Ethnobotanical study of the traditional use of *Atriplex halimus* L. in north-western Algeria (Oran): popular knowledge and health safety issues

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Research

Abstract

Background: *Atriplex halimus* L. is a halophytic plant widely distributed across the Mediterranean and traditionally used for nutritional and medicinal purposes. In Algeria, particularly in the north-western regions, scientific data on its traditional uses, perceived efficacy, and potential risks are scarce. This study aimed to document local knowledge on the use of *Atriplex halimus* L. in the Wilaya of Oran, focusing on preparation methods, therapeutic indications, perceived effectiveness, and reported adverse effects.

Methods: Ethnobotanical and ethnopharmacological fieldwork was conducted from February to April 2025 with 100 informants using semi-structured questionnaires and semi-direct interviews. Data collected included socio-demographic characteristics, plant parts used, preparation methods, therapeutic indications, frequency of use, and adverse effects. Quantitative analysis employed the Relative Frequency of Citation (RFC), Fidelity Level (FL), and Informant Consensus Factor (ICF).

Results: The study highlighted the ethnobotanical importance of *Atriplex halimus* L. (RFC = 0.81). Use was most frequent among socio-economically active young adults. Leaves were the most commonly used part, primarily prepared as decoctions (ICF > 0.6). The therapeutic indications reported were dominated by the treatment of ovarian cysts and fibroid (FL = 56.76 %), followed by goiter and diabetes. To the best of our knowledge, this is one of the first studies to provide detailed quantitative information on traditional dose, frequency, posology, and duration of use. Most users had limited knowledge regarding potential toxicity, contraindications, and precautions.

Conclusions: *Atriplex halimus* L. plays a significant role in the traditional pharmacopoeia of the Wilaya of Oran, reflecting rich indigenous ethnomedical knowledge. These findings underscore the need for comprehensive phytochemical, pharmacological, and toxicological studies to validate reported uses and ensure safe application.

Keywords: *Atriplex halimus* L., ethnobotanical survey, phytotherapy, traditional medicine, Algeria-Oran.

Background

Traditional medicine remains an essential component of healthcare systems in many regions of the world, particularly in developing countries. According to the World Health Organization (WHO 2003), traditional medicine continues to play an important role in healthcare, while many populations rely on medicinal plants for primary healthcare (Hayta *et al*. 2014, Tabuti *et al*. 2003). This reliance may be explained by the proximity, economic accessibility, and affordability of such treatments, as well as limited access to modern medicine in these regions (Iserin *et al*. 2001, Rammal *et al*. 2009, Zeggwagh *et al*. 2013). In Algeria, the flora is particularly rich and diverse, comprising approximately 4,000 taxa distributed across 131 families and 917 genera (Radford *et al*. 2011). This floristic richness has, over time, contributed to the traditional use of numerous medicinal plants. The associated ethnobotanical knowledge has consequently been passed down from generation to generation (Hadjadj *et al*. 2015). *Atriplex halimus* L. (Amaranthaceae, Sp. Pl. 2: 1052 (1753)), commonly known as saltbush or "G'ettaf," is a halophytic plant widely distributed in the arid and semi-arid areas of the Mediterranean basin. In northwestern Algeria, particularly in the Wilaya of Oran, this species is traditionally used for both nutritional and therapeutic purposes, notably for the treatment of cysts, diabetes, digestive disorders, and certain inflammatory conditions (Benarba 2016, Chikhi *et al*. 2014, Yabrir *et al*. 2018). Despite its widespread use, scientific data regarding its ethnobotanical validation, frequency of use, and informant consensus remain limited. The use of quantitative ethnobotanical indices allows for the objective characterization of reported traditional uses by assessing their citation frequency, the degree of consensus among informants, and their relative importance, while identifying uses that may warrant further pharmacological investigation.
The aim of this study was to investigate the traditional use of *Atriplex halimus* L. in the Wilaya of Oran using quantitative ethnobotanical indices, in order to characterize the cultural and reported therapeutic importance of this species, while also addressing safety issues associated with its use. The study also aimed to provide quantitative data on patterns of use, particularly the traditionally used dose, frequency of use, dosage regimen, and treatment duration, thereby allowing the estimation of an equivalent daily dose.

To this end, the study sought to address the following research questions:

- What the traditional knowledge and practices are associated with the use of *Atriplex halimus* L. in the Wilaya of Oran?
- What are the main reported therapeutic indications, plant parts used, and methods of preparation and administration of this species?
- To what extent can the data collected on dose, frequency of use, dosage regimen, and treatment duration be used to estimate daily exposure and identify potential safety concerns associated with its traditional use?

Materials and Methods

The study was conducted in the Wilaya of Oran, located in northwestern Algeria, a region characterized by a Mediterranean climate with semi-arid tendencies, featuring mild winters and hot, dry summers, resulting in low and irregular annual rainfall. These climatic conditions, combined with soils that are often saline, alkaline and low in organic matter, constitute major constraints for both natural and cultivated vegetation in the region (Abdelguerfi & Ramdane 2003). However, these edaphic and climatic factors favor the establishment of plant species tolerant to water and salt stress, particularly certain halophytic medicinal and forage plants adapted to arid and semi-arid environments. The close interaction between the semi-arid climate, soil characteristics, and plant physiology underscores the importance of climatic and edaphic factors in the adaptation of plant species and represents a key leverage point for developing sustainable management strategies for agricultural and pastoral ecosystems in the Oran region (Bouzid & Benabdeli, 2011). This study was carried out across three villages: Messerghin, Es-Sénia, and Arzew (Fig. 1).

Data Collection

This study was a field-based investigation aimed at directly engaging with users of medicinal plants to document their practices and knowledge regarding the use of herbal remedies. It was designed as a prospective, cross-sectional, quantitative ethnobotanical and ethnopharmacological study. Field surveys were conducted from 1 February to 30 April 2025.

Data were collected using semi-structured questionnaires and open-ended interviews. Participants were selected based on their knowledge of local medicinal plants, particularly *Atriplex halimus*, while individuals not residing in the study area were excluded.

The survey was initially conducted in Oran through direct, face-to-face interviews and lasted approximately 15-20 minutes per participant. During the interviews, participants were asked about their place of origin and where they usually obtained or purchased *Atriplex halimus* L. Although the participants came from several communes within the Wilaya of Oran, many

reported Messerghin, Es-Sénia, and Arzew as their places of origin or as the main places where they obtained the plant. These communes were therefore identified based on the information provided by the participants during the survey, rather than being predetermined as sampling sites.

The ethnobotanical survey included 100 informants aged 18 to 80 years, comprising herbalists, pharmacists, practitioners, and traditional healers in the Oran region. Family members and acquaintances of the researchers were also interviewed. Interviews were conducted in various settings, including hospitals, pharmacies, medical analysis laboratories, weekly markets, and private homes. They were carried out in either French or the local Arabic dialect, depending on the language preferred by each informant. The methodology followed that described by Gary Martin (1995), with certain modifications to adapt it to the local context of the Wilaya of Oran and the addition of questions addressing the traditional dose, frequency of use, dosage regimen, duration of treatment, as well as adverse effects and contraindications reported by the participants. The questionnaire was structured into two sections. The first section focused on the socio-demographic characteristics of the respondents, including age, sex, level of education, professional category, place of residence, and origin. The second section addressed the ethnopharmacological properties of *Atriplex halimus* L. as reported and used by the informants. The questionnaire was pre-tested with a small group of participants and then adjusted to improve the clarity and understanding of the questions. Furthermore, sampling was conducted using a stratified random sampling method, allowing surveys to be carried out across different sites within the study area.

