



# Medicinal plants used in traditional management of breast cancer: An ethnobotanical survey in Sidi Bel Abbès and Saïda, Northwestern Algeria

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## Research

### Abstract

**Background:** Breast cancer is the most prevalent malignancy among women worldwide and represents a major public health challenge in Algeria. Despite advances in modern therapies, their limited accessibility and potential side effects lead many communities to continue relying on herbal remedies. Documenting this traditional knowledge is essential for preserving cultural heritage and identifying promising candidates for future pharmacological research. This study aimed to document the traditional use of medicinal plants for breast cancer management in northwestern Algeria, focusing on the wilayas of Sidi Bel Abbès and Saïda

**Methods:** An ethnobotanical survey was conducted between 2023 and 2024 among 300 informants, using semi-structured interviews and free-listing techniques. Data were collected on plant species, parts used, and preparation methods. Botanical identification was confirmed using reference floras and specialized databases, and validated by taxonomic experts. Quantitative ethnobotanical indices, including Relative Frequency of Citation (RFC) and Use Value (UV), were applied to assess the cultural significance of the recorded species.

**Results:** A total of 59 species belonging to 55 genera and 34 families were recorded. Herbs predominated (81%), with Lamiaceae, Amaranthaceae, and Apiaceae as the most represented families. Leaves (29%) and seeds (20%) were the most frequently used plant parts, while infusion (36%) and decoction (27%) were the dominant preparation methods. The most cited species included *Ephedra alata* Decne., *Nigella sativa* L., *Allium sativum* L., *Curcuma longa* L., and *Berberis vulgaris* L., alongside therapeutic uses of several less-documented taxa in the context of breast cancer treatment, such as *Euphorbia officinarum* L., *Annona muricata* L., and *Hammada articulata* (Moq.).

**Conclusion:** This study provides the first comprehensive ethnobotanical documentation of medicinal plants used for breast cancer in northwestern Algeria. The results reveal both widely recognized and previously underreported species, highlighting the potential of local knowledge to inspire the discovery of novel therapeutic agents.

**Keywords:** Ethnobotany; Breast cancer; Herbal medicine; Traditional knowledge; Lamiaceae; Northwestern Algeria.

## Background

Breast cancer is the most commonly diagnosed malignancy in women worldwide and remains a leading cause of cancer-related morbidity and mortality (Sung et al. 2021). In 2020, it was estimated to account for approximately 2.3 million new cases and 670,000 deaths, making it the foremost cause of cancer mortality among women (GLOBOCAN 2022; WHO 2023). In low- and middle-income countries, including those of North Africa, both incidence and mortality continue to rise, reflecting demographic transitions, increasing exposure to risk factors, and limited access to early detection and effective treatment (Benkhelifa et al. 2023; Bray et al. 2018; Gaobotse et al. 2023).

In Algeria, breast cancer is the most prevalent malignancy among women and constitutes a major public health concern. According to GLOBOCAN estimates and national cancer registries, more than 14,000 new cases were reported in 2022, representing nearly 40% of all female cancers. However, diagnosis is often delayed, leading to presentation at advanced stages of the disease, when therapeutic options are limited and survival outcomes are poor (Benkhelifa et al. 2023; Gadouche & Wietrzyk 2025; IARC 2022; Smaili et al. 2020).

Despite progress in surgery, hormone therapy, targeted chemotherapy, and radiotherapy, conventional treatments remain constrained by high costs, unequal geographic accessibility, and considerable adverse effects (Sung et al. 2021). In many rural and peri-urban areas, traditional medicine, particularly the use of medicinal plants, continues to play an important role in health care. Ethnobotanical and ethnopharmacological surveys conducted in Algeria and neighboring countries have documented a wide variety of species used in cancer management; however, the existing literature is heterogeneous and pharmacological validation remains scarce (Belhouala et al. 2021; Harbane et al. 2022; Taïbi et al. 2020).

Historically, ethnobotanical knowledge has been instrumental in the discovery of modern therapeutics. Several major anticancer agents currently in clinical use are plant-derived, including paclitaxel from *Taxus spp.*, vincristine and vinblastine from *Catharanthus roseus*, and etoposide derived from podophyllotoxin of *Podophyllum peltatum* (Butler 2008; Kingston 2011; Newman & Cragg 2020). These examples highlight the considerable potential of traditional practices for guiding the identification of bioactive plant-derived compounds with clinical relevance (Baker et al. 2007; Cordell 2011; Cordell & Colvard 2012; Cragg et al. 2009; Kingston & Newman 2005; Newman & Cragg 2012).

However, breast cancer is a life-threatening disease, and reliance on medicinal plants does not always guarantee safety or efficacy. Misidentification of species, ambiguities in preparation methods, and inappropriate use may lead to treatment failure or adverse effects. In this context, the present study was undertaken to document traditional knowledge related to medicinal plants used in breast cancer management in northwestern Algeria, specifically in the wilayas of Sidi Bel Abbès and Saïda. It aimed to establish a comprehensive inventory of the species employed by local communities, describe their therapeutic applications and preparation methods, and assess their cultural significance through ethnobotanical indices. By doing so, the study seeks to reduce confusion regarding plant identity and usage and provide a valuable foundation for future pharmacological and clinical investigations.

## Materials and Methods

### Study area

This ethnobotanical survey was conducted in two provinces (wilayas) of northwestern Algeria: Sidi Bel Abbès and Saïda (Fig. 1). These regions display marked biogeographic diversity, encompassing rural, peri-urban and urban settings with heterogeneous access to healthcare services. The Mediterranean climate and varied geomorphological features support a rich and diverse medicinal flora.

The study area is characterized by substantial vegetation cover, including forest massifs, maquis/scrublands and steppe formations, which sustains high floristic richness and a wide array of medicinal taxa. Recent regional assessments and floristic inventories report important forested and semi-natural areas in both wilayas, contributing to local plant availability and diversity (Saidi et al. 2023; Cherifi et al. 2017; Aouadj et al. 2023; Chalane et al. 2019). Moreover, a longstanding ethnomedical culture in these provinces means that local communities possess substantial practical knowledge and familiarity with wild and cultivated medicinal plants, especially in rural zones where access to biomedical services is limited.

### Ethnobotanical survey and ethical considerations

Fieldwork was conducted between January 2023 and December 2024. A total of 300 informants were randomly selected across the study area to ensure a representative sample. During fieldwork, individuals reported by the community as

particularly knowledgeable about traditional remedies were occasionally visited to ensure comprehensive data collection, but this did not affect the overall balance of the sample. Data were collected using a structured questionnaire administered in face-to-face interviews, in Arabic or French according to participants' preferences. Interviews were conducted without strict time limits to allow unhurried, detailed responses.

The questionnaire comprised two main sections:

1. Sociodemographic data: age, gender, education level and marital status.
2. Medicinal plant uses for breast cancer: vernacular names, parts used, preparation methods, route of administration, and any reported contraindications or perceived side effects.

In addition to structured questions, free-listing and open-ended discussions were encouraged to capture spontaneous and culturally salient information. Oral informed consent was obtained from all participants prior to interviews, in accordance with the Code of Ethics of the International Society of Ethnobiology (ISE 2008). When appropriate, anonymity of informants was preserved and sensitive details were handled following ethical best practice.



