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ETHNOBOTANICAL DOCUMENTATION AND PHARMACOLOGICAL POTENTIAL OF MEDICINAL PLANTS IN RELIZANE, ALGERIA

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Abstract

This study aims to document traditional knowledge related to medicinal plants used by local communities in the Relizane Province of Northwestern Algeria, with the dual objective of preserving cultural heritage and supporting the sustainable use and pharmacological potential of these resources. Ethnobotanical surveys were conducted in seven regions of Relizane, engaging 210 local informants. A total of 70 medicinal plant species, belonging to 32 families, were identified. The most frequently cited families were Lamiaceae, Apiaceae, and Asteraceae, with *Thymus vulgaris*, *Matricaria chamomilla*, and *Mentha spicata* emerging as the most commonly used species. Data were analyzed using ethnobotanical indices such as Use Value (UV) and Informant Consensus Factor (ICF). *Thymus vulgaris* had the highest UV (0.080), while the highest ICF values were observed for respiratory (0.80) and digestive disorders (0.72), indicating a high level of agreement among informants. In contrast, reproductive health exhibited the lowest ICF (0.25).

Introduction

Medicinal plants have played an indispensable role in human history for centuries, and their relevance persists today as they are often regarded as effective and accessible alternatives to modern treatments (Chaachouay and Zidane 2024). This growing interest in natural remedies is driven by the abundance of bioactive compounds in plants, celebrated for their diverse therapeutic properties, including antimicrobial, anti-inflammatory, and antioxidant effects (Monari *et al*. 2022). Like many other nations, Algeria's traditional medicine is deeply rooted in the natural wealth of its ecosystems and the ancestral knowledge passed down through generations (Djahra *et al*. 2023).

Algeria is the largest Maghreb country and hosts a rich diversity of medicinal and aromatic plants (Souilah *et al*. 2018). In recent years, several ethnobotanical and ethnopharmacological studies have aimed to preserve this knowledge and promote biodiversity conservation (Belhouala and Benarba 2021, Djouamaa *et al*. 2022).

This study aims to comprehensively document the diversity of medicinal plant species, together with their traditional therapeutic applications, modes of preparation, and routes of administration. In addition, it seeks to analyze how socio-demographic variables, such as age, gender, education level, occupation, and place of residence, influence the distribution, transmission, and preservation of ethnobotanical knowledge within the population. Through this approach, the study intends to better understand patterns of traditional plant use and the factors shaping local medicinal knowledge systems.

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Material and Methods

An ethnobotanical survey was carried out in seven municipalities of Relizane in 2023 and 2024, following standard ethnobotanical research methodologies. Data were collected using a combination of quantitative and qualitative methods, including structured questionnaires and semi-structured interviews. A total of 210 structured questionnaires were administered, with 30 participants selected and interviewed in each site. The structured questionnaire enabled the collection of detailed information on the characteristics of the informants, including age, gender, and educational level. Participants were also asked to provide, the scientific and vernacular names of the medicinal plants they used, along with the plant parts utilized, the ailments treated, and the methods of preparation.

Information was obtained from a diverse range of informants involved in the use and knowledge of medicinal plants. Additional field visits were carried out to observe some of the reported species in their natural habitats. For plant species that were not naturally available in the area, informants indicated that they were commonly obtained from local herbalists. Voucher specimens were prepared according to standard herbarium procedures, identified using appropriate taxonomic references and expert consultation, and deposited at the University of Relizane Herbarium for future reference and authentication.

The importance of each medicinal plant was evaluated by considering the Use Value (UV), and calculated as: $UV = \frac{\sum U}{N}$

Where, U = number of citations, N = number of informants.

The level of agreement among informants regarding the use of plants for specific ailment categories was assessed using the Informant Consensus Factor (ICF), defined as

$$ICF = (Nur - Nut)(Nur - 1)$$

Nur = number of use-reports, *Nut* = number of species used for that ailment.

Results and Discussion

The study consists of two parts: one on participants' sociodemographic data, and the other on medicinal plants and their uses.This division allows for a comprehensive analysis of both the societal and botanical dimensions of traditional medicine. Fig. 1a shows that among the 210 surveyed individuals, 68% were female and 32% male. These results reflect that both the genders show interest in medicinal plants, although women demonstrate a greater interest, broader use, and more extensive knowledge of medicinal plants compared to men. This finding aligns with several previous studies (Ramdane *et al*. 2015, Zahariev and Radeva 2020). Additionally, women play a key role in transmitting traditional knowledge within families, especially between mothers and daughters (Leonti and Casu 2013, Meddour *et al*. 2020). They are also known for sharing medicinal plant information within their social networks (Makhlouf *et al*. 2024). Finally, their responsibility for preparing and preserving herbal remedies ensures their families' continued health (Djouamaa *et al*. 2022).