All participants provided prior, free, and informed oral consent after being clearly informed about the exclusively scientific objectives of the study. Participation was entirely voluntary, and each participant was free to decline participation or withdraw from the survey at any time. The traditional knowledge collected was treated confidentially and reported anonymously and collectively, without allowing identifying individual participants. The study was conducted in accordance with the principles of the Convention on Biological Diversity concerning the recognition and respectful documentation of traditional knowledge.

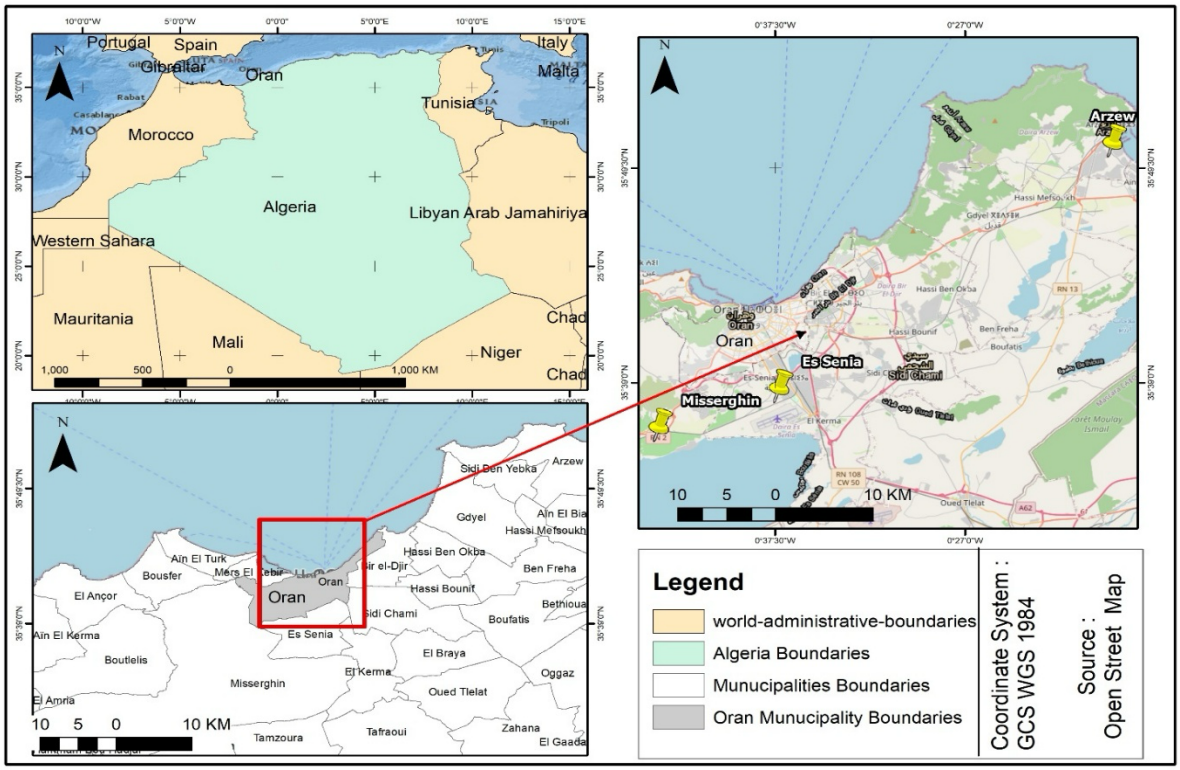


Figure 1. Geographic location of the study area in Oran province (Northwestern Algeria) and surveyed sites Messerghin, Es-Sénia and Arzew

Botanical identification

Specimens of *Atriplex halimus* L. and related species were collected in the field, photographed, and identified by Dr. Rihab Haddi (Laboratory of Valorization of Biological Resources and Food Security, University Tahri Mohamed, Bechar, Algeria). The taxonomic identification of the plants, referred to by their vernacular names, was carried out using the *Flora of Algeria*

by Quézel and Santa (1962-1963) with the assistance of herbarium specimens available at the Herbarium of the Faculty of Nature and Life Sciences, University of Ahmed Benbella Oran 1, Oran, Algeria. The samples were subsequently preserved in the herbarium of the Laboratory of Nutrition Physiology and Food Safety.

Data processing

The ethnobotanical information collected was entered into a raw data table and processed using Microsoft Excel® 2016. The data were checked, organized, and standardized before analysis.

Data analysis

The results of the ethnobotanical and ethnopharmacological surveys were analyzed using quantitative and Microsoft Excel® 2016.

Relative Frequency citation

The ethnomedicinal data were assessed using a Relative Frequency of Citation (RFC) (Tardío & Pardo-deSantayana 2008)**:**

$$RFC = FC / N$$

Where, FC is the frequency of citation; N is the total number of respondents participating in the study, without considering use categories into account.

Fidelity Level (FL):

$$FL (\%) = (Np / N) \times 100$$

NP is the number of informants citing the species for a specific use, and N is the total number of informants who mentioned the plant for treating a particular ailment in the study area.

The Plant Part Value (PPV):

$$PPV = RU_{part} / RU$$

The PPV was calculated by dividing the number of reported uses for a specific plant part (RU part) by the total number of reported uses for the entire plant (RU). A higher PPV indicates the plant part most frequently utilized by the informants.

Informant Consensus Factor (ICF):

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

Nur represents the total number of use-reports in each disease category and Nt is the number of species used. A high ICF value indicates strong agreement among informants regarding the plants used to treat a particular ailment. The ICF is used to measure the level of consensus among informants on the remedies cited for each disease category.

Results and Discussion

Socio-demographic characteristics

Profile of the informants

The survey was conducted with 100 participants, including 10 herbalists and 90 local Residents of the Wilaya of Oran. The respondents belonged to the categories of herbalists and medicinal plant users, including both men and women, covering a range of age groups and diverse family situations (Table 1). The distribution of informants according to the source of information showed that 83% of respondents resided in the capital of the Wilaya of Oran, while 17% came from other Wilayas in northwestern Algeria. The results indicate that *Atriplex halimus* L. is a widely recognized species in the study area, with 81% of the respondents reporting familiarity with and use of the plant in their daily lives. This widespread recognition can be attributed to the central role of the informants in household healthcare, the preparation of traditional plant-based remedies, and the intergenerational transmission of ethnomedical knowledge. The high RFC value of 0.81 (Fig. 2), consistent with the proportion of informants reporting the use of *Atriplex halimus* L. (Table 1), confirms the major ethnobotanical importance of this species within the local pharmacopoeia. Such a level of citation frequency is typically characteristic of culturally well-established species that are used regularly and whose knowledge is stably transmitted across generations, as reported in other studies conducted in semi-arid regions of North Africa (Hadjadj *et al.* 2016, Nedjimi 2013).

