



Ethnopharmacological survey of *Matricaria chamomilla* L. in the Béja Governorate (Northwestern Tunisia): Traditional uses, preparation methods, and perceived therapeutic benefits

Ghofrane Khouildi, Fatma Arrari, Marwa Tabouii, Asma Chaibni, Karima Maaroufi

Correspondence

Ghofrane Khouildi¹, Fatma Arrari¹, Marwa Tabouii¹, Asma Chaibni², Karima Maaroufi^{1*}

¹Laboratory of Functional Physiology and Valorization of Bio-Resources (LR23ES08), Higher Institute of Biotechnology of Beja, University of Jendouba, Beja 9000, Tunisia

²Laboratory of Natural Substances, National Institute of Research and Physico-Chemical Analysis, Sidi Thabet, Tunisia.

*Corresponding Author: karimahedhli@yahoo.fr

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Research

Abstract

Background: *Matricaria chamomilla* L. (chamomile) is among the most widely used medicinal plants, valued for calming, anti-inflammatory, and digestive effects. Despite its popularity in North Africa, little is known about its traditional uses and cultural role in Tunisia. This study documents ethnopharmacological practices, consumption patterns, and perceived benefits of chamomile in the Béja Governorate, northwestern Tunisia.

Methods: A cross-sectional survey of 120 adults was conducted using convenience sampling and a structured questionnaire (online and face-to-face). Data covered sociodemographics, knowledge, preparation, administration, and perceived effects of chamomile. Ethnomedicinal importance was assessed with RFC, UV, FL, and ICF indices. Associations with sociodemographic variables were analyzed using Chi-square and logistic regression.

Results: Chamomile showed strong cultural importance (RFC = 0.33; UV = 0.49). Respondents were mainly female (61%), young (18-30 y, 61%), and university-educated (59%). Flowers were most used (82%), prepared as decoctions (39%) or infusions (33%), and consumed orally (68%). Health motivations dominated (79%), with calming effects most cited (61.7%). Informant consensus was high (ICF = 0.857-0.974). Adults ≥ 31 were more likely to use chamomile (aOR = 4.36) and report calming effects (aOR = 4.71), while women showed better knowledge (aOR = 3.29). Satisfaction was high (87.5%) and adverse effects rare (13%).

Conclusion: *Matricaria chamomilla* L. is widely used in Béja for stress relief and well-being. Findings mainly reflect young, educated respondents and should be complemented by studies on older and rural groups. Its frequent citation confirms cultural importance and supports scientific validation, suggesting integration into evidence-based care to link traditional and modern health systems.

Keywords: *Matricaria chamomilla* L.; ethnopharmacology; medicinal plants; traditional knowledge; Tunisia

Background

Medicinal plants have been used for centuries as an essential component of traditional healthcare systems and continue to play a major role in disease prevention and treatment worldwide. Their growing popularity is associated with increasing interest in natural products and their potential therapeutic benefits. Among medicinal plants, *Matricaria chamomilla* L. (German chamomile) is one of the most widely recognized and utilized species due to its long history of traditional use and broad spectrum of biological activities (Melnyk *et al.* 2024).

M. chamomilla L., a member of the Asteraceae family, is an aromatic annual herb characterized by flower heads composed of white ray florets surrounding a yellow conical receptacle. Chamomile is native to Europe and Western Asia but is currently cultivated worldwide because of its medicinal, cosmetic, and nutritional importance (Chauhan *et al.* 2021; Dai *et al.* 2022). The species is widely distributed across Europe, Asia, and Africa and has become one of the most commercially important medicinal plants in the herbal industry (Chauhan *et al.* 2021).

The medicinal value of chamomile is mainly attributed to its rich phytochemical composition. Its flowers contain numerous bioactive compounds, including flavonoids such as apigenin, luteolin, and quercetin, as well as terpenoids such as α -bisabolol and chamazulene, along with coumarins, phenolic acids, and essential oils (Setzer 2009, Maimedy *et al.* 2021). These constituents are responsible for a wide range of pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, antifungal, gastroprotective, wound-healing, antispasmodic, anxiolytic, and sedative effects (Singh *et al.* 2011, Ubessi *et al.* 2019). Owing to these properties, chamomile has attracted considerable scientific interest and remains an important medicinal species in both traditional and modern healthcare systems (Fen 2021).

Traditionally, chamomile has been used in many cultures for the management of digestive disorders, sleep disturbances, anxiety, inflammatory conditions, and skin ailments. Recent scientific studies have confirmed several of these traditional applications and highlighted its potential role in improving well-being and reducing stress-related symptoms (Kenda *et al.* 2022). Furthermore, the consumption of herbal infusions has gained increasing attention due to their contribution to health promotion and their richness in bioactive compounds (Talib *et al.* 2020, Sousa *et al.* 2024).

In North Africa, medicinal plants remain an integral component of traditional healthcare practices. Chamomile is particularly valued for its calming and digestive properties and is commonly consumed as an infusion or decoction. The species has been reported in Algeria and Morocco (Quézel & Santa 1963), while its occurrence in Tunisia has been documented in northwestern regions, including the Kroumirie Mountains (El Mokni & Verloove 2019). Despite its widespread use among Tunisian populations, information regarding its ethnomedicinal applications, preparation methods, consumption patterns, and perceived therapeutic benefits remains poorly documented. This gap is notable given that ethnobotanical surveys in neighboring Algeria and Morocco have already generated substantial quantitative data on chamomile use, including RFC and UV indices in Saharan, pre-Saharan, and Atlas communities (Bouafia *et al.* 2021, Sraoui *et al.* 2026). The present survey extends this regional literature by focusing on a distinct Mediterranean, sub-humid agricultural setting in northwestern Tunisia, where climatic conditions, crop patterns, and healthcare access differ markedly from the arid and semi-arid contexts previously studied. Documenting chamomile use specifically in the Béja Governorate therefore adds an ecologically and socioculturally distinct data point to the North African evidence base, rather than duplicating findings already established elsewhere in the region.