Figure 1. Location of the cities of Sidi Bel Abbès and Saïda in Algeria

#### Botanical identification and voucher specimens

Plant identification was conducted primarily by the authors, all trained in botany and taxonomy, and corroborated by additional university botanists and experienced traditional healers when necessary. Identification was based on standard floras and taxonomic keys, and scientific names were validated against authoritative databases such as Plants of the World Online, The Plant List, and the African Plant Database. Voucher specimens of freshly collected plants were prepared and deposited in the herbarium of the Eco-Development of Spaces Research Laboratory, Faculty of Natural and Life Sciences, Djilali Liabès University, Sidi Bel Abbès (herbarium accession numbers available upon request). Vernacular names were cross-checked using classical references on Maghreb flora and pharmacopoeia, including *Répertoire des noms des plantes du Maghreb* (Louis Trabut, reissued by Rebahi 2015) and *Contribution à l'étude de la pharmacopée traditionnelle au Maroc* (Bellakhdar 1997).

#### Cultural importance indices

To quantify the cultural importance and versatility of recorded taxa, two widely used ethnobotanical indices were calculated:

##### **Relative Frequency of Citation (RFC):**

$$\text{RFC} = (\text{Number of informants mentioning the use of species}) / (\text{total number of informants})$$

RFC values range from 0 to 1 and reflect the relative cultural importance of each species (Leonti 2022).

#### **Use Value (UV):**

$$UV = (\text{total number of use-reports across all use-categories for species}) / \text{total number of informants}$$

UV provides an estimate of the versatility and significance of each species within the local pharmacopoeia (Leonti 2022).

#### **Statistical analysis**

Data were processed using descriptive and multivariate statistical approaches. Percentages were calculated with precision to quantify the relative use of each plant part (leaves, stems, branches, etc.) and each preparation method, allowing a clearer assessment of their respective importance. Descriptive analyses were performed using Microsoft Excel LTSC 2024, while multivariate analyses were carried out with PAST software (version 4.03) to explore patterns and relationships among variables.

## **Results and discussion**

### **Socio-demographic profile of respondents**

Table 1 presents the socio-demographic characteristics of the 300 informants interviewed in the wilayas of Sidi Bel Abbès (170 respondents) and Saïda (130 respondents). The majority of participants were aged between 40 and 60 years (42.3%), followed by those aged 20-40 years (36.3%), whereas only 3.7% were aged above 80 years. Female informants (52.3%) slightly outnumbered males (47.7%). Most respondents were married (68.0%), while single individuals accounted for 32.0%. Educational attainment was heterogeneous: 6.7% of participants were illiterate, 12.0% had completed only primary education, whereas the largest groups had achieved secondary (25.3%) and high school (29.3%) education. A considerable proportion had pursued university studies (26.7%).

Table 1. Sociodemographic characteristics of informants interviewed regarding medicinal plants used for breast cancer in northwestern Algeria

	<b>Sidi bel Abbes</b>	<b>Saida</b>	<b>Total</b>	<b>Proportion</b>
<b>Number</b>	170	130	<b>300</b>	<b>100</b>
<b>Age</b>				
<b>20-40</b>	65	44	<b>109</b>	<b>36,3</b>
<b>40-60</b>	72	55	<b>127</b>	<b>42,3</b>
<b>60-80</b>	28	25	<b>53</b>	<b>17,7</b>
<b>80-100</b>	5	6	<b>11</b>	<b>3,7</b>
<b>Sexe</b>				
<b>Male</b>	82	61	<b>143</b>	<b>47,7</b>
<b>Female</b>	88	69	<b>157</b>	<b>52,3</b>
<b>Marital status</b>				
<b>Single</b>	54	42	<b>96</b>	<b>32,0</b>
<b>Married</b>	116	88	<b>204</b>	<b>68,0</b>
<b>Educational level</b>				
<b>Illiterate</b>	11	9	<b>20</b>	<b>6,7</b>
<b>Primary school</b>	20	16	<b>36</b>	<b>12,0</b>
<b>Secondary school</b>	41	35	<b>76</b>	<b>25,3</b>
<b>High school</b>	52	36	<b>88</b>	<b>29,3</b>
<b>University</b>	46	34	<b>80</b>	<b>26,7</b>

### Relationships between socio-demographic profiles and ethnomedicinal knowledge

In this study, the level of ethnobotanical knowledge was quantified through two complementary indicators: the number of citations of plant parts used (PP) and the number of citations of preparation methods (PM). These variables were analyzed in relation to socio-demographic characteristics (sex, age, marital status, and education level) in order to identify the informant profiles most strongly associated with the preservation and transmission of traditional knowledge on medicinal plants for breast cancer management.

The principal component analysis revealed a clear socio-ethnobotanical structure within the dataset, with the first two components explaining almost all the observed variance (PC1 = 96.92% and PC2 = 2.98%). The first component was strongly and positively correlated with all ethnobotanical variables, including PP\_Male (0.503), PP\_Female (0.501), PM\_Male (0.498), and PM\_Female (0.499), representing a general gradient of ethnobotanical engagement. High scores on this axis correspond to individuals who provided a greater volume of ethnobotanical information, including a higher number of cited species, a wider diversity of plant parts, and a broader range of preparation methods.

The second component, although explaining a smaller portion of the variance, revealed a distinct gender-based differentiation in ethnobotanical knowledge. Variables associated with male respondents (PP\_Male and PM\_Male) were positioned toward the upper side of the second axis, whereas those associated with female respondents (PP\_Female and PM\_Female) were oriented toward the opposite side. This separation indicates that men and women emphasize different aspects of traditional knowledge. Women demonstrated greater familiarity with plant parts and preparation techniques, reflecting a more practical and experience-oriented understanding of medicinal plant use (Belhacini *et al.* 2024; Gherib *et al.* 2024; Mohammadi *et al.* 2023). In contrast, men appeared to focus more on plant identification and species recognition, showing less diversity in preparation methods.

In the biplot representation (Fig. 2), married individuals were located in the lower right quadrant, corresponding to high values on the first component and in close proximity to the female-related variables. This position confirms that married respondents, regardless of gender, possess the most extensive ethnobotanical knowledge and are more actively involved in the transmission and use of medicinal plant practices. Their strong association with the first component reflects a higher degree of ethnomedicinal engagement, likely linked to their family and community healthcare responsibilities. Conversely, younger and university-educated individuals appeared on the left side of the first axis, indicating a lower level of engagement in traditional practices. The group of elderly respondents (80-100 years old) was also located in the lower left quadrant, near the younger age group (20-40 years). This position does not necessarily reflect a lack of knowledge but rather the very small number of elderly participants included in the sample, which reduces their statistical influence and makes their apparent level of ethnobotanical involvement seem lower than it actually is. (Belhouala *et al.* 2021; Haba *et al.* 2023; Prinsloo *et al.* 2023). Qualitative observations suggest that, despite their small number, elderly respondents often possess richer and more detailed ethnobotanical knowledge per informant compared to younger participants.