Distribution by sex

Among the 100 respondents, 78 were women and 22 were men, resulting in a female-to-male ratio of 3.54. The results highlight the predominance of women in participation, with a high proportion of 78%, compared to only 22% for men (Table

1). This difference may be explained by the tendency of some women to favor phytotherapeutic treatments and natural remedies over consulting a physician or purchasing pharmaceuticals, particularly when they perceive their symptoms as mild. Women reported using medicinal plants such as *Atriplex halimus* L. not only for therapeutic purposes but also in the preparation of culinary recipes or mixtures for cosmetic care. Moreover, they appeared to be more aware of the nutritional benefits of this plant, which they regularly incorporated into their diet. These findings are consistent with the majority of ethnobotanical studies conducted at both the national level (Adaouane 2016, Derridj *et al*. 2010) and international level (Morocco) (Benkhnigue 2011). The predominance of women among the participants could also be associated with the main indications attributed to *Atriplex halimus* L., particularly those related to gynecological conditions. This trend is consistent with several ethnobotanical studies conducted in Algeria and, more broadly, in North Africa, which highlight the influence of traditional knowledge and sociodemographic characteristics on the use of herbal medicine, particularly in the context of reproductive health (Ayat 2020, Bah *et al*. 2011, Jamila & Mostafa, 2014, Zatout *et al*. 2021). However, this female predominance is not a universal pattern. For example, the study by Hadjaj *et al*. (2016), conducted in the Ouargla region, reported a slightly higher proportion of men than women among the participants. These variations suggest that the distribution of knowledge and practices related to medicinal plants according to gender may be influenced by the sociocultural context, the profile of the participants, and the sampling strategy adopted.

Table 1. Socio-demographic details of the respondents in the study area

Variables	**Categories**	**Number of informants**	**Percentages %**	♀	♂
Gender					
	Women	78	78		
	Men	22	22		
Age group					
	18-20	2	2	2	0
	21-40	50	50	39	11
	41-60	29	29	20	9
	61-80	19	19	14	5
Origin					
Oran		83	83		
Other states of Oran		17	17		
Education level					
	University	21	21		
	Secondary	74	74		
	Primary	1	1		
	Illiterate	4	4		

Distribution by age

The use of *Atriplex halimus* L. among the population of the Wilaya of Oran spans several age groups, divided into four categories: [18-20], [21-40], [41-60] and [61-80] years (Table 1). The [21-40] age group represents the highest proportion of users, accounting for nearly 50% of the informants, followed by the [41-60] age group, accounting for 29% and the [61-80] age group accounting for 19%. Individuals under 20 years of age constitute the least represented category (2%). This predominance of young adults is also reflected in the ethnobotanical indices, particularly by the high Relative Frequency of Citation (RFC = 0.50), indicating strong recognition and frequent use of *Atriplex halimus* L. within this age group. These findings indicate that *Atriplex halimus* L. is widely known and used among young adults in the study population. Moreover, the high Fidelity Level (FL) values observed for certain therapeutic indications (often exceeding 50%) suggest consistency in the reported uses, reflecting a relatively stable transmission of traditional knowledge within this age category. Furthermore, the high Informant Consensus Factor (ICF > 0.6) recorded for the main categories of treated ailments confirms a notable agreement among informants regarding the effectiveness of *Atriplex halimus* L., regardless of age, with a predominant contribution from young adults. The convergence of RFC, FL, and ICF indices further reinforce the reliability of the ethnopharmacological uses reported in the study area. In contrast, the low representation of individuals under 20 years of age is associated with lower citation values and limited recourse to phytotherapy, suggesting a gradual disruption in the intergenerational transmission of ethnomedicinal knowledge. This apparent disinterest may be attributed to the growing influence of modernization and an increased preference for contemporary medical practices over traditional knowledge, a

phenomenon already well documented in the literature (Meddour *et al*. 2020, Zatout *et al*. 2021). Our results indicate that the majority of *Atriplex halimus* L. users in the study population have a secondary level of education, representing 74% of cases, followed by individuals with a university-level education (21%). In contrast, individuals with a primary education use this plant less frequently (1%), while illiterate users account for 4% of the respondents (Table 1).

The majority of users are adult women aged between 30 and 80 years, with a higher educational level and engaged in professional or salaried activities. These observations suggest that the knowledge and use of *Atriplex halimus* L. are influenced by the educational background of individuals. This pattern is further supported by ethnobotanical indices: the high Relative Frequency of Citation (RFC = 0.70) indicates the widespread and regular use of the plant among educated informants, the elevated Fidelity Level (FL > 60%) reflects the consistent citation of specific therapeutic indications, and the high Informant Consensus Factor (ICF > 0.6) demonstrates strong agreement among informants regarding the principal uses of the plant. It is likely that individuals with a higher academic level have better access to information from academic sources, such as scientific studies or research highlighting the potential benefits of *Atriplex halimus* L. These findings contrast with those of some previous studies, which reported that the majority of informants were illiterate (Belaidi 2025, Meddour *et al*. 2020, Zatout *et al*. 2021).

Ethnobotanical and pharmacological analysis

Knowledge and consumption of Atriplex halimus L.

The responses of the participants indicate that *Atriplex halimus* L. is widely used and well known among the population of the Wilaya of Oran, with approximately 81% of the informants reporting its consumption, whereas 19% indicated that they were not familiar with the plant (Fig. 2). The integration of this species into the daily lives of local residents is particularly noteworthy. Several factors may explain this high level of use:

-*Atriplex halimus* L. appears to be deeply embedded in local traditional knowledge systems, with its uses being transmitted across generations due to its medicinal, nutritional and culinary importance.
-The wide distribution of the species in semi-arid environments ensures its availability and contributes to its frequent use in the Oran region.

Its easy collection and low economic cost render it an accessible food resource and an economical seasoning for local communities. The high and sustained level of consumption observed among informants reflects a strong perception of its health-related benefits, both for general well-being and for the management of certain ailments, as well as its role as a dietary supplement.

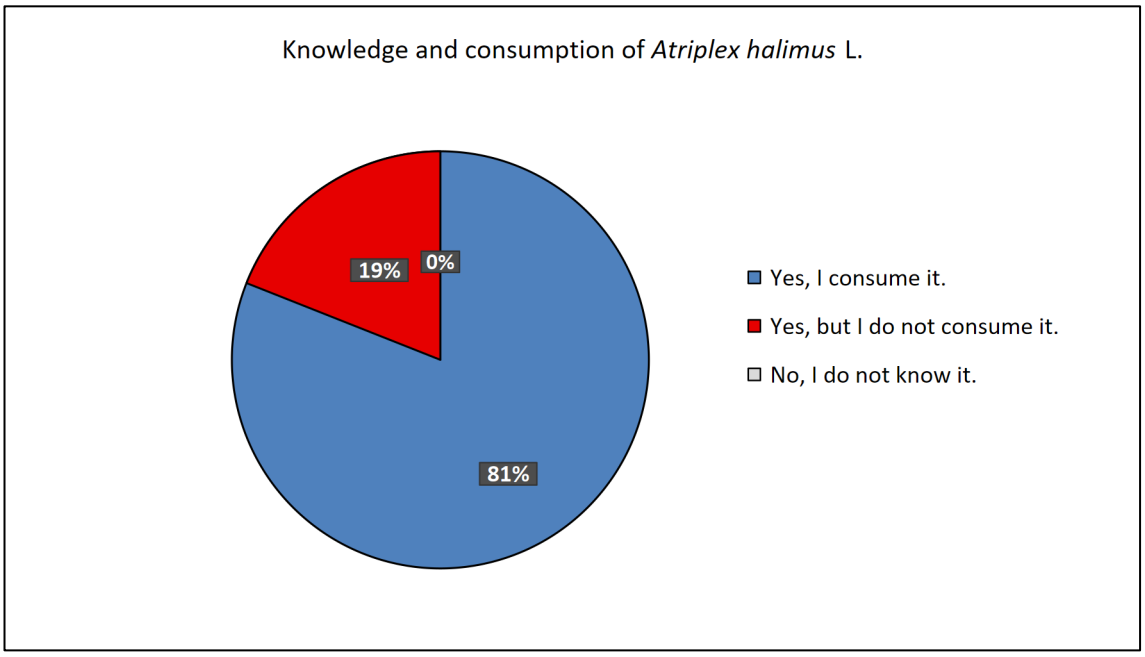


Figure 2. Knowledge and consumption of *Atriplex halimus* L.