The results presented in Fig. 1b reveal that 53% of the participants are university students, followed by 17% with a secondary education level. Lastly, an equal percentage of 15% is observed for both the illiterate and primary education groups. These findings indicate that university students demonstrate a greater awareness of medicinal plants, likely due to their exposure to scientific knowledge and the promotion of entrepreneurial projects within universities, particularly in western Algeria. The lower percentage observed among the secondary education group may reflect limited access to specialized academic training in this field. Meanwhile, the equal percentages for the illiterate and primary education groups suggest that their understanding

of medicinal plants is primarily rooted in cultural traditions and personal experiences rather than formal scientific knowledge. According to the results presented in Fig. 1c, 63% of participants were married, while 37% were single. These findings suggest that married individuals are more likely to possess knowledge and interest in medicinal plants. This can be attributed to the greater sense of responsibility they often feel towards their family's well-being, which encourages them to rely on traditional remedies. Additionally, married individuals may turn to medicinal plants as a way to reduce healthcare expenses and independently manage their health (Chohra and Ferchichi 2019).

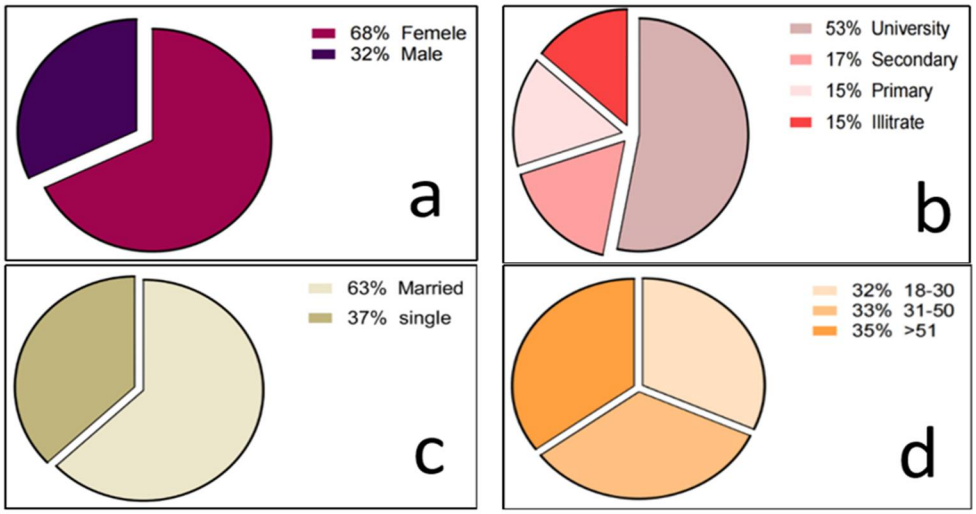

Fig. 1. Sociodemographic factors influencing medicinal plant use in Relizane. a: sex group, b: educational level, c: marital status, and d: age group.

The age group over 51 years old uses medicinal plants at the highest rate (35%, Fig. 1d). This is explained by the fact that older people frequently have a wealth of knowledge about medicinal plants and their uses. This observation aligns with findings from other researchers (Adli *et al.* 2021, Kachmar *et al*. 2021). The results indicate that the 18-30 age group represents 32% of medicinal plant knowledge, demonstrating increasing interest among younger generations. This suggests that ethnobotanical knowledge is no longer limited to older adults. The COVID-19 pandemic likely contributed to this trend by raising awareness of the health benefits of medicinal plants (Hamdani and Houari 2020). Additionally, young people are exploring not only therapeutic uses but also economic opportunities in natural product development and entrepreneurship, reflecting a renewed appreciation for natural resources.

The results in Fig. 2a showed that leaves were the most frequently used plant parts (39%), followed by seeds (15%), while fruits, flowers, and whole plants each accounted for 8%. Roots and underground parts represented 6%, aerial parts 5%, stems 4%, and cores only 0.3%. Similar findings were reported, identifying leaves as the predominant plant parts used in traditional medicine (Naceiri-Mrabti *et al.* 2022). The preference for leaves can be attributed to their ease of collection and their richness in bioactive compounds (Karous *et al.* 2021). Moreover, the use of leaves is more sustainable than harvesting roots, which often requires uprooting the plant and may negatively affect plant regeneration and ecosystem stability (Alalwan *et al.* 2019).