Tunisia possesses a rich ethnobotanical heritage that reflects centuries of interactions between local communities and medicinal plant resources. However, socio-economic transformations, urbanization, and lifestyle changes may contribute to the gradual erosion of traditional knowledge and practices. Ethnobotanical and ethnopharmacological surveys are therefore essential for documenting indigenous knowledge, preserving cultural heritage, and identifying medicinal plants with potential relevance for future pharmacological and clinical investigations.

Although numerous studies have focused on the phytochemical composition and biological activities of *M. chamomilla* L., few investigations have specifically addressed its traditional uses and cultural importance in Tunisia. To our knowledge, no comprehensive ethnopharmacological survey has examined the knowledge, attitudes, consumption patterns, preparation methods, and perceived health benefits associated with chamomile use among communities in the Béja Governorate.

Therefore, the present study aimed to document the ethnomedicinal of *M. chamomilla* L. in the Béja Governorate (northwestern Tunisia). Specifically, the objectives were to investigate local knowledge related to chamomile, identify the plant parts used, preparation methods, routes of administration, consumption habits, and perceived therapeutic benefits,

and to assess its cultural importance through ethnobotanical indices. The findings contribute to the preservation of traditional knowledge and provide a scientific basis for future phytochemical, pharmacological, and clinical studies on this culturally important medicinal species.

Materials and Methods

Study Area

The study was conducted in the Béja Governorate, located in northwestern Tunisia between March and July 2025 (Figure 1). Béja is characterized by a Mediterranean climate with mild, rainy winters and hot, dry summers. The region is recognized for its rich agricultural activity, diverse natural resources, and longstanding traditions associated with the use of medicinal plants. Owing to its important rural population and strong cultural heritage, Béja represents a suitable area for documenting traditional ethnomedicinal knowledge.



Figure 1. Map of Tunisia showing the location of Béja Governorate.

Study Design and Population

A cross-sectional survey was conducted to assess the knowledge, attitudes, and practices of residents of the Béja Governorate regarding the use of *M. chamomilla* L. and its therapeutic applications. Data were collected over a five-month period (March–July 2025) using a structured questionnaire, a methodology widely employed in ethnopharmacological and pharmacological research. The survey provided a comprehensive overview of consumption patterns, perceptions, and traditional uses of chamomile.

The study involved 120 adults (≥ 18 years old) residing in different areas of the Béja Governorate in northwestern Tunisia (Figure 1), a region known for its agricultural importance and diverse natural resources. Participants were recruited through non-probabilistic convenience sampling using two modes: 70 questionnaires completed online via social networks and university/professional contact lists and 50 collected through face-to-face interviews conducted by the first author in urban and rural localities of the Béja Governorate (e.g., Béja city, Amdoun). Inclusion criteria were age ≥ 18 years and residence in the governorate; prior knowledge or use of medicinal plants was not required. This approach, although non-probabilistic, is commonly applied in exploratory ethnopharmacological studies to capture diverse patterns of plant use, perceptions, and traditional knowledge. Although non-probabilistic, this sampling method is commonly used in exploratory and ethnopharmacological studies to capture heterogeneous patterns of plant use, perceptions, and traditional knowledge within the population. Because online recruitment favors younger, more educated and digitally connected respondents, the

resulting sample is not statistically representative of the population of the governorate. The findings are therefore interpreted as describing chamomile knowledge and use within the surveyed sample, rather than community-wide traditional knowledge, and this limitation is discussed in detail in the Limitations section.

Questionnaire Design

Data was collected using a structured questionnaire developed based on previous ethnobotanical and ethnopharmacological studies. Prior to administration, the questionnaire was reviewed for clarity and comprehensibility.

The questionnaire consisted of four sections:

1. **Sociodemographic characteristics**, including age, gender, educational level, occupation, and place of residence.
2. **Knowledge and awareness of medicinal plants and chamomile**, including familiarity with medicinal plants used for stress management and self-assessed knowledge of *M. chamomilla* L.
3. **Traditional uses and consumption practices**, including plant parts used, preparation methods, dosage, frequency of consumption, routes of administration, procurement sources, and reasons for use.
4. **Perceived therapeutic benefits, safety, and satisfaction**, including reported health effects, occurrence of adverse reactions, perceived efficacy, and overall satisfaction with chamomile use.

Both closed-ended and open-ended questions were included to obtain quantitative and qualitative information regarding the traditional use of chamomile.

Plant Identification and Nomenclature

Matricaria chamomilla L. (flowering heads) was collected in Amdoun, Béja Governorate, and purchased from local markets where informants reported obtaining the plant. The specimens were identified by Professor Hela Mahmoudi, Botanical Coordinator at the Higher Institute of Biotechnology of Béja. Identification was carried out using the Flore de la Tunisie (Pottier-Alapetite 1979, 1981)-, and voucher specimens were deposited in the herbarium of the Higher Institute of Biotechnology of Béja (ISBB), University of Jendouba (Deposition No. ISBB-MC2025-20, deposited in 2025). Other species spontaneously cited by informants (Table 3) were identified from their vernacular names. Scientific names, authorities, and families were verified against Plants of the World Online (POWO 2026). Throughout the text, tables, and figures, species are cited with their full binomial and authority at first mention, and in abbreviated form thereafter (*M. chamomilla* L.).