Different** Atriplex **species consumed

Four species belonging to the same botanical family and sharing a similar biogeographical origin were recorded during the survey. Analysis of the ethnobotanical questionnaires allowed the identification of the vernacular names of the plants used, which were then matched to their scientific names, primarily based on botanical nomenclature references. Among the *Atriplex* genus, *Atriplex halimus* L. is the most commonly consumed species and constitutes the primary focus of this study. Indeed, 92% of informants reported consuming this species, corresponding to a Relative Frequency of Citation (RFC > 0.92), reflecting its major ethnobotanical importance within the Wilaya of Oran. In contrast, *Atriplex hortensis* (garden orache) is consumed by only 21% of respondents, with an RFC of 0.21 (Fig. 3). The majority of reported uses for *Atriplex halimus* L. are primarily medicinal. This predominance of therapeutic uses reflects the local population's knowledge of and recognition of the potential medicinal properties of this species, traditionally employed to alleviate various ailments. These findings are consistent with previous studies conducted in semi-arid regions of North Africa, which highlight the central role of *Atriplex halimus* L. in traditional medicine (Hadjadj *et al*. 2016).

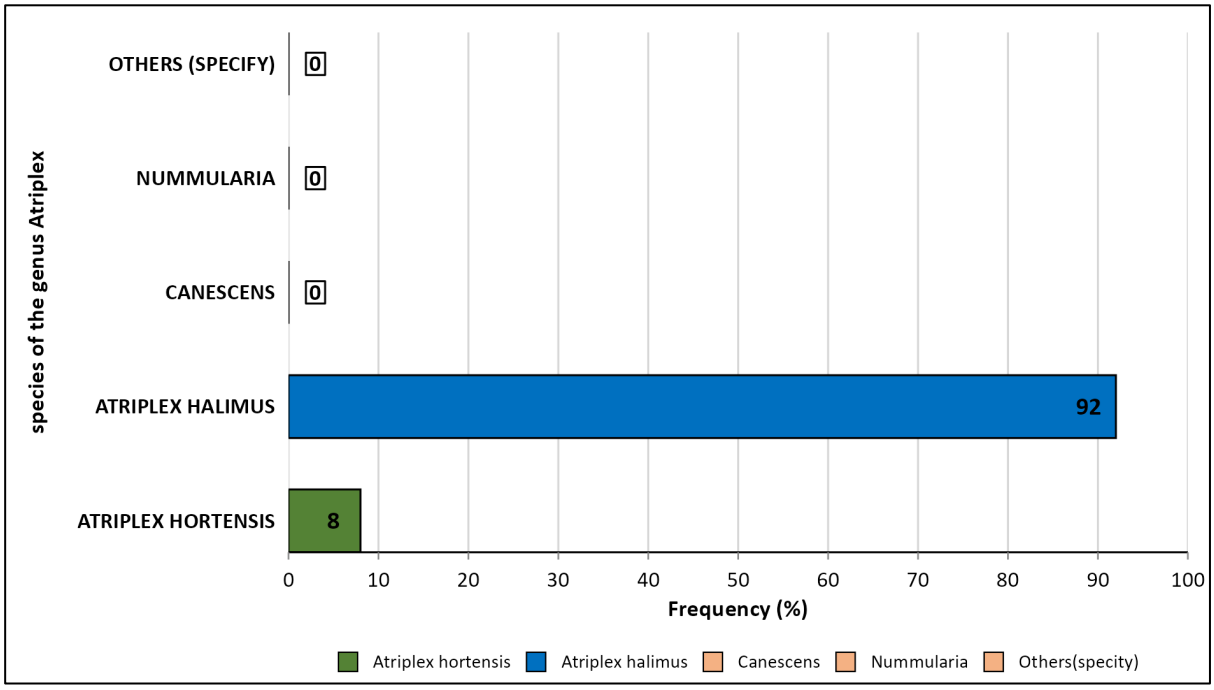


Figure 3. The different species of the genus *Atriplex* consumed

Source of the plant

The survey conducted among the population of the Wilaya of Oran revealed that 64% of participants obtain their plants from stores or local markets, while 30% reported collecting *Atriplex halimus* L. directly from the wild, particularly in the regions of Es-Sénia, Messerghin, and Arzew (Fig. 4). This distribution indicates that the plant is both widely available in local commerce and accessible in natural environments, reflecting its ethnobotanical and therapeutic importance.

Only a small minority of 3% of participants reported obtaining the plant directly from a farm producer, and another 3% procured it via online sources. These findings highlight the value of traditional knowledge and the importance of access to natural resources for the use of *Atriplex halimus* L. in the local pharmacopoeia.

Duration and frequency of use

All informants unanimously reported the exclusive use of the Atriplex genus, administered alone once daily, without combination with other plant species or substances of any other origin. The results indicate that the most frequently reported duration of *Atriplex halimus* L. consumption was approximately one month, as stated by 61% of informants. In contrast, 18% of respondents reported a consumption period of less than one month, 9% reported use for six months to one year, and 12% indicated use extending beyond one year (Fig. 5). The most commonly reported duration of use was approximately one month (28-30 days), reported by 61% of participants. This pattern, together with the high Relative Frequency of Citation for therapeutic use (RFC = 0.74), suggests frequent but often episodic reliance on this plant within traditional medicine practices.