According to the data presented in Fig. 2b, decoction stands out as the predominant method for preparing medicinal plants in Relizane, representing 43% of reported usage. This is followed by infusion (27%), oil-based preparations (10%), and powdered forms (9%). Additional methods include cooked formulations (6%), juices (3%), and creams or other minor forms (1%). These findings highlight the central role of decoction in traditional medicinal practices, reflecting its widespread acceptance and the strong cultural belief in its therapeutic efficacy (Makhlouf *et al.* 2024). The preference for decoction is likely attributed to its capacity to extract a broad spectrum of bioactive compounds, thereby maximizing the medicinal potential of plant-based remedies.

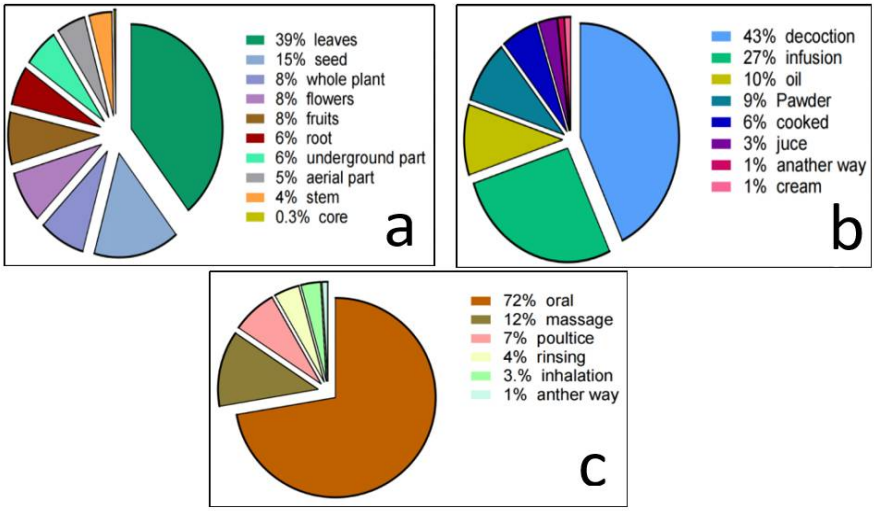

Fig. 2. Ethnobotanical usage of medicinal plants. a: plant part used, b: mode of preparation, and c: mode of use.

The results presented in Fig. 2c illustrate the various modes of plant usage. Oral ingestion is the most common way of administration (72%), followed by massage (13%), poultice (7%), rinse (4%), inhalation (3%), and other methods (1%). The predominance of oral consumption (72%) can be attributed to its effectiveness and convenience as a treatment method. This suggests that users are well-aware of the therapeutic benefits of consuming medicinal plants directly (Hidar *et al.* 2024).

The ethnobotanical survey conducted across seven regions in Relizane, western Algeria, identified 70 medicinal plant species from 32 families, with the Lamiaceae, Apiaceae, and Asteraceae being the most commonly used. These results align with Hedidi *et al.* (2024), who also found these families to be the most dominant in their ethnobotanical studies in Algeria. These families are well-known for their medicinal value, attributed to their bioactive compounds (Ulewicz-Magulska and Wesolowski 2023). In Algeria, the dominance of these families' use is due to their abundance and therapeutic applications; they are primarily used for digestive, respiratory, and anti-inflammatory treatments, reflecting both ecological availability and deep-rooted traditional knowledge (Benaiche *et al.* 2019, Brahmi *et al.* 2023).

Table 1 shows that *Thymus vulgaris* (UV = 0.080), *Matricaria chamomilla* (UV = 0.061) and *Mentha spicata* (UV = 0.057) were the most frequently cited species, indicating their extensive use for digestive, respiratory and stress-related treatments. The high UV values of these plants suggest a strong transmission of ethnobotanical knowledge and widespread recognition of their medicinal properties.The informant consensus factor (ICF) illustrated in Table 2 of values ranged

from 0.25 to 0.80, with respiratory diseases (ICF = 0.80) and digestive disorders (ICF = 0.72) having the highest values, indicating a strong agreement among informants. It is noteworthy that such high ICF values have been reported in other Algerian studies (Madani *et al*. 2017) suggesting that medicinal plant knowledge for these conditions is well-established and windely shared. In contrast, the domain of reproductive and hormonal health exhibited the lowest ICF value of 0.25, indicating a deficiency in consensus, which may be ascribed to variability in treatment practices or reliance on modern medicine (Pan 2023).