Ethical Considerations

Participation in the study was voluntary. Prior to data collection, all participants were informed about the objectives of the study informed consent was obtained (oral consent for face-to-face interviews; an explicit consent statement that had to be accepted before accessing the online questionnaire. Respondents were assured that their responses would remain anonymous and confidential and would be used exclusively for scientific research purposes. The study complied with the ethical principles governing ethnobotanical and ethnopharmacological research involving human participants. The survey was conducted in accordance with the International Society of Ethnobiology (ISE) Code of Ethics (2006). The study was anonymous and non-interventional and did not collect any identifying or clinical data. Under the applicable Tunisian regulations, surveys of this nature do not require full review by a biomedical research ethics committee. Nevertheless, the study protocol was submitted to the Ethics Committee of Biomedical Research (CEBM), which granted a formal exemption from full ethical review (Reference No. 25.L54, 2026).

Ethnobotanical Indices

Several quantitative indices are used to assess the cultural and therapeutic importance of medicinal plants within a community. They convert qualitative data from surveys into numerical values, making comparison and statistical analysis easier.

Relative Frequency of Citation (RFC) measures the local importance of a species based on the proportion of informants who cite its use (Vitalini *et al.* 2013).

$$RFC = FC / N$$

Where FC is the number of informants mentioning *M. chamomilla* L., and N is the total number of informants (N = 120). RFC values range from 0 to 1, with higher values indicating greater cultural significance.

Use Value (UV) was calculated to assess the level of medicinal plant knowledge among informants. It is defined as:

$$UV = \sum U_i / N$$

Where $\sum U_i$ represents the total number of use reports cited for the plant by all informants, and N is the total number of informants (N = 120) (Phillips & Gentry 1993). A higher UV indicates that the plant is cited for a greater diversity of uses, reflecting its broader ethnobotanical importance.

Fidelity Level (FL) was calculated to determine the relative importance of each therapeutic use reported by respondents, as conceptualized by Friedman *et al.* (1986):

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

Where N_p is the number of informants citing the plant for a particular ailment, and N is the total number of informants who cited the plant for any use. High FL values indicate high consensus for a specific therapeutic use.

In the present study, FL was calculated for *M. chamomilla* L. only, from the closed multiple-choice question on the benefits for which chamomile is used. All 120 respondents, including the 34 who reported never consuming chamomile, selected at least one benefit; the denominator is therefore N = 120, which here equals the number of informants citing chamomile for at least one use, and N_p is the number of respondents selecting a given benefit. FL values thus correspond to the percentages of respondents shown in Figure 7. The spontaneous free-listing question used to calculate RFC (FC = 40) and the closed benefit question used for FL measure different things and are not interchangeable.

Informant Consensus Factor (ICF) was used to quantify agreement among informants regarding plants used for the investigated ailment category and was calculated as:

$$ICF = (N_{ur} - N_t) / (N_{ur} - 1)$$

Where (N_{ur}) is the number of use reports within a therapeutic category and (N_t) is the number of plant taxa used for that category. Reported uses were grouped into eight therapeutic categories based on informants' statements (e.g., calming and sedative effects, digestive disorders, and hormonal balance) and aligned, whenever possible, with the corresponding chapters of the International Classification of Diseases (ICD-11). In the present survey, each respondent's citation of a therapeutic use was considered a single use report. Therefore, the number of use reports (N_{ur}) was identical to the number of citations (N_p) for each therapeutic category. The number of taxa (N_t) corresponded to the distinct plant species reported within each category.

In the present study, the pooled Informant Consensus Factor (ICF) was 0.900, derived from the aggregated figures across all eight therapeutic categories (total N_{ur} = 240; total N_t = 25). This global index reflects overall agreement among informants, whereas the category-specific ICF values in Table 7 (ranging from 0.857 for immune system strengthening to 0.974 for anti-inflammatory properties) provide a more precise measure of consensus within individual therapeutic domains. The pooled value is reported only as a summary indicator, to allow comparison with studies that report an overall or mean ICF (e.g., Ssenku *et al.* 2022, Shen *et al.* 2026). Because the same taxon can be counted in several categories, the pooled N_t (25) exceeds the number of distinct taxa cited (8), so the pooled index must be regarded as an approximation. Interpretation in this study is therefore based primarily on the category-specific values, whose unweighted mean (0.916) is very close to the pooled estimate.

Statistical Analysis

Data obtained from the questionnaires were coded and entered into Microsoft Excel. Descriptive analyses were performed with SPSS (version 20); association tests and logistic regression models were run in Python 3.12 (SciPy 1.17 and stats models 0.15). For each sociodemographic variable (sex, age group, socio-professional status and education level), a Chi-square goodness-of-fit test (χ^2) was applied to test whether respondents were evenly distributed among categories; these tests describe the composition of the sample and do not test associations. Statistical significance was considered at $p < 0.05$. To

examine associations between sociodemographic characteristics and chamomile-related outcomes, Chi-square tests of independence (or Fisher's exact test when more than 20% of expected cell counts were below 5) were performed between sex, age group, education level and socio-professional status, on the one hand, and chamomile consumption (consumer vs. non-consumer), self-assessed knowledge of chamomile (none/low vs. moderate to very good) and citation of calming/sedative effects, on the other. Because of sparse cells, categories were merged where necessary (age: 18-30 vs. ≥ 31 years; education: university vs. non-university; occupation: students vs. employed vs. others). For each of the three outcomes, a binary logistic regression model including sex, age group and education level simultaneously was then fitted. Socio-professional status was not entered because it was strongly collinear with age (80% of students were aged 18-30 years), and restricting the models to three predictors kept at least ten events per variable. Results are expressed as adjusted odds ratios (aOR) with 95% confidence intervals (CI), and model fit was assessed with the Hosmer-Lemeshow test and Nagelkerke R^2 . Statistical significance was set at $p < 0.05$.