Among men, the most significant contributions to the PCA were associated with middle-aged and less-educated respondents, suggesting that male ethnobotanical knowledge remains concentrated among individuals with more practical and field-based experience. For women, ethnobotanical knowledge appeared more evenly distributed across all age and education categories, indicating that female engagement in traditional healing practices transcends social and educational boundaries. This widespread participation may be linked to women's greater exposure to family health issues, particularly breast-related illnesses, which may enhance their practical knowledge of medicinal plant preparation and use (Bensizerara *et al.* 2025; Benamar *et al.* 2023).

Overall, the PCA confirms a coherent socio-ethnobotanical pattern in which married individuals, especially women, display broader and more practical ethnomedicinal knowledge, particularly concerning plant parts and preparation methods, while men contribute more to the identification and recognition of medicinal species. This gender-based differentiation can be explained by two main factors. First, in the study area, as in much of Algeria and North Africa, women are primarily responsible for household care, including the preparation and administration of remedies as well as culinary practices. This cultural role makes women more familiar with plant parts, preparation techniques, and usage. Men, while knowledgeable about the plants themselves and their general properties, are less involved in household preparation, which accounts for their lesser familiarity with practical aspects. Second, since breast cancer predominantly affects women, traditional knowledge related to its management tends to be concentrated among female informants. This complementarity reflects gender-based specialization in traditional medicine and underscores the central role of socially and domestically active individuals in maintaining and transmitting ethnobotanical heritage within the studied community.

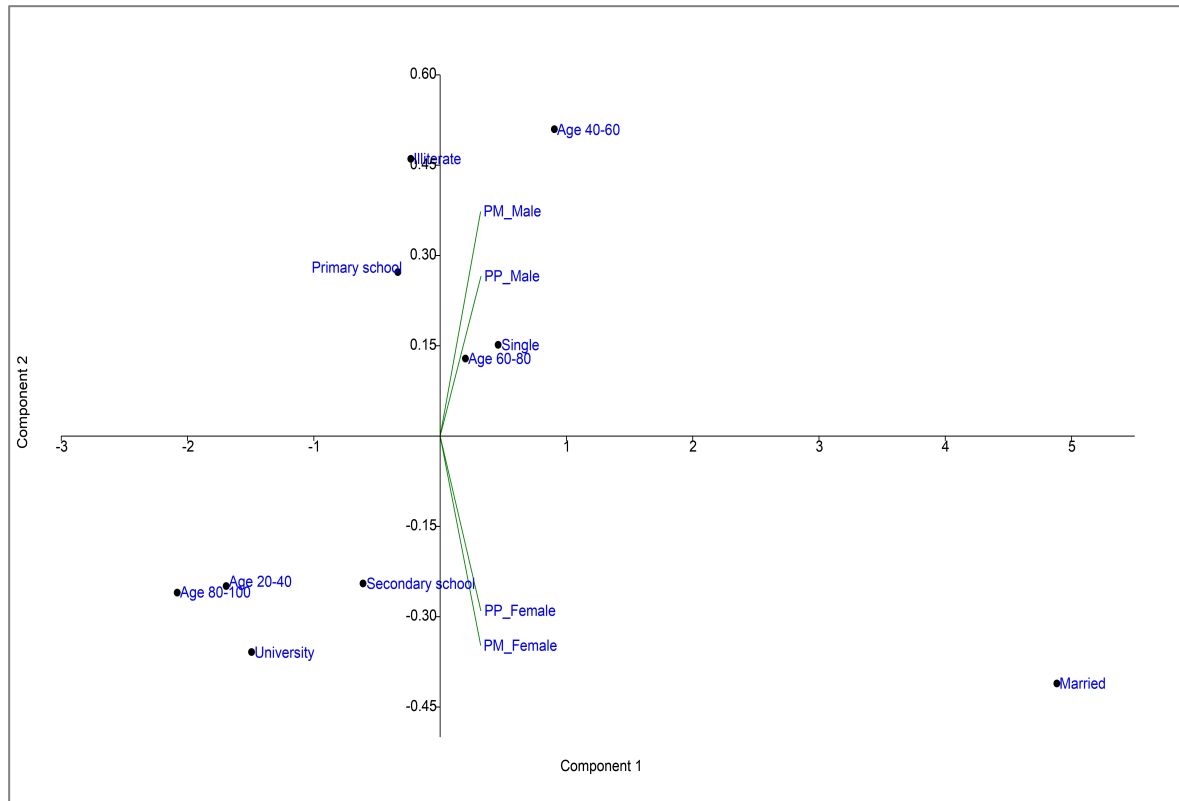


Figure 2. PCA biplot of socio-demographic variables and ethnomedicinal knowledge indicators

#### Taxonomic diversity of medicinal plants

A total of 59 medicinal plant species, distributed across 55 genera and 34 families, were documented for the treatment of breast cancer in the study area. Herbs were by far the predominant growth form (81.36%), followed by shrubs (13.56%) and trees (5.08%) (Table 2). The dominance of herbaceous taxa has also been reported in several ethnobotanical surveys conducted in Algeria and across North Africa (Bensizerara *et al.* 2025; Bouasla & Bouasla 2017; Senoussi *et al.* 2021). This trend is often attributed to the abundance, accessibility, and rapid regeneration of herbs compared with woody plants, which makes them more practical and sustainable for frequent medicinal use (Li *et al.* 2024).

Table 2. Classification of plants used against breast cancer according to their botanical category and growth

Category	Habit	Number of families	Number of genera	Number of species	Percentage of total species (%)
Angiospermae	Tree	2	4	3	5,08
	Shrub	4	6	8	13,56
	Herb	28	45	48	81,36
<b>Total</b>	—	<b>34</b>	<b>55</b>	<b>59</b>	<b>100</b>

Among the 59 recorded species (Table 3), the Lamiaceae emerged as the most represented family (7 species), followed by Apiaceae, Asteraceae, and Fabaceae with 5 species each. Several families, including Brassicaceae, Ranunculaceae, and Zingiberaceae, were represented by two species, while many others were represented by a single taxon (Fig 3). This distribution pattern mirrors findings from previous ethnobotanical surveys in Algeria and North Africa (Bensizerara *et al.* 2025; Soltani *et al.* 2025). The prominence of these dominant families may be attributed to their phytochemical richness, particularly in flavonoids, terpenoids, alkaloids and phenolic compounds, which are widely recognized for their anticancer and therapeutic properties (Hamel *et al.* 2018; Sehaki *et al.* 2023).