Table 1. Plant species used by the local population of Relizane.

Family	Scientific name	Vernacular name	Therapeutic property	UV value
Amaranthaceae	*Atriplex halimus*	Elktaf	Hormonal Health-Immune System	0.014
Amaryllidaceae	*Allium sativum*	Thoum	Diabetes - Respiratory System- Cardiovascular	0.019
	Allium cepa	basal ahmar	prostate health	0.004
Anacardiaceae	*Pistacia lentiscus*	eldarw	Skin- respiratory system	0.009
	Apium graveolens	Krafes	Weight management	0.004
	Cuminum cyminum	Kamoun	Digestive system	0.023
	Petroselinum crispum	Bakdonas	Cardiovascular - kidney and urinary health - immune system	0.009
	Visnagadaucoides	Noukha	bone and joint health- Digestive system- Fever	0.047
Apiaceae	*Buniummauritanicum*	Talghouda	Hormonal health – Coughing	0.014
	Carum carvi	Karouia	lower blood pressure and improvecirculation-menstrual cycles pain	0.009
	Coriandrum sativum	Kosber	stomach pain	0.004
	Foeniculum vulgare	Basbas	Digestive system	0.023
	Pimpinella anisum	Yansoun	Abdominal pain	0.014
Apocynaceae	*Tabernaemontanacrassa*	tofahatadam	Immune system boost	0.004
Araliaceae	*Panax ginseng*	Genses	diabete	0.004
Asphodelaceae	*Aloe vera*	Sabar	treating acne- cosmetic treatments	0.009
	Matricaria chamomilla	babouneg	stress reduce- Irritable bowel syndrome- Hemorrhoid disease- Reduces anxiety- Insomnia and allergies-Back pain- digetion-For small intestine disorders	0.061
	Echinacea purpurea	Konfodia	Disinfection, antiviral properties, and immune system stimulation	0.004
	Cichorium intybus	Handabaa	Lowering blood sugar levels	0.004
Asteraceae	*Artemisia herba-alba*	elchih	Used for pain relief, including abdominal and joint pain- Diabete- Colds	0.019
	Silybum marianum	choukateljamal	Used to liver health - Liver benefits	0.009
	Dittrichiaviscosa	Magraman	joint pain relief	0.014
	Saussureacostus	elkasthindi	Digestive system	0.009
Brassicaceae	*Lepidium sativum*	habelrachad	relieve joint pain	0.014
	Raphanus sativus	elfidjel	back pain	0.004
Cucurbitaceae	*Cucurbita pepo*	Yktin	combating cancer cells	0.004
	Citrullus colocynthis	el hadj	treating psoriasis	0.004
	Juniperus communis	Araar	Used as a diuretic- headaches and fever-Sore throat and nose -skin	0.038
Euphorbiaceae	*Ricinus communis*	kharwaa	cosmetic treatments	0.004
Fabaceae	*Glycyrrhiza glabra*	ark sous	Supports digestive health and combats inflammation	0.004
	Trigonella foenum-graecum	elhalba	Galactagogue -diabetes management- promote weight gain- skin	0.023
Iridaceae	*Crocus sativus*	Zaafran	for eye health	0.004
Juglandaceae	*Juglans regia*	eljouz	Mouth	0.004
Lamiaceae	*Mentha spicata L*	Nanaa	colon disease-High blood pressure-Calms the nerves-Digestive system-colds & abdominal pain	0.057
	Thymus vulgaris	Zaater	Cold-Digestive system -Irritable bowel syndrome-Cough treatment and bad breath-skin diseases-Menstrual and uterine pain --abdominal pain	0.080
	Rosmarinus officinalis	iklileljabal	Circulatory system problems-cold-Alzheimer's disease-Memory enhancement-Blood -circulation-cholesterol	0.033

