjelal et al. 2013, Aćimović et al. 2020). These phytochemicals are known to inhibit histamine release, mast cell degranulation, and the production of pro-inflammatory cytokines, thereby attenuating inflammatory responses (Kaur et al. 2018). Likewise, *Salvia officinalis* L. and *Salvia rosmarinus* L. (syn. *Rosmarinus officinalis* L.) contain oxygenated monoterpenes (1,8-cineole, α -pinene) and phenolic acids such as rosmarinic acid, which are associated with significant anti-inflammatory and antioxidant effects, primarily through the modulation of NF- κ B and the neutralization of free radicals (Ghorbani & Esmaeilzadeh 2017, de Oliveira et al. 2019).

In contrast, species such as *Origanum majorana* L. and *Zataria multiflora* Boiss. exhibited relatively low RFC values (0.009), suggesting limited local use or recognition in the study area. Nevertheless, phytochemical investigations indicate that these plants are rich in bioactive compounds, including thymol, carvacrol and rosmarinic acid, which possess well-established anti-inflammatory properties (Bina & Rahimi 2017, Mahdavi et al. 2020). This discrepancy between documented traditional use and established phytochemical potential underscores the importance of further ethnopharmacological and experimental investigations to bridge the gap between local knowledge and scientific validation.

It is also critical to acknowledge that certain plant constituents, particularly essential oils, may exhibit dose-dependent biphasic effects. While compounds such as menthol and 1,8-cineole are widely recognized for their anti-inflammatory and analgesic properties at therapeutic concentrations, higher doses or inappropriate topical application may induce irritation of the skin or mucous membranes and potentially trigger pro-inflammatory responses (Eccles 1994, Juergens 2014). This biphasic behavior emphasizes the critical importance of dosage optimization and appropriate administration routes in the safe and effective therapeutic use of medicinal plants.

Furthermore, several recorded species, including *Alchemilla vulgaris* L., *Aloysia citrodora* Palau, *Vitex agnus-castus* L. and *Foeniculum vulgare* Mill, have limited or insufficient documented evidence specifically supporting their anti-inflammatory activity in rigorous pharmacological models (Bahramsoltani et al. 2020, Souto et al. 2021). Additionally, *Nerium oleander* L. warrants particular caution due to its well-documented toxicity arising from cardiac glycosides, and the current absence of robust evidence supporting its safe use for inflammatory conditions (Farkhondeh et al. 2020). These findings collectively highlight the urgent need for comprehensive phytochemical characterization and rigorous pharmacological and toxicological assessments to fully elucidate the therapeutic potential and safety profiles of these under-investigated species.

Overall, the convergence of high citation frequencies with established pharmacological mechanisms for species like *Origanum vulgare*, *Zingiber officinale*, and *Curcuma longa* strongly supports the relevance of traditional knowledge as a valuable starting point for identifying plants with genuine anti-inflammatory potential. Concurrently, this study underscores the imperative for integrating phytochemical characterization and controlled usage guidelines to ensure both the efficacy and safety of traditional herbal remedies.

Table 2. Medicinal plants used to treat inflammatory diseases in the Sétif region