Results and Discussion

Sociodemographic Characteristics of Participants

Table 1 summarizes the sociodemographic characteristics of the 120 participants drawn from different socio-professional backgrounds.

According to gender

The sample of 120 informants shows a predominance of women (61%; Chi-square goodness-of-fit test: $\chi^2 = 5.633$, $p = 0.018$), which may reflect their traditional role in family healthcare and in transmitting medicinal plant knowledge within Tunisian households. In line with Bennour *et al.* (2026), female participants were also more represented than males, accounting for 58.7% versus 41.3% of the sample. Comparable trends have been documented in other ethnobotanical studies across North African communities (Hedidi *et al.* 2024, Gherib *et al.* 2024, Nouri *et al.* 2025).

This predominance of women highlights the gendered dimension of ethnomedicinal knowledge transmission. Women often act as custodians of household health, responsible for preparing remedies and caring for family members, which explains their stronger representation in such surveys. The consistency of these findings across multiple studies suggests that women's role in preserving and disseminating medicinal plant knowledge is not only a cultural trait but also a structural feature of healthcare practices in the region.

According to age

Age distribution in our sample is skewed toward younger participants: 61% are between 18-30 years, while only 1% are over 65 (Chi-square goodness-of-fit test: $\chi^2 = 95.333$, $p < 0.0001$). This distribution mainly reflects the recruitment channels used, particularly the online questionnaire, and should not be interpreted as evidence that medicinal plant knowledge is concentrated among younger generations. Consistent with Bennour *et al.* (2026), respondents aged 20-40 years constituted the largest group (41.3%), followed by those aged 40-60 years (36.7%) and those over 60 (12.8%). However, our findings differ from those of Bouafia *et al.* (2021), Gherib *et al.* (2024), and Nouri *et al.* (2025), who reported that most respondents were between 40 and 60 years old.

This divergence may be explained by cultural and sampling differences. In the present survey, younger respondents, particularly students, were more readily reached through the online questionnaire and university networks, and their participation may also reflect a growing interest in natural health products among educated young adults. In contrast, studies such as Nouri *et al.* (2025) highlight the persistence of traditional knowledge among older age groups in other North African communities, reflecting different dynamics of knowledge transmission.

According to Socio-professional status

In our study, students (38%) and employees (32%) represent the largest groups, followed by healthcare professionals (16%), while farmers (2%) and housewives (4%) are underrepresented (Chi-square goodness-of-fit test: $\chi^2 = 82.300$; $p < 0.0001$). Although this composition is largely a consequence of the sampling strategy, it shows that familiarity with chamomile is not confined to traditional rural communities but is also present among educated and urban populations. By contrast, the survey conducted by Sraoui *et al.* (2026) highlights a different socio-professional distribution, with self-employed individuals forming the largest proportion (24%), followed by unemployed participants (19%). Teachers and students each account for 17%, and 14% of respondents work in the medical field. Taken together, these results reveal that while our study emphasizes the predominance of educated and salaried groups, Sraoui *et al.* (2026) underscore the importance of independent workers and

unemployed individuals, illustrating how socio-economic context and sampling methods can shape the profile of those engaged with ethnobotanical knowledge.

According to education level

The distribution of respondents across education levels was also highly uneven (Chi-square goodness-of-fit test: $\chi^2 = 89.667$, $p < 0.0001$): 59% had university education, while only 3% were illiterate. A predominance of educated respondents among medicinal plant users has also been reported by Hamdani and Houari (2020), Helali *et al.* (2020) and Sraoui *et al.* (2026). This contrasts with other studies: Benkhniue *et al.* (2011) and Jdaidi and Hasnaoui (2016) reported that approximately 60% of individuals without formal education relied on herbal remedies, compared to less than 6% among academics.

The predominance of highly educated participants in our study can be partly explained by the online distribution of the questionnaire, which favors urban and digitally connected populations (Bennour *et al.* 2026). However, the inclusion of face-to-face interviews helped to mitigate this bias by reaching rural informants, who are often the primary holders of traditional knowledge. This dual approach enabled the study to capture both modernized perspectives associated with higher education and ancestral knowledge transmitted orally within less educated communities.

The demographic profile of the sample reveals a pronounced bias: 61% of respondents were young adults aged 18-30 years and 59% held university degrees, while farmers (2%) and housewives (4%) were severely underrepresented. This composition reflects the practices of a young, educated, and digitally connected population, shaped by modern wellness trends and globalized health discourses, rather than those of traditional knowledge custodians, typically older, rural, and less formally educated individuals. Consequently, the reported uses may not fully capture the long-standing ethnomedicinal practices maintained by elderly rural healers; indeed, older respondents in our sample were more likely to consume chamomile and to cite its calming and hormonal uses (see below). The underrepresentation of these traditional custodians limits the generalizability of the findings and underscores the need for more systematic face-to-face interviews to achieve balanced representation across age groups and social backgrounds.

Table 1. Sociodemographic characteristics of participants.