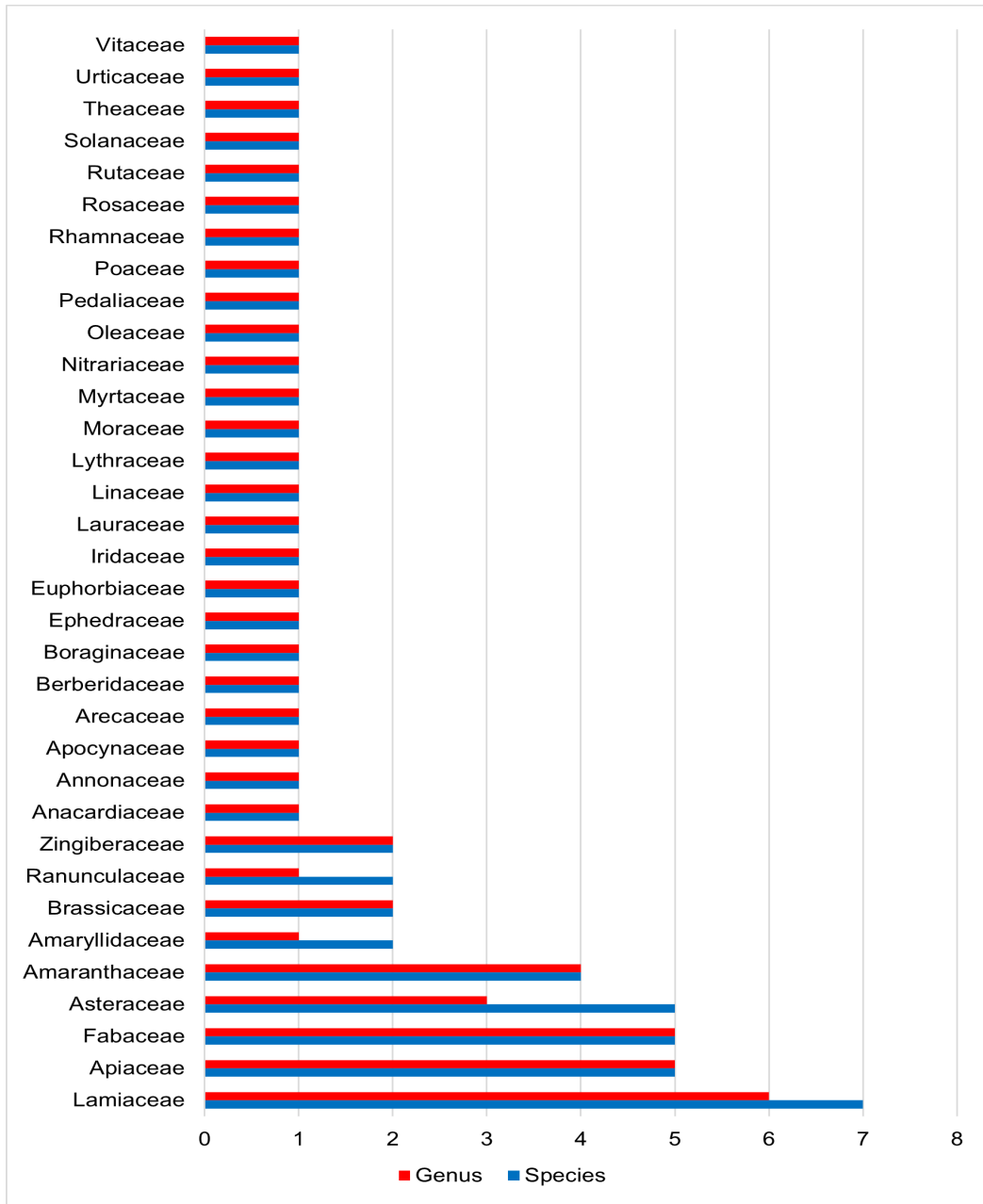


Figure 3. Botanical families and genera of plants used in the treatment of breast cancer

Table 3. Ethnomedicinal uses of medicinal plant species for breast cancer management in Sidi Bel Abbès and Saïda (Northwestern Algeria).

Scientific name Family	Local name	Part used (%)	Use method (%)	Specimen	UV	RFC
<i>Ephedra alata</i> Decne. Ephedraceae	علندة <i>Alenda</i>	Aerial part (100%)	Decoction (63%) Infusion (33%) Maceration (4%)	H-ECODEV-054	0,523	0,523
<i>Allium sativum</i> L. * Amaryllidaceae	ثوم <i>Thoum</i>	Bulb (100%)	D.consumption (68%) Infusion (23%) Decoction (9%)	H-ECODEV-002	0,463	0,463
<i>Curcuma longa</i> L. ** Zingiberaceae	كركم <i>Kourkoum</i>	Rhizome (100%)	Infusion (53%) D.consumption (24%) Decoction (15%) Maceration (8%)		0,443	0,443
<i>Prunus persica</i> (L.) Batsch * Rosaceae	خوخ <i>Khoukh</i>	Leaves (100%)	Decoction (75%) D.consumption (14%) Infusion (11%)	H-ECODEV-67	0,43	0,43
<i>Berberis vulgaris</i> L. Berberidaceae	أغريس <i>Argis</i>	Bark (100%)	Infusion (65%) D.consumption (16%) Decoction (16%) Maceration (3%)	H-ECODEV-59	0,403	0,403
<i>Nigella arvensis</i> L. ** Ranunculaceae	حبة البركة <i>Habat el baraka</i>	Seeds (100%)	Decoction (69%) D.consumption (21%) Infusion (10%)		0,396	0,396
<i>Nigella sativa</i> L. ** Ranunculaceae	حبة السوداء/سانوج <i>Sanoudj / Haba sawda</i>	Seeds (100%)	D.consumption (66%) Infusion (20%) Inhalation (14%)		0,366	0,366
<i>Allium cepa</i> L. * Amaryllidaceae	بصل <i>Bssal</i>	Bulb (100%)	D.consumption (63%) Decoction (26%) Infusion (7%) Inhalation (4%)	H-ECODEV-006	0,34	0,34
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants Amaranthaceae	مخينزة <i>Mkhinza</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-073	0,33	0,33
<i>Crocus sativus</i> L.** Iridaceae	زعفران <i>Zaafraan</i>	Flowers (100%)	D.consumption (54%) Infusion (46%)		0,296	0,296