Family	Scientific name	WFO ID	Vernacular name	Plant parts used	Harvesting Season†	Harvesting Technique	Preparation method	Mode of Administration	Ethnobotanical uses	FC	RFC	FIV
Lamiaceae	<i>Origanum vulgare</i> subsp. <i>Glandulosum</i> (Desf.) Ietsw.	wfo-0000260608	Zaatar	Whole plant	Spring / Year-round	Manual	Decoction, Infusion	Oral, Topical (compress)	Tonsillitis, rhinitis, fever, osteoarthritis, nasopharyngitis, gastroenteritis, influenza, cough, cold, chronic digestive inflammation, joint pain, asthma, sinusitis, oral inflammation, bronchitis, irritable bowel syndrome, headaches	24	0.224	0.061
	<i>Mentha spicata</i> L.	wfo-0000241390	Naanaa	Aerial parts, leaves, flowers, stems, roots	Spring / Summer	Manual	Decoction, Infusion	Oral, Inhalation, Topical	Nasopharyngitis, skin conditions, influenza, gastroenteritis, sciatica, migraine, headache, irritable bowel syndrome, nausea, oral infection, cold, cough, tonsillitis	13	0.121	
	<i>Marrubium vulgare</i> L.	wfo-0000236711	Marriwa	Leaves	Spring	Manual	Maceration	Oral, Topical (wash)	Wound healing, wound disinfection, respiratory diseases, cardiotoxic agent	10	0.093	
	<i>Salvia officinalis</i> L.	wfo-0000301765	Miramia	Aerial parts, leaves, flowers, stems	Spring / Summer	Manual	Maceration, Infusion	Oral, Gargling, Topical	Skin inflammation, genital tract infection, allergy, respiratory conditions, gastric ulcer, sinusitis, skin irritation	6	0.050	
	<i>Lavandula angustifolia</i> Mill.	wfo-0000224116	Khozama	Leaves	Summer	Manual	Maceration	Oral, Inhalation	Nasopharyngitis, gastroenteritis, common cold	2	0.018	
	<i>Ocimum basilicum</i> L.	wfo-0000253230	Rayhane	Leaves, bark	Summer	Manual	Decoction	Oral	Joint pain, dysmenorrhea	2	0.018	
	<i>Origanum majorana</i> L.	wfo-0000260658	Bardakouche	Leaves	Spring / Summer	Manual	Decoction, Infusion	Oral	Dysmenorrhea	1	0.009	
	<i>Salvia rosmarinus</i> L. (syn. <i>Rosmarinus officinalis</i>)	wfo-0000302167	Ikil el-djabel	Leaves	Year-round	Manual	Maceration, Infusion	Oral, Inhalation	Nasopharyngitis, gastroenteritis	1	0.009	
	<i>Zataria multiflora</i> Boiss.	wfo-0000335234	Zaatar chirazi	Leaves, flowers	Year-round (Market)	Manual	Infusion	Oral	Carminative, stimulant, astringent, diuretic,	1	0.009	

									anesthetic, antispasmodic, analgesic			
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	wfo-0000617397	Zanjabil	Rhizome s	Year-round (Market)	Manual	Decoction, Infusion	Oral	Joint and muscle pain, osteoarthritis, colds, acute and chronic inflammation, influenza, digestive inflammation, tonsillitis, sinusitis, rheumatism, oral and dental inflammation, gastric ulcer, gingivitis, gout, fever, sore throat, headache	22	0.205	0.172
	<i>Curcuma longa</i> L.	wfo-0000365771	Korkom	Rhizome s	Year-round (Market)	Manual	Decoction, Infusion	Oral	Osteoarthritis, influenza, arthritis, Alzheimer's disease, joint pain, acute and chronic inflammation, digestive inflammation, tonsillitis, skin inflammation	15	0.140	
Asteraceae	<i>Anthemis arvensis</i> L.	wfo-0000950712	Babounj	Whole plant	Spring	Manual	Decoction, Infusion	Oral, Topical	Skin conditions, gout, nasopharyngitis, gastroenteritis, irritable bowel syndrome, digestive tract inflammation, muscle pain, colds	12	0.112	0.065
	<i>Artemisia herba- alba</i> Asso.	wfo-0000066428	Chih	Whole plant	Spring	Manual	Decoction, Infusion	Oral	Rhinitis	2	0.018	
Verbenaceae	<i>Aloysia citrodora</i> Palau	wfo-0000950712	Tizana	Leaves, stems, seeds	Spring / Summer	Manual	Infusion	Oral	Tonsillitis, irritable bowel syndrome, osteoarthritis, headaches, sore throat	3	0.028	0.018
	<i>Vitex agnus-castus</i> L.	wfo-0000332916	Kaf meriem	Stems	Summer	Manual	Infusion	Oral	Ovarian syndrome	1	0.009	
Myrtaceae	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	wfo-0000318267	Kranfoul	Flowers	Year-round (Market)	Manual	Infusion	Oral	Acute and chronic inflammation, pulpitis	2	0.018	0.013
	<i>Eucalyptus radiata</i> Sieber ex DC.	wfo-0000955747	Kalitous	Leaves	Year-round	Manual	Decoction, Fumigation	Inhalation, Oral	Respiratory diseases (colds, flu, asthma), cough, nasal congestion	1	0.009	
Urticaceae	<i>Urtica dioica</i> L.	wfo-0000416616	Qorasse	Whole plant	Spring / Summer	Manual	Infusion, Fumigation	Oral, Topical, Inhalation	Joint and muscle pain, rhinitis, seasonal allergies, gout, knee arthritis, skin inflammation	7	0.065	0.065