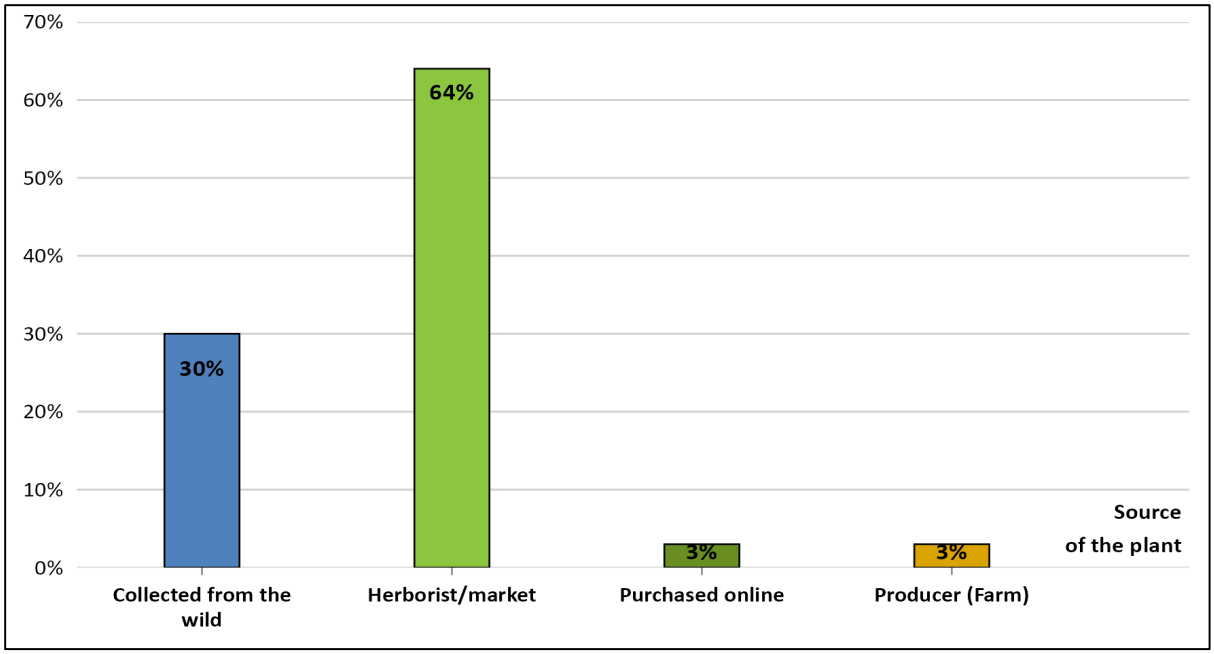


Figure 4. The source of the plant

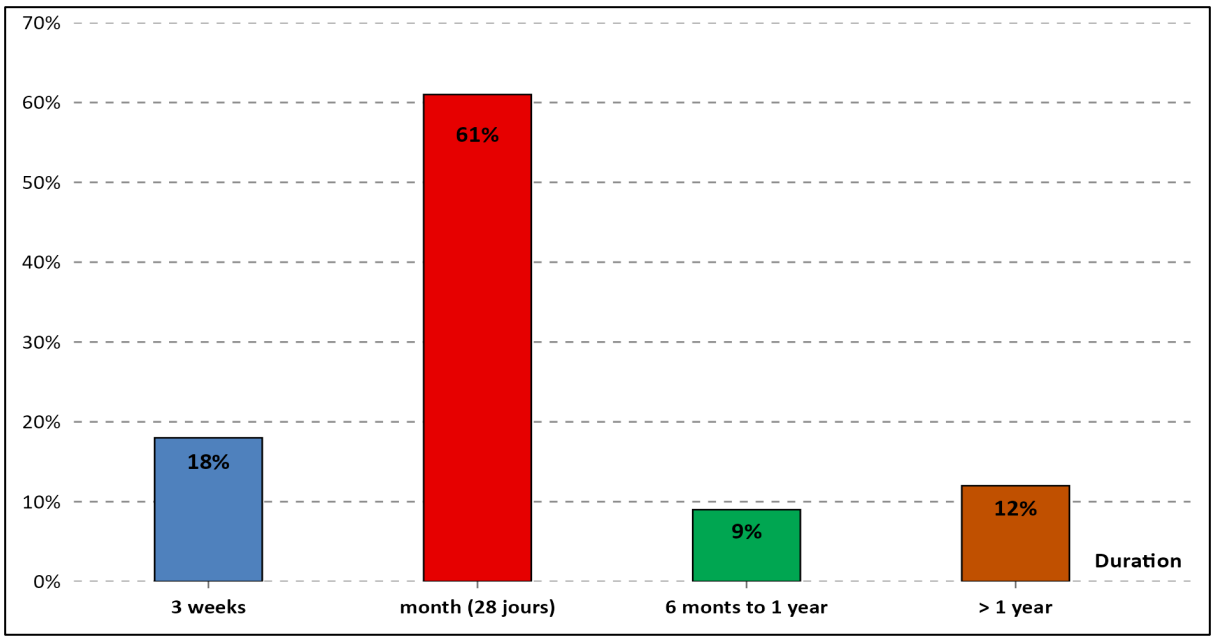


Figure 5. The duration of consumption of *Atriplex halimus* L.

Furthermore, the results concerning consumption frequency indicate that 86% of participants consume *Atriplex halimus* L. on a daily basis, 11% weekly, and 3% occasionally (Fig. 6). This regular consumption over a relatively short period appears to correspond to the dominant therapeutic uses according to specific pathologies, as highlighted by the Fidelity Level (FL), particularly for the treatment of ovarian cysts, followed by goiter and diabetes. Thus, the duration of treatment appears to depend on both the individuals and the disorder being treated. The predominance of daily consumption, together with the relatively consistent duration of use reported by participants, suggests a structured pattern of traditional use, although the duration of treatment appears to vary according to individual practices and the condition being treated. These results suggest that the effects of the plant are generally perceived in the short term, with the majority of consumers reporting an improvement in health status as well as a reduction in certain ailments after approximately one month of regular consumption. This empirical perception may be related to the various biological activities reported for *Atriplex halimus* L., particularly its antioxidant and antidiabetic properties (Bouallag 2024, Roubi *et al*. 2025). However, further studies are needed to determine whether these activities can explain the effects perceived by users as well as the time required for their

onset. However, these findings differ from those reported in other studies in the literature, highlighting the variability of therapeutic practices and perceptions of the plant's efficacy depending on socio-cultural contexts and modes of use.

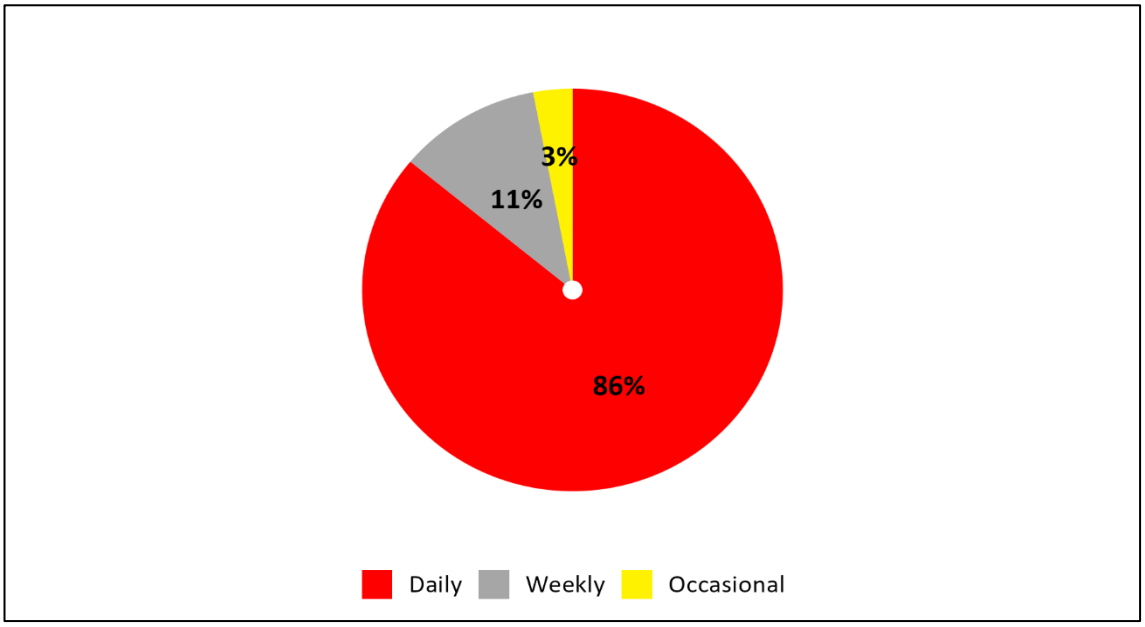


Figure 6. The frequency of consumption of *Atriplex halimus* L

Dose and quantity of consumption

The results illustrated in Fig. 7 indicate that the modes of consumption of *Atriplex halimus* L. vary according to the dosing methods adopted. The majority of informants (76%) reported using a leaf decoction (20 to 30 minutes), prepared at a rate of one glass of the preparation per liter of water (approximately 25 g/day), administered once daily by oral route. This regimen represents the most commonly reported dose and is consistent with the high relative frequency of citation (RFC=0.74) associated with the plant's therapeutic use. Approximately 14% of participants favored the use of one tablespoon of the plant material, with 10% reported employing variable or non-standardized dose, adjusted according to personal experience or the type of pathology being treated. These data provide a novel and valuable contribution to scientific research, as they offer for the first time detailed and quantified information on the exact traditional dosage and duration of consumption of *Atriplex halimus* L. within a traditional context. Such precision is essential for guiding future pharmacological, toxicological, and clinical studies, enabling a more rigorous evaluation of the plant's therapeutic efficacy and safety, and for establishing recommendations based on actual consumption practices observed within the population (Said 2025).