<i>Trigonella foenum graecum</i> L. *	حلبة <i>Helba</i>	Seeds (100%)	Infusion (67%) D.consumption (22%) Decoction (11%)	H-ECODEV-050	0,29	0,29
<b>Fabaceae</b>						
<i>Zingiber officinale</i> Roscoe **	زنجبيل <i>Zendjabil</i>	Rhizome (100%)	Infusion (70%) D.consumption (22%) Decoction (8%)		0,29	0,29
<b>Zingiberaceae</b>						
<i>Zizphus lotus</i> (L.) Lam.	نبق/سدرة <i>Sedra / Nbag</i>	Leaves (51%) Fruits (49%)	D.consumption (43%) Infusion (25%) Decoction (21%) Inhalation (11%)	H-ECODEV-033	0,263	0,263
<b>Rhamnaceae</b>						
<i>Ficus carica</i> L.	تين <i>Tine</i>	Fruits (100%)	D.consumption (100%)	H-ECODEV-016	0,253	0,253
<b>moraceae</b>						
<i>Euphorbia officinarum</i> L. **	دغموس <i>Daghmous</i>	Aerial part (100%)	Infusion (100%)		0,25	0,25
<b>Euphorbiaceae</b>						
<i>Annona muricata</i> L. **	غرافيل <i>Al-gravila</i>	Flowers (100%)	D.consumption (100%)		0,25	0,25
<b>Annonaceae</b>						
<i>Artemisia herba alba</i> Asso.	شيع <i>Chih</i>	Leaves (75%) Aerial part (25%)	Infusion (67%) Decoction (28%) Maceration (5%)	H-ECODEV-043	0,243	0,243
<b>Asteraceae</b>						
<i>Linum usitatissimum</i> L. **	زريرة الكتان <i>Zri'at el-Kittān</i>	Seeds (100%)	D.consumption (71%) Infusion (29%)		0,243	0,243
<b>Linaceae</b>						
<i>Origanum vulgare</i> L.	زعر <i>Zaatar</i>	Leaves (85%) Aerial part (15%)	Infusion (59%) Decoction (28%) Inhalation (13%)	H-ECODEV-011	0,263	0,263
<b>Lamiaceae</b>						
<i>Atriplex halimus</i> L.	قطف <i>Qṭef</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-040	0,23	0,23
<b>Amaranthaceae</b>						
<i>Borago officinalis</i> L.	لسان الفرد <i>Lissan el ferd</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-025	0,196	0,196
<b>Boraginaceae</b>						
<i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb.	قرص <i>Kard</i>	Leaves (100%)	Decoction (100%)	H-ECODEV-058	0,19	0,19
<b>Fabaceae</b>						
<i>Glycine max</i> (L.) Merr. **	حبوب الصويا <i>Soja</i>	Seeds (100%)	D.consumption (91%) Decoction (9%)		0,18	0,18
<b>Fabaceae</b>						
<i>Trifolium alexandrinum</i> L.	برسيم <i>Bersim</i>	Leaves (67%) Seeds (23%)	D.consumption (63%) Decoction (37%)	H-ECODEV-61	0,17	0,17
<b>Fabaceae</b>						

<i>Nerium oleander</i> L. Apocynaceae	دفل <i>Defla</i>	Leaves (80%) Flowers (20%)	Infusion (86%) Maceration (14%)	H-ECODEV-70	0,153	0,153
<i>Punica granatum</i> L. * Lythraceae	رمان <i>Rumaane</i>	Fruits (100%)	Decoction (64%) D.consumption (22%) Infusion (14%)	H-ECODEV-066	0,15	0,15
<i>Vitis vinifera</i> L. * Vitaceae	دالية <i>Dalia</i>	Leaves (73%) Fruits (27%)	Infusion (59%) D.consumption (31%) Macération (10%)	H-ECODEV-075	0,146	0,146
<i>Hammada articulata</i> (Moq.) O. Bolòs & Vigo Amaranthaceae	رمت <i>Rimth,</i>	Leaves (51%) Aerial part (49%)	Decoction (60%) Infusion (23%) D.consumption (17%)	H-ECODEV-060	0,143	0,143
<i>Capsicum annum</i> L. * Solanaceae	فلفل أحمر <i>Felfel ahmar</i>	Fruits (100%)	D.consumption (100%)	H-ECODEV-072	0,143	0,143
<i>Carum carvi</i> L. ** Apiaceae	كروية <i>Karwiya</i>	Seeds (100%)	Infusion (45%) Decoction (32%) D.consumption (23%)		0,123	0,123
<i>Olea europaea</i> L. Oleaceae	زيتون <i>Zitoun</i>	Leaves (89%), Fruits (11%)	Infusion (40%) Decoction (31%) Macération (29%)	H-ECODEV-024	0,113	0,113
<i>Cinnamomum verum</i> J. Presl ** Lauraceae	قرفة <i>Karfa</i>	Bark (100%)	Decoction (54%) D.consumption (32%) Infusion (14%)		0,103	0,103
<i>Daucus carota</i> L. Apiaceae	جزر <i>Djazar</i>	Roots (64%) Seeds (36%)	D.consumption (80%) Decoction (20%)	H-ECODEV-056	0,103	0,103
<i>Taraxacum officinale</i> F.H. Wigg. Asteraceae	الهندبة البرية <i>Hendba</i>	Leaves (67%) Flowers (33%)	Decoction (51%) Infusion (31%) D.consumption (18%)	H-ECODEV-046	0,096	0,096
<i>Thapsia garganica</i> L. Apiaceae	درياس/بونافع <i>Bounafaa / Deryas</i>	Roots (100%)	D.consumption (58%) Decoction (42%)	H-ECODEV-064	0,096	0,096
<i>Syzygium aromaticum</i> L. Merr. & L.M. Perry ** Myrtaceae	قرنفل <i>Kronfol</i>	Buds (100%)	Decoction (75%) Infusion (25%)		0,08	0,08

<i>Glycyrrhiza glabra</i> L.** Fabaceae	عرق السوس <i>Areq souss</i>	Stem (100%)	Decoction (54%) Infusion (27%) D.consumption (19%)		0,073	0,073
<i>Apium graveolens</i> L. Apiaceae	كرافس <i>Krafas</i>	Leaves (61%), Seeds (39%)	Infusion (100%)	H-ECODEV-021	0,07	0,07
<i>Camellia sinensis</i> (L.) Kuntze ** Theaceae	أتاي <i>Atai</i>	Leaves (100%)	Decoction (96%) Infusion (4%)		0,07	0,07
<i>Brassica oleracea</i> var. <i>italica</i> Brassicaceae	بروكلي <i>Brocli</i>	Flowers (53%) Aerial part (47%)	D.consumption (68%) Infusion (32%)	H-ECODEV-068	0,063	0,063
<i>Citrus limon</i> Osbeck * Rutaceae	ليمون <i>Laymoun</i>	Fruits (100%)	D.consumption (78%) Infusion (10%) Decoction (7%) Maceration (3%)	H-ECODEV-013	0,063	0,063
<i>Triticum turgidum</i> L. * Poaceae	قمح <i>Gamh</i>	Seeds (100%)	D.consumption (100%)	H-ECODEV-055	0,063	0,063
<i>Artemisia campestris</i> L. Asteraceae	ألالة <i>Alalal</i>	Leaves (67%) Aerial part (33%)	Infusion (66%) Decoction (28%) Maceration (6%)	H-ECODEV-071	0,06	0,06
<i>Peganum harmala</i> L. Nitrariaceae	حرملة <i>Harmal</i>	Seeds (65%) Leaves (35%)	Decoction (47%) Inhalation (29%) Infusion (17%) D.consumption (7%)	H-ECODEV-065	0,056	0,056
<i>Sesamum indicum</i> L. ** Pedaliaceae	جلجلان / سمسم <i>Semsem / Jaljlan</i>	Seeds (100%)	D.consumption (88%) Infusion (12%)		0,053	0,053
<i>Phoenix dactylifera</i> L. Arecaceae	تمر / نخل <i>Nakhl / Tmar</i>	Fruits (91%) Seeds (9%)	D.consumption (87%) Decoction (13%)	H-ECODEV-026	0,053	0,053
<i>Mentha spicata</i> L. * Lamiaceae	نعناع اخضر <i>Na'na' akhdar</i>	Leaves (93%) Aerial part (7%)	Decoction (100%)	H-ECODEV-010	0,036	0,036
<i>Cuminum cyminum</i> L. ** Apiaceae	كمون <i>Kamoun</i>	Seeds (100%)	Infusion (72%) D.consumption (28%)		0,036	0,036
<i>Spinacia oleracea</i> L. Amaranthaceae	سبانغ <i>Sabanikh</i>	Leaves (100%)	D.consumption (100%)	H-ECODEV-057	0,033	0,033
<i>Ocimum basilicum</i> L. Lamiaceae	ريحان / حبق <i>habaq / riḥān</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-015	0,03	0,03