Asphodelaceae	<i>Aloe arborescens</i> Mill.	wfo-0000757866	Sabar	Leaves, stems, flowers	Year-round	Manual	Infusion	Topical, Oral	Osteoarthritis, mouth ulcers	4	0.037	0.037
Fabaceae	<i>Glycyrrhiza glabra</i> L.	wfo-0000212813	Ark souse	Roots	Year-round (Market)	Manual	Infusion	Oral	Eczema, tonsillitis, bronchitis, dry cough, sinusitis	3	0.028	0.028
Amaryllidaceae	<i>Allium sativum</i> L.	wfo-0000757248	Thom	Leaves, stems, seeds	Year-round	Manual	Decoction, Infusion	Oral	Rhinitis, cough	2	0.018	0.018
Lauraceae	<i>Cinnamomum verum</i> J.Presl	wfo-0000605512	Lqorfa	Leaves, roots, bark	Year-round (Market)	Manual	Infusion	Oral	Cervicitis, dysmenorrhea	2	0.018	0.018
Apiaceae	<i>Foeniculum vulgare</i> Mill.	wfo-0000691487	Habet hlawa	Seeds	Summer / Autumn	Manual	Infusion	Oral	Flatulence, nervous system disorders	1	0.009	0.009
Apocynaceae	<i>Nerium oleander</i> L.	wfo-0000251577	Dafla	Flowers, leaves	Spring / Summer	Manual	Infusion	Topical, Oral [‡]	Rheumatic pain, uterine fibroids, uterine cleansing, uterine and ovarian infections	1	0.009	0.009
Araliaceae	<i>Panax ginseng</i> C.A.Mey	wfo-0000263606	Ginseng	Roots	Year-round (Market)	Manual	Decoction, Infusion	Oral	Skin inflammation	1	0.009	0.009
Rosaceae	<i>Alchemilla vulgaris</i> L.	wfo-0001007689	Rijl alasad	Stems	Summer	Manual	Infusion	Oral	Ovarian syndrome	1	0.009	0.009

Harvesting season, technique, and administration mode were mapped per species based on informant responses and aligned with overall survey findings (Manual harvesting: 98%; Oral administration: 62.9%; Seasonal collection: Spring/Year-round). Market-available species (e.g., *Zingiber*, *Curcuma*, *Syzygium*, *Panax*, *Glycyrrhiza*, *Cinnamomum*, *Zataria*) were reported as year-round due to commercial availability rather than local wild harvesting.

[‡] *Nerium oleander* was reported for oral use by a single informant; however, its high toxicity warrants strict topical application and professional supervision.

Plant part uses

The analysis of plant parts used in traditional medicine revealed that leaves constitute the most frequently utilized plant organ, accounting for 34.21% of total usage (Fig. 8). This was followed by stems (18.42%) and flowers (13.16%), while the use of the whole plant represented 10.53%. Other plant parts were used less frequently, including roots (7.9%), rhizomes (5.26%), seeds (5.26%), and bark (5.26%).

The predominance of leaf use is consistent with numerous ethnobotanical studies conducted across Algeria and North Africa. Similar findings were reported in the Sétif region (Chermat & Gharzouli 2015), the Algerian steppe (Mechaala *et al.* 2022, Miara *et al.* 2018), and northeastern Algeria (Souilah *et al.* 2022), where leaves accounted for 25-50% of used parts. This preference is also documented in neighboring countries, including Morocco (Chaachouay *et al.* 2019) and Mauritania (Yebouk *et al.* 2020). This trend can be explained by both biological and practical factors. From a phytochemical perspective, leaves are the primary site of photosynthesis and metabolic activity, where a wide range of bioactive secondary metabolites, such as flavonoids, tannins and essential oils, are synthesized and accumulated (Chamouleau 1979). From an ecological standpoint, leaves are generally more accessible and renewable than underground or structural organs, allowing for harvesting practices that are less destructive and more sustainable (Chen *et al.* 2016).

In contrast, the use of roots, rhizomes, and bark, although less frequent, reflects their role as storage organs for bioactive compounds. However, the collection of these parts may pose greater risks to plant survival and regeneration, raising important concerns regarding the conservation of medicinal plant resources, particularly given the high reliance on wild-harvested species (61.9%) observed in this study (Miara *et al.* 2018).