Within a traditional context, the predominance of oral administration of *Atriplex halimus* L., as well as of numerous other aromatic and medicinal plants across the different regions of the Wilaya of Oran, is consistent with findings reported in the majority of ethnobotanical studies conducted in Africa (Chermat & Gharzouli 2015, El Hafian *et al*. 2014).

Plant parts used of Atriplex halimus* L. *for remedy preparation

The study shows that the leaves of *Atriplex halimus* L. are the most commonly used plant part (93%), mainly due to their ease of harvesting, drying, and storage. The use of the whole plant was reported by 6% of participants, often for reasons of convenience, whereas the seeds, which are less accessible and poorly known, were used by only 1% of respondents. The underground parts were never mentioned (Fig. 8). These results are comparable to those reported by, Ould El Hadj *et al*. (2003), Lituka (2005), Ouattara (2006) and Diatta *et al*. (2013), who indicated that leaves constitute the most commonly used medicinal plant organ.

Form of use

Atriplex halimus L. is predominantly used in dried form, as reported by 80% of informants, reflecting the high relative frequency of citation of the species (RFC = 0.74) for therapeutic purposes in local traditional medicine (Fig. 9). In contrast, 20% of respondents indicated using the plant in its fresh state, mainly in culinary preparations. This practice can be explained by the plant's well-recognized nutritional value as well as the perceived effectiveness of its bioactive compounds, in accordance with the specific uses identified by the fidelity level (FL), particularly for the treatment of ovarian cysts, goiter,

and diabetes. This finding contrasts with the results reported by Ngbolua *et al.* (2019), who showed that 60% of the respondents prepared remedies using fresh plant material, whereas only 27% used plants in their dried form. However, the use of self-reported information may limit the generalizability of the findings. In addition, the data collected mainly reflect the practices and perceptions of the informants and, on their own, cannot confirm the therapeutic efficacy or safety of the plant.

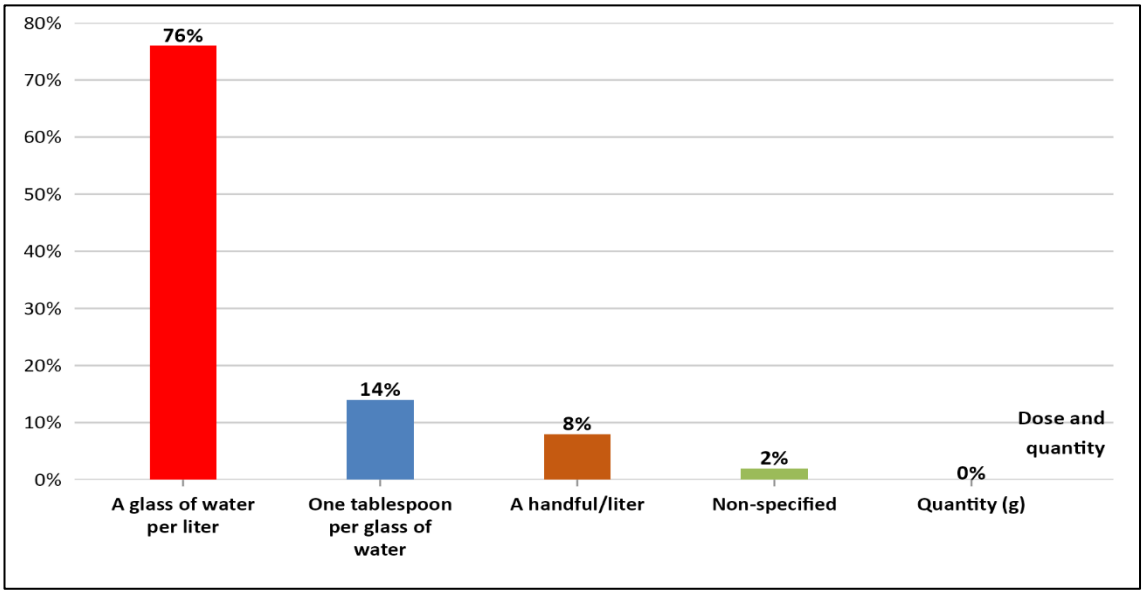


Figure 7. The dose and quantity of consumption of *Atriplex halimus* L.

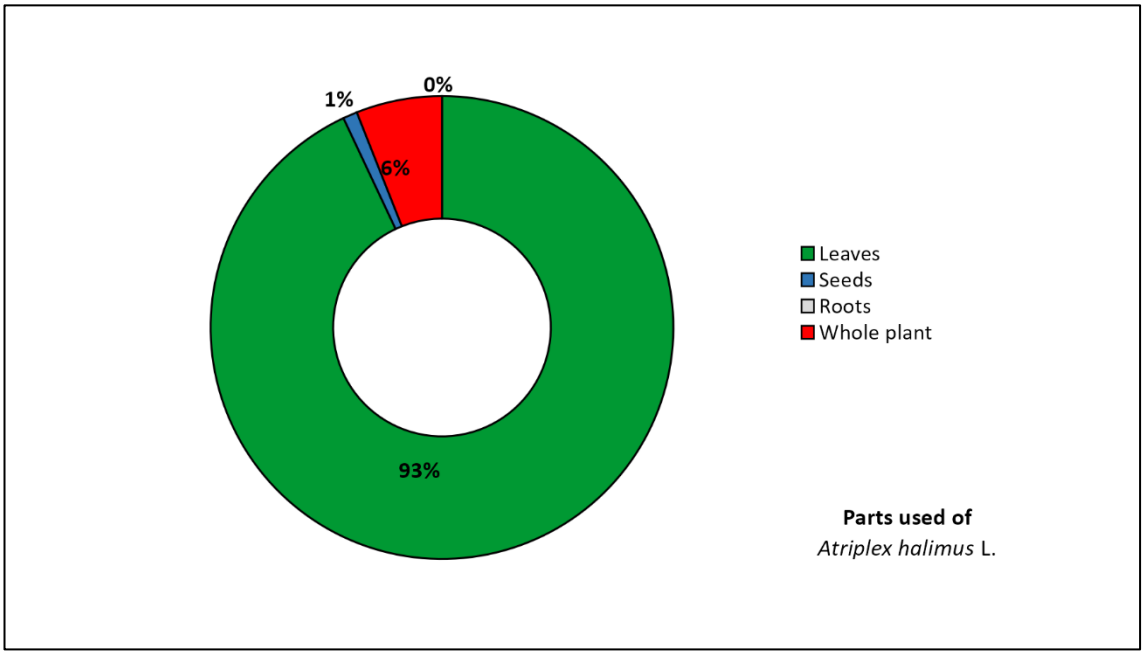


Figure 8. The parts used of *Atriplex halimus* L.