<i>Marrubium vulgare</i> L. Lamiaceae	مريوة <i>Mriywa</i>	Leaves (100%)	Infusion (75%) Decoction (25%)	H-ECODEV-001	0,023	0,023
<i>Lavandula stoechas</i> L. Lamiaceae	خزامة <i>Khezzama</i>	Leaves (50%) Flowers (50%)	Infusion (86%) Decoction (14%)	H-ECODEV-034	0,02	0,02
<i>Urtica dioica</i> L. Urticaceae	حريق <i>Horiq</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-049	0,02	0,02
<i>Pistacia lentiscus</i> L. Anacardiaceae	ضرو <i>Darw</i>	Leaves (100%)	Infusion (50%) Decoction (50%)	H-ECODEV-014	0,016	0,016
<i>Salvia rosmarinus</i> Spenn. Lamiaceae	أكليل الجبل / يازير <i>Iklil el-jabal / Yazir</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-035	0,01	0,01
<i>Dittrichia viscosa</i> (L.) Greuter Asteraceae	مقرمان <i>Magramane</i>	Leaves (100%)	Decoction (100%)	H-ECODEV-063	0,01	0,01
<i>Anastatica hierochuntica</i> L. Brassicaceae	كف مريم <i>Kaff Maryam</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-074	0,01	0,01
<i>Matricaria chamomilla</i> L. Asteraceae	بابونج <i>Baboundj</i>	Flowers (100%)	Infusion (100%)	H-ECODEV-030	0,006	0,006
<i>Origanum majorana</i> L. Lamiaceae	بردقوش <i>Bardaqušh</i>	Leaves (100%)	Infusion (100%)	H-ECODEV-020	0,006	0,006

Legend: \* Introduced species; \*\* Imported species; no asterisk: native species.

### Quantitative ethnobotanical indices and key medicinal species

Quantitative indices (UV and RFC) highlighted several species of outstanding cultural and therapeutic significance within the surveyed regions. *Ephedra alata* Decne., *Allium sativum* L., *Curcuma longa* L., *Prunus persica* (L.) Batsch, *Berberis vulgaris* L., and *Nigella sativa* L. emerged as the most frequently cited taxa. The predominance of these species is consistent with findings from other ethnobotanical studies addressing cancer treatment in Algeria (Ounaissia *et al.* 2021; Taïbi *et al.* 2021) and neighboring North African countries (Sawadogo *et al.* 2012). Their prominence likely stems from both their deep-rooted reputation in traditional medicine and their well-established pharmacological properties. For instance, *Allium sativum* and *Nigella sativa* are renowned for their anticancer and immunomodulatory activities, while *Curcuma longa* and *Zingiber officinale* Roscoe are widely appreciated as both culinary and medicinal agents.

Among these plants, *Ephedra alata* Decne. exhibited the highest quantitative indices, confirming its dominant role in the regional ethnopharmacopoeia. This desert shrub, well documented in North African traditional medicine, is frequently prescribed for respiratory ailments and cancer-related disorders (Benarba *et al.* 2015; Taïbi *et al.* 2021). Its exceptional frequency of citation in the present survey underscores its cultural and therapeutic centrality among local communities of western Algeria. Modern pharmacological research corroborates these observations, reporting bioactive alkaloids and flavonoids with potential cytotoxic and antiproliferative effects, which may justify its recurrent inclusion in cancer-related remedies (Abdelmoumene *et al.* 2025; Al Jaafreh 2024; Benarba *et al.* 2025).

*Nigella sativa* and *Allium sativum* also ranked among the most culturally salient taxa, their significance extending beyond Algeria into the broader Mediterranean and Islamic world (Merrouni & Elachouri 2021; Ounaissia *et al.* 2021). In particular, *Nigella sativa* holds strong cultural and religious resonance, being explicitly mentioned in prophetic traditions, which enhances its symbolic and therapeutic legitimacy among healers and users alike. Such sociocultural reinforcement may contribute to its widespread and enduring use in breast cancer management.

Notably, exotic species such as *Curcuma longa* and *Zingiber officinale*, which are not native to Algeria, were also frequently cited. Their presence reflects the incorporation of globally traded spices into the local pharmacopoeia, revealing the adaptive nature of traditional medical systems that integrate novel botanical resources while preserving cultural coherence. Similar trends have been documented in Morocco and other North African contexts (Merrouni & Elachouri 2021), although their prominence in western Algeria, particularly concerning breast cancer, represents a novel and significant observation.

Beyond these emblematic taxa, the survey identified several less-documented species associated with breast cancer treatment, including *Euphorbia officinarum* L., *Annona muricata* L., and *Hammada articulata* (Moq.) Moq. The inclusion of these plants highlights the depth and originality of local knowledge and underscores the existence of underexplored therapeutic resources in the region. Documenting these rare uses not only enriches the ethnobotanical inventory of Algeria but also provides a valuable foundation for future pharmacological and phytochemical investigations.

A further noteworthy aspect of the data concerns the structure of species citation, which exhibits a clear “drape effect”: a limited number of highly cited species dominate the ethnomedicinal repertoire, serving as symbolic and practical umbrella taxa under which a diversity of secondary, less-cited species persist. This hierarchical structure reflects both the pragmatic tendencies of local communities, favoring trusted, efficacious species; and the resilience of traditional medical systems, which maintain a broad reservoir of ancillary remedies. Similar citation patterns have been reported in other ethnobotanical contexts, where cultural preferences and ecological availability converge to shape a core set of medicinal taxa (Alves-Silva *et al.* 2017; Dihia & Belaid, 2023).

Several of the highly cited species documented in this study are supported by experimental pharmacological evidence reported in the literature. For example, *Nigella sativa* has been widely investigated for its anticancer-related biological activities, including induction of apoptosis, inhibition of tumor cell proliferation, and modulation of oxidative stress, effects largely attributed to thymoquinone (Randhawa *et al.* 2011). Similarly, *Curcuma longa* contains curcumin, a compound extensively studied for its antiproliferative, anti-inflammatory, and anti-metastatic effects in breast cancer experimental models (Tomeh *et al.* 2019). In addition, *Zingiber officinale* has demonstrated cytotoxic, antioxidant, and anti-inflammatory activities in various *in vitro* studies (Panyajai *et al.* 2025).

Other frequently cited species such as *Allium sativum* have been associated with chemopreventive effects linked to organosulfur compounds (Bianchini *et al.* 2001), while *Trigonella foenum-graecum* has shown antiproliferative and antioxidant properties in experimental systems (El Bairi *et al.* 2017). Furthermore, *Camellia sinensis* is rich in catechins,

particularly epigallocatechin gallate (EGCG), which has been reported to inhibit cancer cell growth, angiogenesis, and inflammatory pathways (Singh *et al.* 2011).