Variable	Category	Number of informants (N=120)	Percentage (%)	χ^2	P-value
Sex	Female	73	61	$\chi^2 = 5.633$	$p = 0.018$
	Male	47	39		
Age (Years)	18-30	73	61	$\chi^2 = 95.333$	$p < 0.0001$
	31-49	29	24		
	50-65	17	14		
	>65	1	1		
Socio-professional status	Farmer	2	2	$\chi^2 = 82.300$	$p < 0.0001$
	Student	46	38		
	Employee	38	32		
	Teacher	10	8		
	Housewife	5	4		
	Healthcare professional	19	16		
Education level	Illiterate	3	3	$\chi^2 = 89.667$	$p < 0.0001$
	Primary	13	10		
	Secondary	33	28		
	University	71	59		

Associations between sociodemographic variables and chamomile use

Bivariate analyses showed that chamomile consumption was significantly associated with age group only: 87.2% of respondents aged ≥ 31 years consumed chamomile, compared with 61.6% of those aged 18-30 years ($\chi^2 = 9.221$, $p = 0.002$), whereas sex ($\chi^2 = 0.488$, $p = 0.485$), education level ($\chi^2 = 0.133$, $p = 0.716$) and socio-professional status ($\chi^2 = 1.792$, $p = 0.408$) were not. Moderate to very good self-assessed knowledge of chamomile was more frequent among women than among men (82.2% vs. 59.6%; $\chi^2 = 7.479$, $p = 0.006$) and was not associated with age, education or occupation (all $p > 0.69$). Citation of calming/sedative effects was more frequent among respondents aged ≥ 31 years (89.4% vs. 64.4%; $\chi^2 = 9.310$, $p = 0.002$), with a non-significant tendency among men (83.0% vs. 68.5%; $p = 0.077$). In the multivariable models (Table 2), age ≥ 31 years remained independently associated with chamomile consumption (aOR = 4.36; 95% CI 1.61-11.77; $p = 0.004$) and with citation of calming effects (aOR = 4.71; 95% CI 1.62-13.66; $p = 0.004$), and female sex with good knowledge of chamomile (aOR = 3.29;

95% CI 1.37-7.90; $p = 0.008$); education level had no independent effect in any model. The Hosmer-Lemeshow test indicated adequate calibration of the consumption and calming models ($p = 0.097$ and 0.766), but not of the knowledge model ($p = 0.025$), whose estimates should therefore be interpreted with caution. These results suggest that, within a sample dominated by young university students, chamomile use and its calming reputation are more firmly anchored among older respondents, consistent with intergenerational transmission of this knowledge, and that women report greater familiarity with the plant, in line with their role in household health care. Conversely, the absence of an education effect indicates that the high proportion of university-educated respondents did not by itself shape the patterns of use reported.

Table 2. Multivariable logistic regression of chamomile-related outcomes on sociodemographic variables (n = 120).

Variable (reference)	Chamomile consumption	Good knowledge of chamomile	Citation of calming effects
	aOR (95% CI); p	aOR (95% CI); p	aOR (95% CI); p
Female (vs. male)	1.50 (0.62-3.61); 0.369	3.29 (1.37-7.90); 0.008	0.44 (0.16-1.16); 0.096
Age ≥ 31 years (vs. 18-30)	4.36 (1.61-11.77); 0.004	1.16 (0.49-2.78); 0.736	4.71 (1.62-13.66); 0.004
University (vs. non-university)	0.96 (0.39-2.34); 0.921	0.87 (0.35-2.12); 0.752	1.14 (0.44-2.91); 0.788
Events / n	86 / 120	88 / 120	89 / 120
Nagelkerke R ²	0.123	0.090	0.153
Hosmer-Lemeshow p	0.097	0.025	0.766

aOR, adjusted odds ratio; CI, confidence interval. Each model includes sex, age group and education level simultaneously. Good knowledge = self-assessed level 3-5 (moderate to very good) on the five-point scale. Values in bold are significant ($p < 0.05$).

Stress Management Strategies

Figure 2 illustrates the strategies participants adopted to manage stress. Nearly half (49%) relied on relaxation and rest, while 16% relied exclusively on traditional plant-based remedies and a further 22% combined them with relaxation and/or medication, so that 38% of respondents used plant-based remedies in some form. Conventional medication alone was reported by only 8%, reflecting a cultural inclination toward natural approaches.

These findings emphasize the importance of stress management in the current context. Techniques such as muscle relaxation, breathing exercises, mindfulness, and meditation are widely recognized for their effectiveness, consistent with the fact that almost half of participants practiced relaxation methods. At the same time, interest in medicinal plants as complementary therapies is growing. Kenda *et al.* (2022) found that such remedies alleviated symptoms in nearly 45% of studies on stress-related conditions, underscoring their potential role in enhancing well-being and resilience. These two sets of figures address different questions and should not be read as contradictory: Figure 2 captures the general stress-management strategies of the whole sample (n = 120), among whom plant-based remedies were used exclusively by 16% and in combination with other strategies by a further 22%, whereas the predominance of calming/sedative effects among the perceived benefits of chamomile (Figure 7) applies specifically to respondents who use chamomile and were asked to characterize its perceived effect. In other words, relatively few respondents turn to herbal remedies as a first-line stress-management strategy, but among those who do consume chamomile, its calming effect is overwhelmingly the reason cited.