	Lavandula angustifolia	elkhozama	Reduces anxiety-stomach pain-digestive	0.014
	Salvia officinalis	Miramiyah	Digestive system-egulate menstrual cycles-Skin-Coughing	0.019
	Marrubium vulgare	Temeriout	cold	0.004
	Origanum majorana	Bardakouch	stress reduce	0.004
	Salvia hispanica	el chia	weight loss	0.004
	Ocimumbasilicum	elraihan	High blood pressure	0.004
	Melissa officinalis	Mlisa	Digestive system	0.004
	Teucrium polium	El jaada	Digestive system - gallbladder health	0.004
Lauraceae	*Cinnamomum verum*	elkarfa	Treatment of endometriosis-High blood pressure	0.009
	Laurus nobilis	el rand	Relieves Gas and Bloating-Used to relieve digestive issues-alleviate menstrual pain	0.009
Linaceae	*Linum usitatissimum*	boudorel katan	weight loss-Memory enhancement-Treating hair split ends and promoting hair health	0.014
Lythraceae	*Punica granatum*	kochourraman	Regulates blood pressure-indigestion-colds	0.019
	Lawsoniainermis	elhanaa	skin inflammation	0.009
Malvaceae	*Hibiscus sabdariffa*	Karkadia	High blood pressure and cough treatment	0.009
Myrtaceae	*Syzygiumaromaticum*	Kronfel	Eliminating germs and tooth pain relief-dental pain	0.019
	Eucalyptus globulus	Kalitous	Cold-respiratory disorders	0.028
Oleaceae	*Olea europaea*	elzaitoun	Joint pain- regulate blood sugar and support kidney detox -immune system strengthening-skin-Virus treatment	0.042
Plantaginaceae	*Globularia alypum*	Tasselgha	diabete	0.014
Ranunculaceae	*Nigella sativa*	habatel baraka	Allergic diseases such as asthma-stomach disorders	0.009
Rhamnaceae	*Ziziphus lotus*	elsidre	Used for relieving hair-skin-digestive	0.019
	Rhamnus alaternus	eldarw	asthma	0.004
Rosaceae	*Malus domestica*	Tofahhiraji	Weight loss, skin diseases, and fat removal	0.004
Sapotaceae	*Argania spinosa*	Argan	Used for hair care and skin health	0.009
Saxifragaceae	*Saxifraga granulata*	fatat al hadjer	kidney diseases and stones	0.004
Solanaceae	*Capsicum annuum*	falfalhar	Used as a pain reliever	0.009
	Withaniasomnifera	achouaghanda	reduce swelling and joint stiffness	0.004
Scrophulariaceae	*Verbascum Sinuatum*	Maslah landar	alzheimer-Anti-cancer	0.004
Urticaceae	*Urtica dioica*	elhourig	Used for respiratory diseases, rheumatism-Anemia	0.014
Verbenaceae	*Verbena officinalis*	Vervana	colds	0.004
Zingiberaceae	*Zingiber officinale*	Zanjabil	Weight loss and immune system support-abdominal pain-diabete-cold-Expel phlegm-throat inflammation	0.047
	Elettaria cardamomum	elhil	Headache treatment and pain relief	0.009
	Curcuma longa	Kourkoum	Anemia-chronic inflammation-heartburn- Fever, pain and inflammation-Anti-cancer- diabete	0.033
Zygophyllaceae	*Fagoniacretica*	elfowa	Anemia	0.004
	Peganum harmala	elharmel	For gray hair	0.004

Table 2. Informant consensus factor (ICF) values for category of ailments.

Category of diseases	Ailments / Disorders	Percentage (%)	Use citations	ICF
Metabolic and endocrine diseases	Diabetes-Weight loss	16.9	18	0.35
Digestive and gastrointestinal diseases	Abdominal pain-Digestive disorders-Indigestion	16.9	37	0.72
Cardiovascular and circulatory diseases	Hypertension-Cholesterol and blood circulation	8.45	19	0.72
Respiratory diseases	Cold and cough- Asthma bronchitis-Sinusitis	14.08	47	0.80
Skin diseases and Dermatological care	skin problems	7.04	16	0.73
Nervous system and mental well-being	Stress and anxiety,Insomia Memory problems	8.45	14	0.61
Liver and kidney diseases	Liver disorders- Kidney stones-Urinary problems	5.63	9	0.62
Immune system and infectious diseases	Immune system support Bacterial and viral infections-Inflammation	9.85	20	0.68
Reproductive and hormonal health	Menstrual disorders and pain -Hormonal issues-Galactagogue	9.85	9	0.25

This study reveals the richness of traditional medicinal plant knowledge in Relizane, emphasizing the importance of preserving both biodiversity and traditional knowledge. It advocates for community-based conservation and scientific validation to support public health and sustainable development.

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