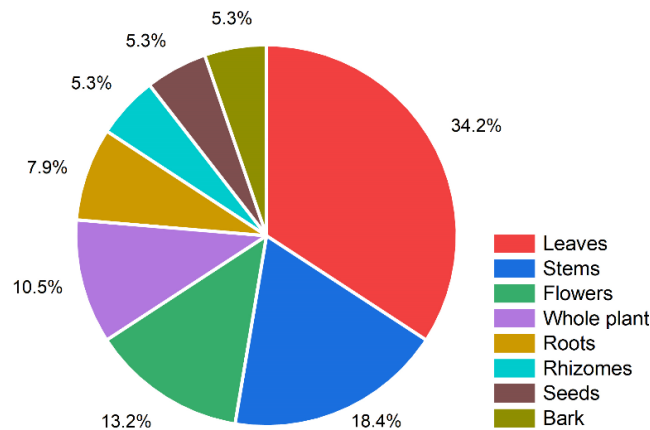


Figure 8. Graphical Representation of Percentages of Medicinal Plant Parts Used.

Methods of preparation

The surveyed population uses various traditional methods to prepare medicinal plants for inflammatory conditions. Infusion is the most common (56.41%), followed by decoction (28.21%), while maceration (10.26%) and fumigation (5.13%) are less frequent (Fig. 9). These practices reflect local knowledge aimed at optimizing bioactive compound extraction while preserving therapeutic properties.

The choice of method depends on plant material and the condition treated, with a preference for simple, accessible techniques. Infusion is suitable for heat-sensitive or volatile compounds, such as essential oils (Nogaret 2003, Karine & Escuder 2019), and is widely reported in Algeria (Chermat & Gharzouli 2015, Mechaala *et al.* 2022). Decoction, in contrast, is used for more resistant materials (roots, bark, seeds), as prolonged boiling enhances extraction (El Hilah *et al.* 2015), though it may degrade thermolabile compounds. This likely explains its lower use compared to infusion, unlike in Algerian steppe populations where decoction predominates (Miara *et al.* 2018).

Maceration and fumigation, though less common, remain important in traditional phytotherapy (El Hilah *et al.* 2015). Maceration enables gradual, heat-free extraction, suitable for alcohol-soluble compounds, while fumigation is mainly used for respiratory or topical conditions such as bronchitis and sinusitis. Its low use (5.13%) in this study may reflect the semi-urban context of Sétif, where modern healthcare is more accessible.

These results highlight the importance of documenting preparation methods alongside plant species, as extraction techniques directly influence therapeutic efficacy. Future pharmacological studies should integrate these traditional practices to better reflect real usage.

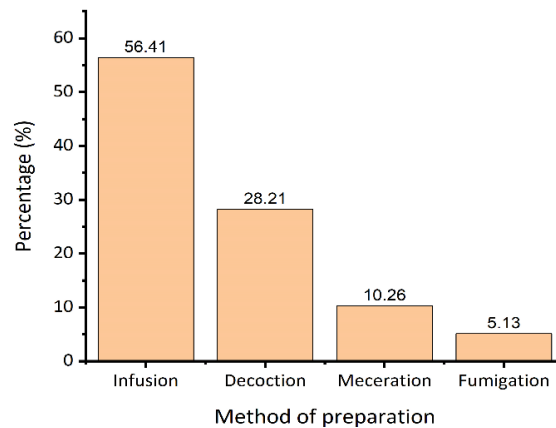


Figure 9. Graphical representation of the percentages of medicinal plant preparation methods.

Correspondence Analysis of Botanical Families and Ethnomedicinal practices

The Correspondence Analysis (CA) biplot (Fig. 10) reveals the associations between botanical families and ethnomedicinal practices, with the first two dimensions explaining 34.3% of the total inertia (Dim1: 17.5%; Dim2: 16.8%). The analysis reveals distinct clustering patterns along the primary axes. On the positive side of Dimension 1, families such as Lamiaceae, Lauraceae, Fabaceae, Asteraceae, and Araliaceae are strongly associated with preparation methods including maceration, decoction, and the use of aerial parts, bark, whole plant, and roots, suggesting these families are predominantly utilized through these extraction methods and plant parts. In contrast, the negative quadrant of Dimension 1 shows Apiaceae and Urticaceae positioned near seeds and fumigation, indicating their specific therapeutic applications. Dimension 2 further differentiates the families, with Zingiberaceae and rhizomes occupying the upper positive quadrant, suggesting a specialized association. The central region contains families like Myrtaceae, Rosaceae, and Apocynaceae, which show moderate associations with infusion and leaves. This spatial distribution indicates that certain botanical families have developed strong traditional associations with specific preparation methods and plant parts, reflecting culturally embedded ethnobotanical knowledge and practical considerations in medicinal plant use within the studied region.