In contrast, *Ephedra alata*, one of the most frequently reported species in the study area, contains ephedrine-type alkaloids with documented biological activity, including cytotoxic effects observed in some experimental models; however, its use is associated with well-established safety concerns, particularly cardiovascular and neurological risks (Sioud *et al.* 2024). Finally, species such as *Euphorbia officinarum*, *Annona muricata*, and *Hammada articulata* remain poorly investigated in the context of breast cancer, highlighting their potential as priority candidates for future pharmacological and phytochemical research.

Comparable ethnobotanical research conducted in eastern Algeria (Annaba) among breast cancer patients reported 35 plant species from 27 botanical families, with the most frequently cited taxa including *Nigella sativa*, *Curcuma longa*, *Allium sativum*, *Berberis vulgaris*, *Annona muricata*, and *Ephedra sp.* The leaves were the most commonly used plant parts, accounting for 20% of citations (Ounaissia *et al.* 2021). Our study in northwestern Algeria identified a higher number of species (59) across 34 families, highlighting additional under-documented taxa specific to the Sidi Bel Abbès and Saïda regions. While there are overlaps in commonly used species, the differences in species composition and local knowledge emphasize the regional specificity of ethnobotanical practices and reinforce the value of focused investigations on breast cancer-related plant use in different parts of Algeria.

#### Biogeographical origin and cultural integration of medicinal Species

In terms of biogeographical origin, most of the species recorded (56%) were native to the study area, while 27% were imported and 17% were introduced (Fig. 4). The predominance of native species reflects the strong cultural integration of local flora into traditional medical practices; a trend similarly observed across North Africa (Bensizerara *et al.* 2025; Senoussi *et al.* 2021). These native plants are often preferred not only because of their abundance and ecological adaptation to local conditions but also due to their long-standing symbolic and cultural significance in traditional healing (Alves-Silva *et al.* 2017; Hosseini *et al.* 2019; Soltani *et al.* 2025). In parallel, the considerable representation of imported species illustrates the enduring impact of historical trade routes and intercultural exchanges in shaping the regional pharmacopoeia, a phenomenon also documented in neighboring countries (Eddouks *et al.* 2002; Salhi *et al.* 2010). Introduced taxa, accounting for 17% of the remedies, likewise hold an important place, as confirmed by ethnopharmacological studies conducted in Tunisia and Egypt (El-Seedi *et al.* 2013; Ghorbani *et al.* 2011). Their assimilation into local practices underlines the adaptive character of traditional knowledge, which successfully integrates external botanical resources into established cultural frameworks.

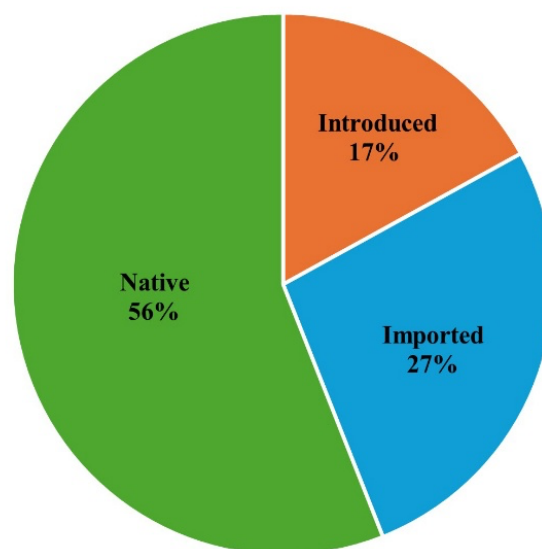


Figure 4. Distribution of native, introduced, and imported species

#### Plant parts used

In the present survey, leaves were the most frequently used plant part (29.11%), followed by seeds (19.97%), fruits (11.39%), stems (11.32%), bulbs (8.34%), rhizomes (7.62%), bark (5.26%), flowers (4.50%), and roots (1.66%), while buds were rarely cited (0.83%) (Fig. 4). The predominance of leaves has been widely documented in ethnobotanical surveys across Algeria and

neighboring countries (Danladi *et al.* 2025; Khusna *et al.* 2023 ; Tahri *et al.* 2020) and is generally explained by their abundance, ease of collection, and their role as primary sites of photosynthesis, which leads to the accumulation of diverse bioactive compounds (Bensizerara *et al.* 2025; El Hachlafi *et al.* 2022). In addition, harvesting leaves is less destructive compared with roots or bark, making it a more sustainable practice for maintaining plant populations (da Silva *et al.* 2019; Maroyi 2013).

Seeds represented the second most cited plant organ, a finding that is particularly noteworthy in the context of breast cancer management. Species such as *Nigella sativa* L. (Ranunculaceae) and *Trigonella foenum-graecum* L. (Fabaceae) are traditionally valued for their high content of secondary metabolites with proven anticancer potential (Alberts *et al.* 2024 ; Merrouni & Elachouri 2021). This emphasis on seeds contrasts with previous Algerian surveys, where fruits or flowers were generally more prominent (Abdel Salam *et al.* 2023; Bouasla & Bouasla 2017), suggesting that therapeutic practices for breast cancer in the studied regions may favor organs particularly associated with bioactive efficacy.

By contrast, the relatively limited reliance on roots and bark likely reflects both ecological considerations and evolving cultural preferences. Overharvesting of these plant parts can jeopardize species survival, and their reduced use aligns with sustainability-oriented recommendations encouraging the preferential collection of aerial organs (Bensizerara *et al.* 2025). Taken together, these results indicate that local communities strategically prioritize plant parts that combine therapeutic effectiveness, cultural familiarity, and ecological sustainability, a pattern that resonates with both traditional wisdom and modern conservation concerns.

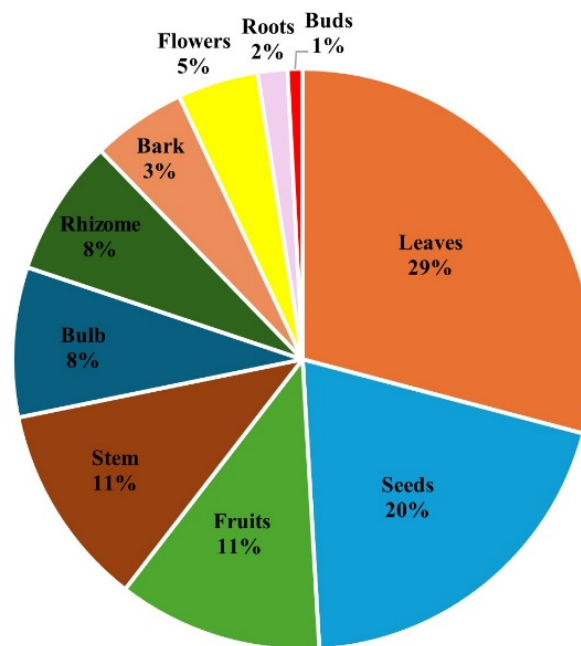


Figure 5. Distribution spectrum of plant parts used.