Mode of preparation

Regarding preparation methods, the results indicate a clear predominance of decoction, reported by 90% of users, far exceeding infusion (5%). Only 3% of informants consume the plant in the form of maceration, most often in combination with other ingredients, such as cinnamon or sugar, while 2% reported consuming it raw (Fig. 9). This strong preference for decoction reflects a well-structured and stable transmission of knowledge related to the use of *Atriplex halimus* L., comparable to that observed for other medicinal plants of the Mediterranean basin (Jdaidi & Hasnaoui 2016, Okello *et al.* 2010, Salhi *et al*. 2010, Stangeland *et al*. 2011, Yetein *et al*. 2013). The predominance of this preparation method is fully consistent with the informant consensus factor (ICF = 1.00) recorded for the main ailments treated, indicating a near-

unanimous agreement among informants regarding its effectiveness in extracting bioactive compounds. Previous studies have likewise reported decoction as the most widely used preparation method in traditional phytotherapy, owing to its ability to extract a maximum amount of bioactive constituents (Ait Ouakrouche 2015, Jdaidi & Hasnaoui 2016, Salhi *et al*. 2010). Furthermore, the choice of preparation method appears to be closely linked to the nature of the targeted pathology, as evidenced by the high fidelity level (FL) values and the strong consensus observed among informants. Finally, other modes of use were reported marginally, including the incorporation of the plant as a dietary supplement or its direct inclusion in food.

All informants (100%) reported that the administration of the plant was carried out exclusively via the oral route, which was considered the most practical and commonly used method, both for therapeutic and culinary purposes. This observation is fully consistent with the majority of ethnobotanical studies previously reported in the literature (Benarba *et al*. 2014, Chermat & Gharzouli 2015).

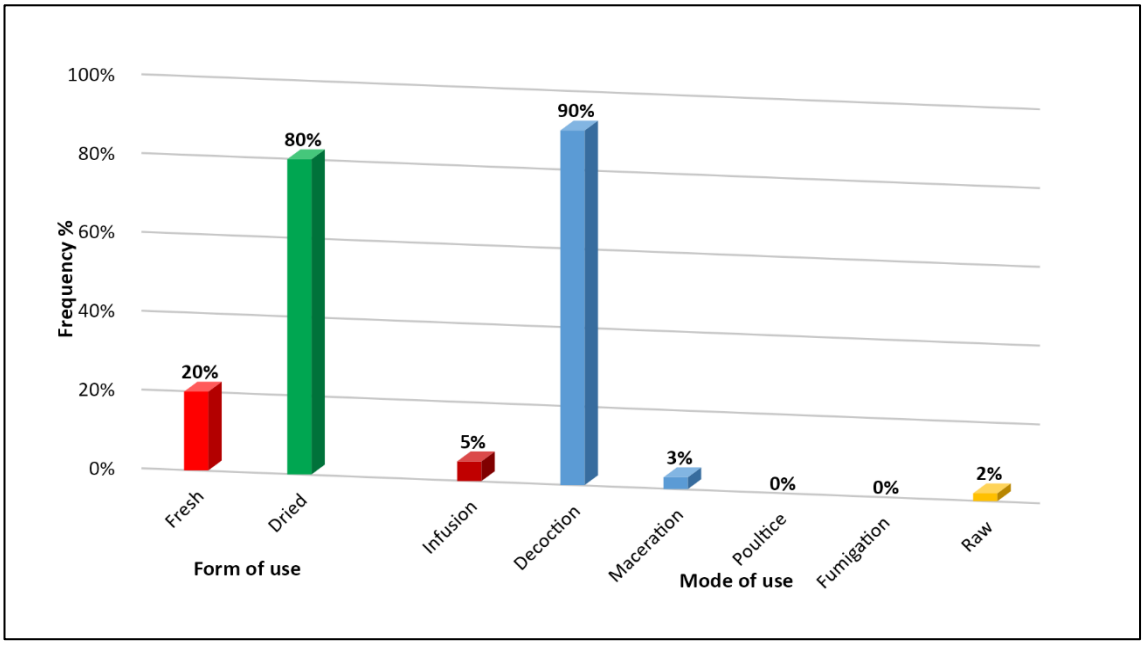


Figure 9. The form of use and method of preparation of *Atriplex halimus* L.

***Reasons for the use of Atriplex halimus* L.**

The results obtained from the ethnobotanical survey show that 74% of the participants use *Atriplex halimus* L. for therapeutic purposes within the framework of traditional medicine, corresponding to a relative frequency of citation (RFC) of 0.74. This reflects the notable ethnobotanical importance of this species within the studied population. Analysis of the fidelity level (FL) indicates that the most specific therapeutic use of *Atriplex halimus* L. concerns the treatment of ovarian cysts and fibroids, reported by 42% of participants with an FL of 56.76%, followed by goiter (10%; FL = 13.51%), diabetes (8%; FL = 9.46%), and menstrual cycle disorders (1%; FL = 1.35%) (Fig. 10). The genus Atriplex, which is rich in flavonoids and mineral salts, is known to exhibit significant therapeutic properties (Gettouche 2021), particularly in the management of cysts (ovarian cysts and fibroids). These beneficial effects may be associated with the specific chemical composition of *Atriplex halimus*, characterized by the presence of saponins, particularly steroidal saponins, whose structure shows similarities to that of female steroid hormones (Chikhi 2014, Croteau & Bérubé 2011, Nedjimi 2013). The 15% of participants indicated the traditional use of *Atriplex halimus* L. for a range of additional health conditions (Fig. 10). Reported indications include rheumatic pain, hyperglycaemia, cardiovascular disorders, regulation of gastric acidity, colic, and emetic use (Bellakhdar 1997, Hadjadj *et al*. 2016, Walker *et al*. 2014). The leaves are known to be rich in proteins, dietary fibre, mineral salts, and vitamins (A, C, and D), and to contain bioactive constituents such as saponins, alkaloids, and flavonoids (Benhammou *et al*. 2009, Bylka *et al*. 2004, Erdman *et al*. 2006). These findings provide evidence of the nutritional and phytochemical composition of the plant; however, they do not, by themselves, establish its therapeutic efficacy. Some of these compounds have been associated in the literature with effects on digestive processes and with potential benefits related to diets high in fats and carbohydrates; however, their specific contribution to the therapeutic effects attributed to *Atriplex halimus* L. remains insufficiently established and requires further pharmacological and clinical validation (Bouchelta 2005, Gerbi 2018,

Laouedj 2017, Slamani & Gerbi 2018). Furthermore, according to participants' reports, 21% of participants used *Atriplex halimus* L. for general well-being, while 2% incorporated the plant into their diet, possibly in relation to its reported nutritional composition and its content of flavonoids and mineral salts (Gettouche 2021) (Fig. 10). These practices reflect local perceptions and traditional uses and should not be interpreted as evidence of clinically established therapeutic effects. The adoption of phytotherapy by a segment of the studied population appears to be influenced by several societal factors, including limited access to modern healthcare services, increasing mistrust toward synthetic pharmaceutical products, and a growing preference for natural or "organic" remedies (Guedje *et al*. 2010).