This pattern is consistent with the pharmacological profile of chamomile: apigenin, one of its principal flavonoids, has documented affinity for the benzodiazepine binding site of the GABA_A receptor, providing a plausible neuropharmacological basis for the anxiolytic and sedative effects reported by users, while chamazulene and α -bisabolol contribute anti-inflammatory and mild antispasmodic activity that may reinforce a general sense of relaxation (Setzer 2009). Locally, chamomile's low cost, wide availability in Béja's markets, and long-standing presence in household repertoires likely explain why it is favored over other plant-based options once a resident does turn to herbal self-care, even though relaxation and rest remain the population's default coping strategy overall. In relation to COVID-19, several plants have demonstrated promise in reducing stress and supporting patient health, including valerian, lemon balm, lavender, chamomile, borage, fennel, ginger, cinnamon, black seed, grapefruit peel, poppy, ginseng, aloe vera, thyme, and sorghum (Shahrajabian, 2022; Pirhadi, 2023).

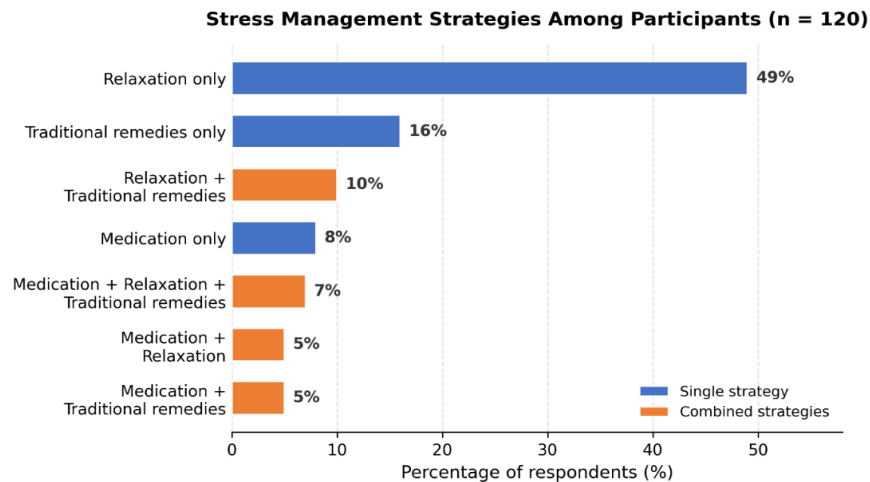


Figure 2. Stress management strategies of participants (n = 120).

Medicinal Plant Knowledge

The data in Table 3 shows that chamomile is the most important plant, widely cited and used, which confirms its central role in traditional medicine and culture. Chamomile is often described as “the star of medicinal plants” for its therapeutic properties and pleasant fragrance, and its name comes from the Greek *chamaimēlon* meaning “earth-apple” (El Joumaa & Borjac 2022). *Verbena officinalis* L. and *Mentha spicata* L. hold secondary positions. Verbena is relatively well recognized, while mint is valued mainly for culinary and medicinal purposes. Both enrich traditional knowledge but remain less central than chamomile.

Other plants such as lavender (*Lavandula angustifolia* Mill.), saffron (*Crocus sativus* L.), roselle (*Hibiscus sabdariffa* L.), sage (*Salvia officinalis* L.) and myrtle (*Myrtus communis* L.) appear only marginally, with very low citation and use values. They may have specialized uses or declining cultural relevance, but they still contribute to the diversity of ethnobotanical knowledge.

Overall, the results highlight a clear hierarchy: one dominant species (chamomile), a few secondary plants, and several marginal ones. According to the study by Klech *et al.* (2022), among the medicinal plants recorded in different localities, chamomile holds a predominant position with a usage rate of 85%, making it the most frequently employed species compared to the others. This structure is consistent with other studies, such as Karima’s (2025) research on respiratory diseases, which found the Lamiaceae family to be the most frequently cited, with *M. chamomilla* L. identified as the main species used for influenza treatment.

Table 3. Medicinal plant knowledge and the prominence of chamomile.

Species	FC	FC (%)	RFC	ΣU	U (%)	UV	Interpretation
<i>Matricaria chamomilla</i> L. (Asteraceae)	40	33.33	0.333	59	59.6	0.49	Most culturally important species: highly cited, with the largest number of uses and a strong use value.
<i>Mentha spicata</i> L. (Lamiaceae)	8	6.67	0.067	10	10.1	0.08	Moderately recognized: some citations and uses, but much less central than chamomile.
<i>Lavandula angustifolia</i> Mill. (Lamiaceae)	3	2.50	0.025	5	5.1	0.04	Minor role: few citations and uses, limited cultural importance.
<i>Crocus sativus</i> L. (Iridaceae)	1	0.83	0.008	2	2.0	0.02	Rarely mentioned: very low citation and use values.
<i>Hibiscus sabdariffa</i> L. (Malvaceae)	1	0.83	0.008	2	2.0	0.02	Marginal importance: cited only once, with minimal uses.
<i>Salvia officinalis</i> L. (Lamiaceae)	1	0.83	0.008	2	2.0	0.02	Very limited recognition: one citation, few uses.
<i>Verbena officinalis</i> L. (Verbenaceae)	13	10.83	0.108	17	17.2	0.14	Secondary but notable species: relatively well cited and used compared to others.
<i>Myrtus communis</i> L. (Myrtaceae)	2	1.67	0.017	2	2.0	0.02	Minor contribution: very few citations and uses.

FC (Frequency of Citation), RFC (Relative Frequency of Citation), ΣU (Sum of Uses), UV (Use Value); U (%), share of all use reports (ΣU) attributed to each species. Nomenclature and families follow POWO (2026).