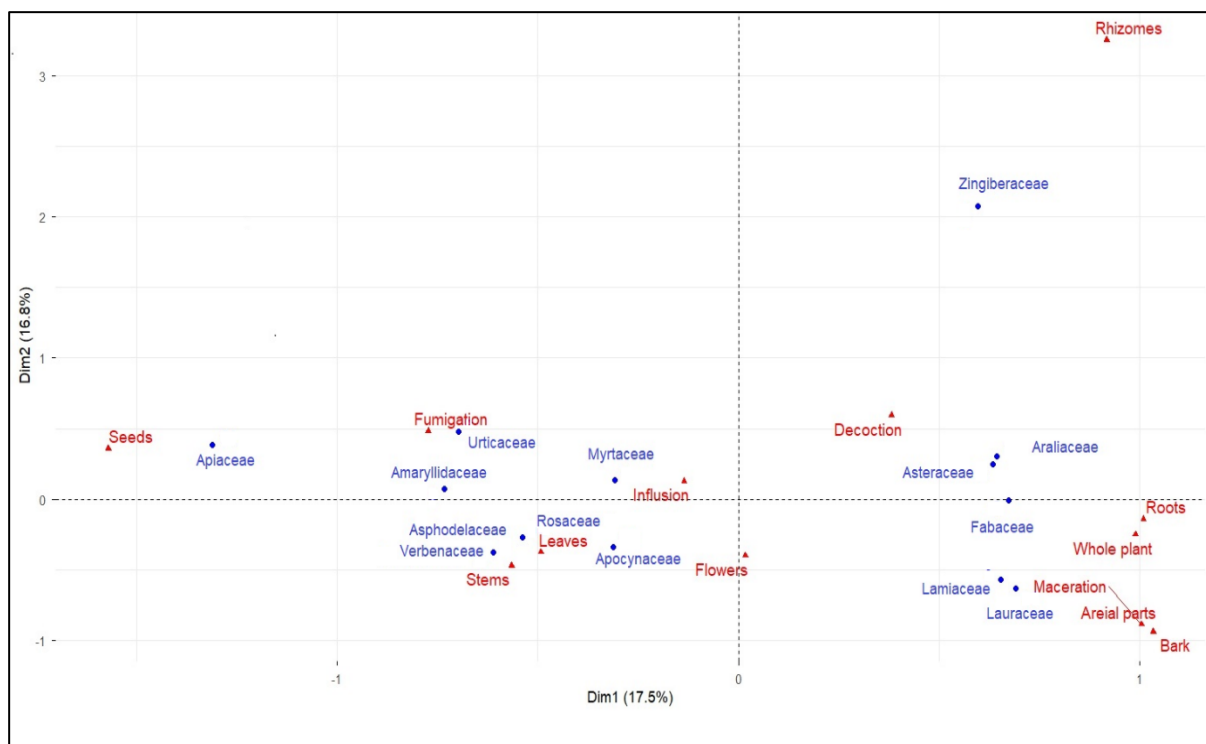


Figure 10. Correspondence Analysis (CA) biplot of medicinal plant families, plant parts used, and preparation methods

Mode of administration

The ethnobotanical survey revealed that medicinal plant preparations used to treat inflammatory conditions are predominantly administered orally, accounting for 62.94% of reported uses. This preference aligns with the high prevalence of internal inflammatory conditions (e.g., digestive and respiratory disorders) reported in this study, where systemic delivery is required for therapeutic efficacy. Topical applications, including massage, compresses, and local rinsing, accounted for 20.28% of uses, primarily for dermatological conditions and disorders affecting mucous membranes. Other localized methods such as gargling (7.69%), rinsing (5.59%), and swabbing (3.5%) were less frequently employed (Fig. 11). Inhalation-based practices were also recorded, particularly for respiratory conditions to facilitate airway clearance, a finding supported by recent surveys in northeastern Algeria (Gherairia *et al.* 2025). These findings corroborate broader North African ethnobotanical patterns, where oral ingestion dominates due to the prevalence of gastrointestinal and respiratory ailments (Miara *et al.* 2018, Souilah *et al.* 2022).