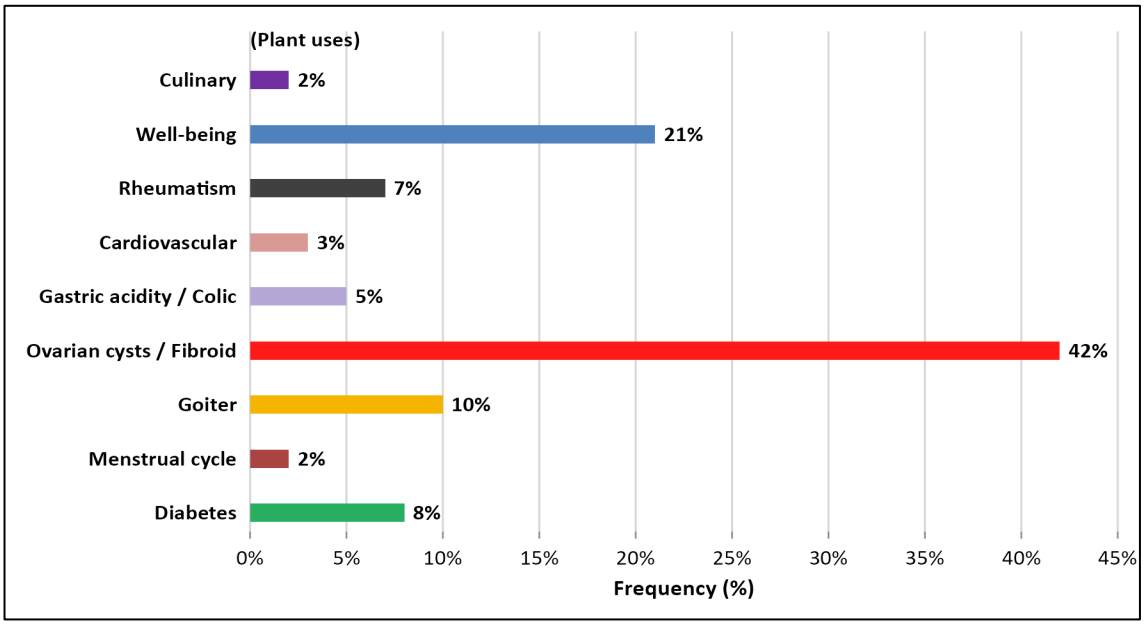


Figure 10. The reasons for using *Atriplex halimus* L.

Adverse effects

The evaluation of *Atriplex halimus* L. indicated that the vast majority of participants (94%) did not report any side effects during or after its use (Fig. 11), corresponding to a high relative frequency of citation (RFC = 0.74) and a strong informant consensus factor (ICF = 1.00) for its main therapeutic applications. Nevertheless, minor adverse effects were reported by a small number of participants: 2% of women reported urinary burning, 2% experienced vomiting, and 2% expressed concerns regarding fertility. The fidelity level (FL) associated with these effects was very low, indicating their rare occurrence and the weak consensus among informants. These observations suggest that while *Atriplex halimus* L. is generally considered safe in traditional use, adverse reactions may occur depending on factors such as dosage, duration of consumption, individual metabolic differences, concomitant use of other medicinal plants, and age of the users. Further pharmacological and toxicological investigations are therefore warranted to rigorously assess the safety profile and establish evidence-based guidelines for its therapeutic application (Bellakhdar 1997, Bruneton 1996).

***Precautions and contraindications associated with the use of** Atriplex halimus* **L.**

This study, aimed at improving knowledge of the precautions and contraindications related to the use of *Atriplex halimus* L., identified several important considerations. According to reports from plant users, 97% stated that they were not informed about the necessary precautions or potential contraindications prior to using this plant. In contrast, 3% of participants indicated that its use is not recommended for individuals with hypertension, liver diseases (hepatitis B and C), or renal disorders requiring dialysis. It is important to note that *Atriplex halimus* L. is strongly contraindicated in patients with hypertension due to its high mineral salt content (Ayat 2020, Foletti *et al*. 2025, Yang *et al*. 2025). Furthermore, the regulations and guidance governing its use are often insufficiently rigorous and do not always align with the requirements of modern therapeutic standards.

Treated conditions and Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) is used to assess the degree of agreement among participants regarding the use of *Atriplex halimus* L. for the treatment of specific health conditions. High ICF values indicate that informants share consistent and reliable knowledge about the use of this plant in the traditional medicine of the Wilaya of Oran. These findings strongly

support the need for further in-depth phytochemical and pharmacological investigations to experimentally validate the reported uses and to better ensure their safe application.

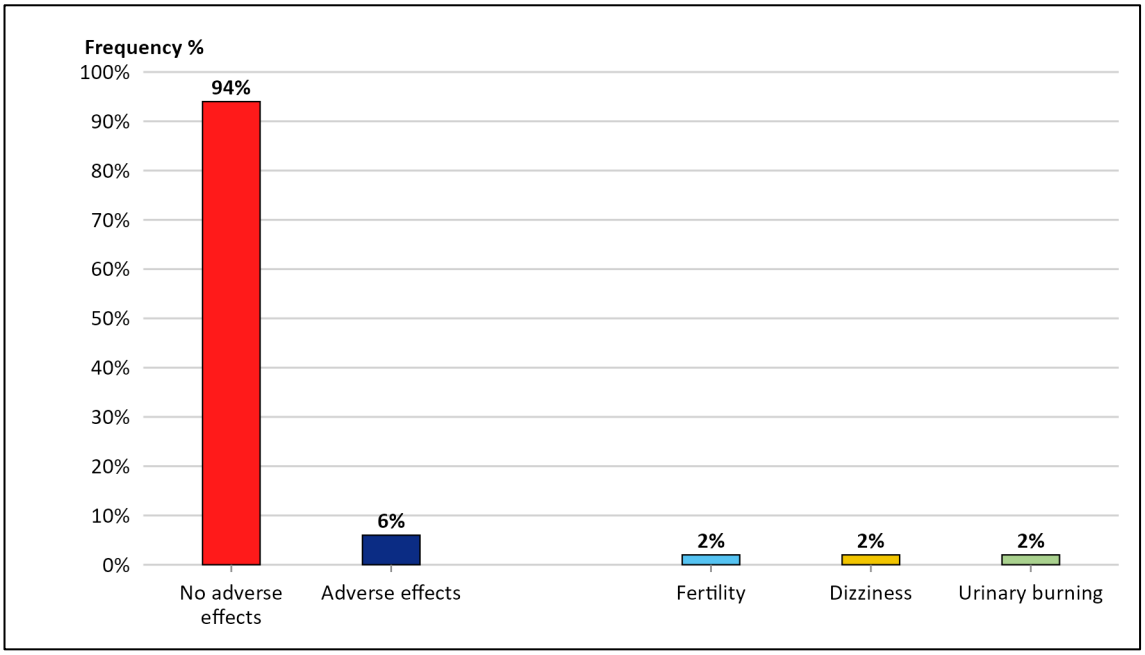


Figure 11. Adverse effects

Conclusion

This study highlights the ethnobotanical significance of *Atriplex halimus* L. in the Wilaya of Oran. The use of quantitative ethnobotanical indices together with the diversity of reported uses, highlights the cultural importance and perceived therapeutic value of this species, particularly for its reported use in the treatment of ovarian cysts. However, an integrated approach combining phytochemical, pharmacological, and toxicological research, safety evaluation, and the preservation of traditional knowledge is essential for the sustainable valorization of this medicinal plant.

Declarations

List of abbreviations: RFC: relative frequency of citation FC is the frequency of citation PPV: plant part value FL: fidelity level ICF: informant consensus factor.

Ethics approval and consent to participate: All participants interviewed provided their prior consent to participate freely in the survey, being fully informed of the exclusively scientific objectives of the study. The authors emphasize that their university does not have an ethics committee in place for ethnobotanical research. The traditional knowledge collected was also reported anonymously and collectively.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

Competing interests: The authors declare no conflicts of interest.

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Author contributions: S.A.T: supervised the work, translated the abstract into English, and drafted the manuscript up to its final version. A.H: collected the data and analyzed. N.M: Compiled the literature sources and data collection. S.A: supervised the work.

Declaration of generative AI use

Statement: During the preparation of this work the author used ChatGPT (GPT-5) in order to rephrase sentences and translate passages into English. The author reviewed and edited the content as needed and take full responsibility for the content of the publication.

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