It is worth clarifying the distinct meaning of the two indices reported in Table 3: RFC reflects how frequently a species was cited by informants relative to the total sample and is therefore a measure of a plant's popularity or salience, whereas UV reflects the average number of distinct uses attributed to a species per informant, and thus captures versatility rather than popularity. A species can score high on one index without scoring equally high on the other. The inclusion of marginally cited species such as *C. sativus* and *H. sabdariffa* in Table 3, despite the study's focus on chamomile, was intentional: it provides the full comparative context of the local medicinal flora spontaneously mentioned by respondents, allowing chamomile's dominance (RFC = 0.333, UV = 0.49) to be interpreted against the complete citation landscape rather than in isolation.

Table 4 presents respondents' awareness and knowledge of medicinal plants. Overall, 77% of participants reported familiarity with medicinal plants used to relieve stress, while 23% indicated no such knowledge. Regarding chamomile specifically, the predominant self-assessed knowledge level was moderate (47%), followed by low (22%) and good (18%). Only 8% of respondents considered their knowledge to be very good, whereas 5% reported no knowledge of chamomile.

These findings suggest that although chamomile is widely recognized, detailed knowledge of its pharmacological properties and evidence-based applications remains limited. This highlights the need for improved scientific communication and public health education.

The widespread recognition of chamomile observed in this study is consistent with global trends in traditional medicine and phytotherapy. Pinakin *et al.* (2018) reported that nearly 80% of the African population relies on medicinal plants for the prevention and treatment of various health conditions, underscoring their importance in primary healthcare systems. Chamomile is among the most valued medicinal species due to its broad range of therapeutic properties and extensive use in the pharmaceutical, cosmetic, and herbal medicine sectors. Similarly, Ahmed *et al.* (2022) highlighted the economic and medicinal importance of chamomile cultivation in Egypt. Therefore, the high RFC value and substantial level of awareness observed in the present study likely reflect both the long-standing traditional use of chamomile and its continued relevance in contemporary healthcare practices.

Table 4. Respondents' knowledge levels of medicinal plants and chamomile.

Category	Medicinal plants (%)	Chamomile (%)
None / Non-knowers	23	5
Low	-	22
Medium	-	47
Good	-	18
Very good	-	8
Knowers	77	-

The dash (-) denotes missing values or categories for which no data were recorded

Usage Patterns of Chamomile: Plant Parts, Forms, Frequency, and Dosage

The flowers represented the most frequently used part of chamomile (82%), followed by the whole plant (6%) and roots (6%), whereas stems (4%) and seeds (2%) were only marginally employed (Figure 3). The predominance of flowers as the preferred plant part is consistent with the findings of Et-tahir *et al.* (2020) and Klech *et al.* (2022) and aligns with the phytochemical profile of *M. chamomilla* L., as the floral heads are particularly enriched in bioactive compounds such as apigenin (Piri *et al.* 2019), chamazulene (Ayran *et al.* 2018), bisabolol (El-Hefny *et al.* 2019), and flavonoids (Elsamelawy 2017).

Table 5 summarizes chamomile consumption patterns among participants. Occasional use was dominant (56%), followed by non-consumption (28%) and weekly intake (12%), while daily and monthly use remained marginal. In terms of dosage, most participants consumed low amounts, primarily 1-2 g/day (53%), with intermediate doses (3-5 g/day) reported by 12% and higher doses being rare. Daily intake volume was mainly concentrated at 125 mL (58%), with 250 mL less frequent and consumption above this level uncommon. Collectively, these findings reflect a predominantly low-dose, occasional consumption pattern. Furthermore, 82% of respondents reported using chamomile flowers, confirming literature that identifies dried flowers as the most used part of the plant due to their richness in bioactive compounds and wide applications in the pharmaceutical and food industries (Chauhan *et al.* 2021).

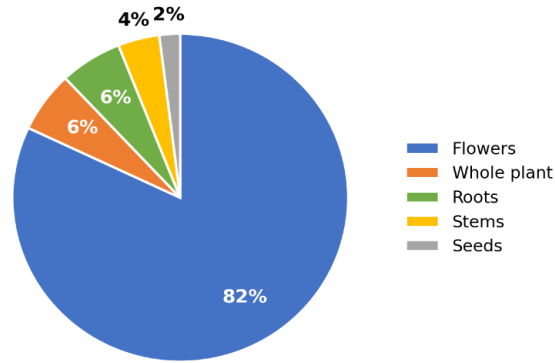


Figure 3. Plant parts of chamomile used by respondents.

Chamomile demonstrates remarkable versatility, both in human health and in animal production. In women's health, a randomized double-blind clinical trial conducted among 118 female students at Guilan University of Medical Sciences showed that the occasional use of chamomile capsules (250 mg, three times daily, from seven days before menstruation until the next cycle) significantly reduced the amount of menstrual bleeding, although no changes were observed in cycle duration or interval (Mollabashi *et al.* 2020). Meanwhile, El-Shhat *et al.* (2021) reported that adding 1 g of chamomile flower powder per kilogram of feed improved livestock performance and profitability, underscoring its agronomic and zootechnical value. Together, these findings highlight chamomile as both a therapeutic and economic resource, with applications ranging from women's health to animal husbandry.

Table 5. Chamomile consumption.