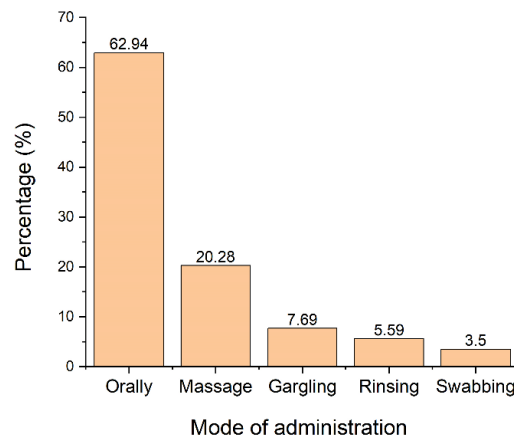


Figure 11. Distribution of the study population according to the mode of administration of medicinal plants.

Purpose of use of medicinal plants in disease treatment

Our findings indicate that medicinal plants in the Sétif region are primarily used to treat respiratory disorders, accounting for 24.29% of reported uses (Table 3). This category includes asthma, influenza, cough, and bronchitis. Its predominance may be linked to the semi-arid highland climate, characterized by temperature fluctuations, dust exposure, and cold winters, which increase vulnerability to respiratory ailments. This finding aligns with recent surveys in neighboring Kabylia, where Hadj-Said and Bouazza (2023) also identified respiratory diseases as a primary therapeutic target. The high Informant Consensus Factor (ICF = 0.798) recorded for respiratory disorders further supports the existence of a strong cultural consensus on the use of specific medicinal plants to treat these conditions.

Digestive disorders rank second (14.86%), including gastritis, ulcers, constipation, and intestinal inflammation. The ICF for this category (0.784) similarly reflects a high degree of agreement among informants, indicating well-established knowledge regarding the treatment of gastrointestinal ailments. Musculoskeletal conditions follow (21.43%), with an ICF of 0.878, the highest among all therapeutic categories, underscoring a very strong consensus on the use of traditional remedies for managing musculoskeletal and inflammatory disorders, particularly among older informants.

Dermatological conditions account for 5.14% of uses, with a moderate ICF of 0.706, reflecting continued reliance on phytotherapy for skin ailments such as eczema and psoriasis (Hantour *et al.* 2026). Gynecological ailments represent 1.43% of uses (ICF = 0.250), consistent with broader ethnobotanical patterns in Algeria (Belhouala & Benarba 2021), though the lower ICF suggests greater variability in the plants used to treat these conditions. Neurological disorders (4.29%) exhibit a very high ICF (0.857), indicating that informants strongly agree on the specific plants used for these ailments, despite their lower frequency of citation. Infectious diseases (11.43%) also show high consensus (ICF = 0.821), while other categories remain marginal (0.57-2.86%).

Notably, the predominance of respiratory disorders contrasts with findings from other Algerian regions, where digestive ailments typically dominate. For instance, Lazli *et al.* (2019) reported digestive disorders as the leading category (29%) in El Kala National Park, compared to 11.25% for respiratory diseases. Similarly, Miara *et al.* (2018) and Mechaala *et al.* (2022) identified gastrointestinal disorders as the primary category in the Algerian steppe and El Kantara region, respectively, with

the highest Informant Consensus Factor (ICF = 0.94) recorded for digestive ailments in El Kantara. In comparison, the ICF values in the present study are more evenly distributed across categories, with the highest consensus observed for musculoskeletal (0.878), neurological (0.857), and infectious (0.821) conditions. These differences likely reflect regional variations in environmental conditions, disease prevalence and cultural practices. Nonetheless, the prominence of both respiratory and digestive disorders aligns with broader North African ethnobotanical patterns, where these two categories consistently represent the most treated ailments (Hadj-Said & Bouazza 2023, Soltani *et al.* 2025).

Table 3 Informant Consensus Factor (ICF) by therapeutic category.