#### Modes of preparation and administration

Infusion was the predominant mode of preparation (36.01%), followed by direct consumption (34.45%) and decoction (27.26%), whereas maceration (1.83%) and inhalation (0.45%) were rarely reported (Fig. 5). The dominance of infusion and decoction aligns with ethnobotanical trends across Algeria and North Africa (Bensizerara *et al.* 2025; Jan *et al.* 2023; Kechidi *et al.* 2021; Uzun & Koca 2020). These methods are favored because heat enhances the solubility and extraction of active phytochemicals while simultaneously reducing potential toxicity (Jan *et al.* 2023; Soltani *et al.* 2025).

Notably, the frequency of direct consumption observed in this study is relatively high compared to other Algerian regions, highlighting a cultural preference for using fresh or minimally processed materials. This practice reflects a widespread belief that raw preparations preserve the “vital force” and potency of the remedy—an idea deeply rooted in local perceptions of natural efficacy and purity. Similar findings have been reported in eastern Algeria (Ounaissia *et al.* 2021) and Morocco (Merrouni & Elachouri 2021), suggesting that immediacy of use and accessibility are major determinants in the choice of preparation mode.

The marginal use of maceration and inhalation demonstrates their limited relevance within breast cancer ethnomedicine in western Algeria. However, their presence in the pharmacopoeia remains notable, as these methods are traditionally employed to treat more common and less severe ailments, such as mild respiratory or digestive disorders. Their occasional mention in this study therefore reflects the flexibility of local therapeutic knowledge, where preparation techniques are adapted according to the perceived gravity and nature of the disease.

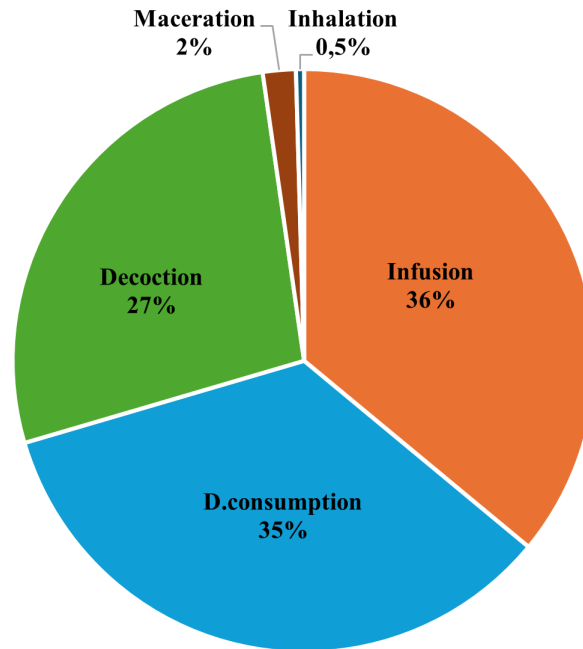


Figure 6. Spectrum of preparation techniques used

#### Monotherapy and combined remedies

In the surveyed regions, medicinal plants used for breast cancer were reported either as single-plant preparations or as complex mixtures incorporating multiple botanical species and other natural ingredients. Although single-plant remedies remain widely used, most informants expressed a preference for combinations, which are believed to enhance therapeutic efficacy, improve taste and odor, and reduce undesirable effects.

The most frequently cited adjuvants included honey, olive oil, milk, butter, and sacred water (Zamzam). These products hold both functional and symbolic significance. Their inclusion is thought to increase the potency of the main ingredient and to facilitate administration, particularly for orally consumed preparations. Such practices are deeply embedded in the local cultural and spiritual context, as honey, olive oil, and black seed (*Nigella sativa* L.) are frequently mentioned in Prophetic Medicine and have retained enduring symbolic importance throughout the Muslim world (Bouasla & Bouasla 2017).

In some cases, respondents also described the concomitant use of several plant species within a single preparation or the simultaneous use of herbal remedies alongside conventional anticancer drugs. This integrative approach reflects the adaptive and dynamic character of traditional healing systems, where empirical knowledge is continuously adjusted to coexist with biomedical practices in order to maximize perceived therapeutic benefits. Nevertheless, such concurrent use may involve significant health risks, particularly due to potential herb-drug interactions and interference with pharmacological treatments. For this reason, it is essential that these practices be approached with caution and, whenever possible, under medical supervision.

Similar combinations of herbal ingredients and adjuvants have been reported across North Africa and the Middle East, where honey and olive oil are frequently employed to potentiate herbal formulations and to mitigate adverse effects (Bayat Mokhtari *et al.* 2017; Fakhich & Elachouri 2014; Ounaissia *et al.* 2021; Taïbi *et al.* 2023). Beyond their sensory and pharmacological contributions, these associations embody a holistic conception of health in which the material, cultural, and spiritual dimensions of healing are closely interwoven.

## Conclusion

This ethnobotanical study, conducted in the regions of Saida and Sidi Bel Abbès in northwestern Algeria, highlights the richness and diversity of local medicinal flora. These areas are characterized by extensive forest ecosystems and a highly diversified vegetation cover, which foster a strong tradition of plant use. The population maintains close ties with nature, and both fresh and dried medicinal plants are widely available in local markets and household remedies, reflecting the living continuity of traditional practices.

A total of 59 medicinal species belonging to 34 families were recorded. Families such as Lamiaceae, Amaranthaceae, Apiaceae, and Asteraceae were the most represented. While well-known species like *Ephedra alata* Decne., *Nigella sativa* L., and *Allium sativum* L. confirmed their prominence in traditional medicine, other taxa, including *Euphorbia officinarum* L., *Annona muricata* L., and *Hammada articulata* (Moq.) Moq., appeared as less frequently cited yet noteworthy discoveries. These species reveal original and locally specific aspects of therapeutic knowledge rarely reported in previous works.

An important outcome of this investigation is the remarkable involvement of women, who demonstrated deep awareness and familiarity with medicinal plants used in the management of breast cancer. This reflects both their central role in family health care and the social significance of breast cancer as a feared and closely monitored illness within the community.

Altogether, the study sheds light on a vibrant and dynamic traditional medical system that continues to evolve while maintaining deep cultural roots. Preserving and documenting such knowledge not only supports cultural heritage but also opens valuable perspectives for future pharmacological exploration and for integrating ethnobotanical insights into community health and sustainable development strategies.

## Declarations

**Ethics approval and consent to participate:** Oral informed consent was obtained from all participants prior to data collection. The study adhered to the principles outlined in the Code of Ethics of the International Society of Ethnobiology (ISE 2008).

**Consent for publication:** Not applicable.

**Availability of data and materials:** All data generated or analyzed during this study are included in this published article. Additional datasets are available from the corresponding author upon reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** Benyamina Abdelfettah and Yamina Soltani designed the study, conducted fieldwork, analyzed data, and wrote the manuscript. Toumi Manel Nardjes and Bouzidi Mohamed Ali contributed to data collection and botanical identification. Toumi Fawzia assisted with manuscript revision. All authors read and approved the final manuscript.

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