Therapeutic Category	Nur (Total Citations)	Nt (Number of Species)	ICF	CF (%)
Cardiovascular	10	1	1	2.86
Musculoskeletal	75	10	0.878	21.43
Neurological	15	3	0.857	4.29
Infectious	40	8	0.821	11.43
Respiratory	85	18	0.798	24.29
Digestive	52	12	0.784	14.86
Dermatological	18	6	0.706	5.14
Inflammatory	48	15	0.702	13.71
Gynecological	5	4	0.25	1.43
Dental	2	2	0	0.57

Duration of medicinal plant use

In the present ethnobotanical survey, most respondents reported using medicinal plants until full recovery (53.3%), reflecting a symptom-driven approach characteristic of empirical traditional medicine. In contrast, fixed treatment durations were less common: one week (34.3%), a single day (7.6%), or up to one month (4.8%) (Fig. 12). These findings suggest that treatment length is largely determined by perceived therapeutic progress rather than standardized protocols. This pattern aligns with broader ethnobotanical studies in Algeria, where treatment duration is often flexible and dependent on symptom relief rather than fixed timelines. For instance, Miara *et al.* (2018) noted that nomadic populations keep plants dry to be used "when necessary", while Meliani *et al.* (2023) reported that 76% of medicinal plants in El Bayadh are utilized with unknown portions. The predominance of use until recovery underscores the role of medicinal plants as primary healthcare resources in the Sétif region, where discontinuation typically coincides with the alleviation of inflammatory symptoms.

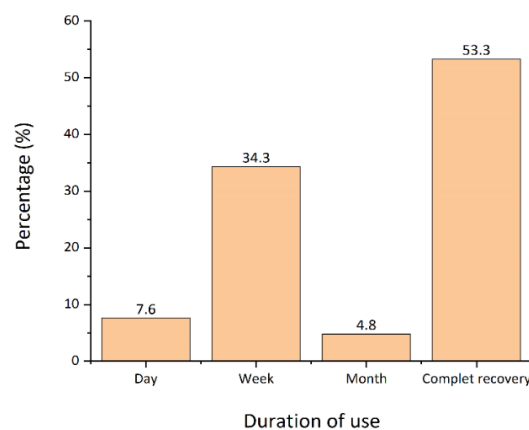


Figure 12. Duration of medicinal plant use by the studied population.

Conclusion

This study provides a comprehensive documentation of medicinal plants traditionally used in the Sétif region (communes of El Eulma and Bougaa) for treating inflammatory conditions. The ethnobotanical survey recorded 26 medicinal species from 14 botanical families, reflecting a rich phytotherapeutic heritage. *Origanum vulgare* L. ssp. *glandulosum* and *Zingiber officinale* emerged as the most culturally significant species, with the highest RFC values, indicating their widespread recognition and therapeutic relevance. At the family level, Zingiberaceae showed the highest Family Importance Value (FIV = 0.175), reflecting the intensive use of *Z. officinale* and *C. longa*.

Leaves were the most frequently used plant part, and infusion the predominant preparation method, reflecting local knowledge of heat-sensitive bioactive compounds. Sociodemographic analysis revealed that women, particularly married

individuals aged 20-30 years, are the primary users, emphasizing their central role in preserving and transmitting ethnobotanical knowledge.

The ICF analysis revealed highest consensus for musculoskeletal (0.878), neurological (0.857), and infectious (0.821) conditions, indicating strong cultural agreement on specific remedies. Correspondence Analysis further illustrated associations between botanical families, plant parts, and preparation methods, revealing distinct ethnomedicinal practices.

Despite the widespread use of medicinal plants, self-medication may pose risks, including adverse effects and herb-drug interactions. This study has limitations, including reliance on self-reported data (potential recall bias) and the absence of phytochemical and pharmacological validation.

Nevertheless, this work provides valuable baseline data. Species with high citation values, particularly *Origanum vulgare* L. ssp. *glandulosum* and *Zingiber officinale*, should be prioritized for phytochemical investigations to identify active constituents, followed by in vitro and in vivo studies to evaluate anti-inflammatory potential and safety. Additionally, conservation strategies are essential to ensure sustainable use of wild-harvested species.

In conclusion, documenting and preserving traditional ethnobotanical knowledge not only safeguards cultural heritage but also supports the discovery of novel bioactive compounds with potential applications in modern medicine.

Ethics approval and consent to participate: This research did not necessitate formal ethical approval since it did not engage in clinical procedures or involve vulnerable populations, in accordance with Algerian national regulations. Participants received an oral explanation of the study's objectives and gave their verbal informed consent prior to participation. Involvement was entirely voluntary, and all collected data were handled confidentially, respecting local cultural customs and traditions.

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