Variable	Category	Percentage (%)
Chamomile consumption frequency	Never	28
	Occasionally	56
	Once or twice a month	4
	Once or twice a week	12
Quantity consumed (g/day)	0 g	30
	1 to 2 g	53
	3 to 5 g	12
	6 to 8 g	5
Quantity consumed (mL/day)	0 mL	32
	125 mL (1 cup)	58
	250 mL (2 cups)	7
	> 250 mL	3

Figure 4 illustrates the different forms of chamomile use reported by participants. Aqueous preparations were predominant, with decoction (39%) and infusion (33%) together accounting for 72% of responses. These were followed by cosmetic products (13%) and essential oils (8%), while dietary supplements (4%) and maceration (3%) were less frequently mentioned. Chamomile has long been valued as a natural remedy, and both decoction and infusion remain among the oldest and most widespread preparation methods, particularly in North Africa. Today, these techniques continue to be employed in the preparation of herbal beverages and plant-based remedies such as teas. Our findings confirm the persistence of these traditional practices, aligning with observations reported by Alia (2020), Mrabti *et al.* (2021) and Sraoui *et al.* (2026). Jdai and Hasnaoui (2016) documented in northwestern Tunisia that chamomile preparation methods were dominated by decoction, accounting for about 40% of reported practices. Infusion followed with 20%, while powdered forms represented 15%. The remaining 25% included maceration, poultices, raw application, and fumigation. Their analysis suggests that decoction not only extracts a broad spectrum of active compounds but may also reduce or neutralize certain toxic effects present in the raw plant material.

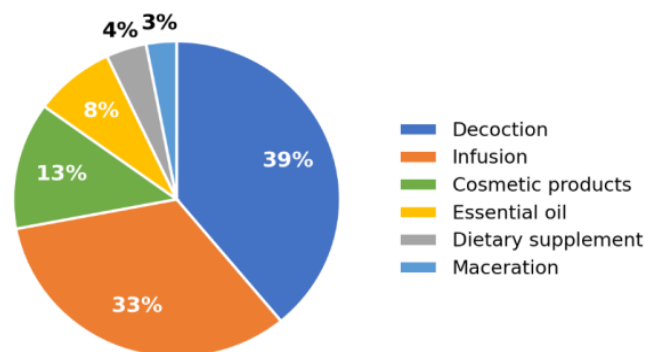


Figure 4. Common forms of use of chamomile.

Modes of Administration and Consumption Forms of Chamomile

Figure 5 illustrates the predominant forms and modes of chamomile use. Oral administration was most common (68%), followed by topical application (26%), while inhalation remained rare (6%). In terms of consumption forms, dried chamomile primarily powdered flowers were most frequently used (73%), with fresh chamomile accounting for 19%. Other forms, including creams, cosmetic products, moisturizers, and shampoos, collectively represented only 8%. Ethnobotanical surveys carried out in Tunisia and neighboring North African regions have likewise highlighted the widespread reliance on orally administered aqueous preparations for digestive complaints (Bennour *et al.* 2026, Hamrouni *et al.* 2026).

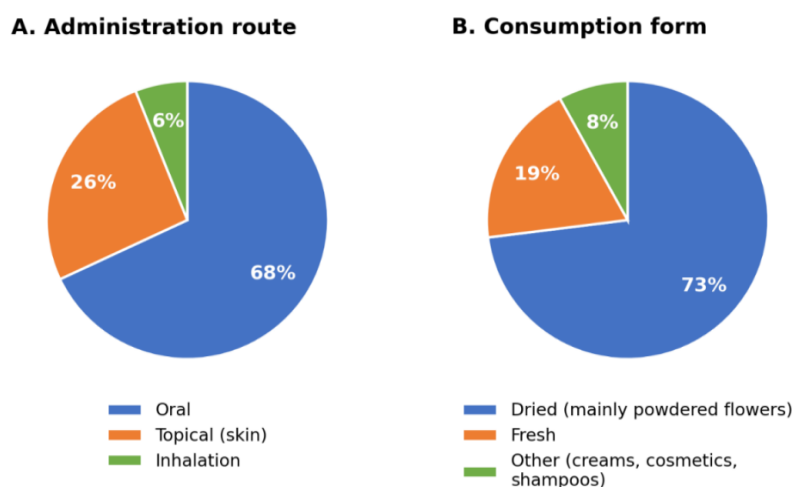


Figure 5. Administration routes (A) and consumption forms (B) of chamomile.

Procurement Sources and Awareness Channels of Chamomile

Figure 6 summarizes the procurement sources and awareness channels of chamomile among participants. Supermarkets and grocery stores were the predominant supply source (41%), reflecting their integration into everyday purchasing habits. Personal collection or cultivation ranked second (25%), indicating the persistence of traditional practices, while pharmacy/parapharmacy (19%), herbal shops (10%), and online purchasing (5%) played secondary roles. Our results are consistent with the study by Sousa *et al.* (2024), where most participants purchased tea and herbal infusions in supermarkets, registered trademark stores, and specialty shops.

Awareness of chamomile was primarily transmitted through social surroundings (30%) and family or close relations (23%), underscoring the importance of intergenerational and social transmission. Social media accounted for 18%, highlighting the growing role of digital platforms, whereas scientific and medical sources including books and articles (9%), nutritionists or physicians (7%) and scientific research (6%) remained limited, suggesting relatively low academic mediation in chamomile

use. These findings are consistent with Klech *et al.* (2022), who reported that more than half of the respondents (55%) acquire their knowledge of medicinal plants from family members, neighbors, or colleagues, through traditional and experience-based understandings of their therapeutic properties. Furthermore, Sousa *et al.* (2024) highlighted that the consumption of tea and herbal infusions is influenced by cultural and socio-economic factors, as well as by perceived health benefits. The predominance of family and social networks in knowledge transmission further confirms that chamomile use remains strongly rooted in cultural traditions, even as digital and media sources gain influence. Overall, the results highlight the coexistence of traditional and modern channels in shaping chamomile consumption and awareness.

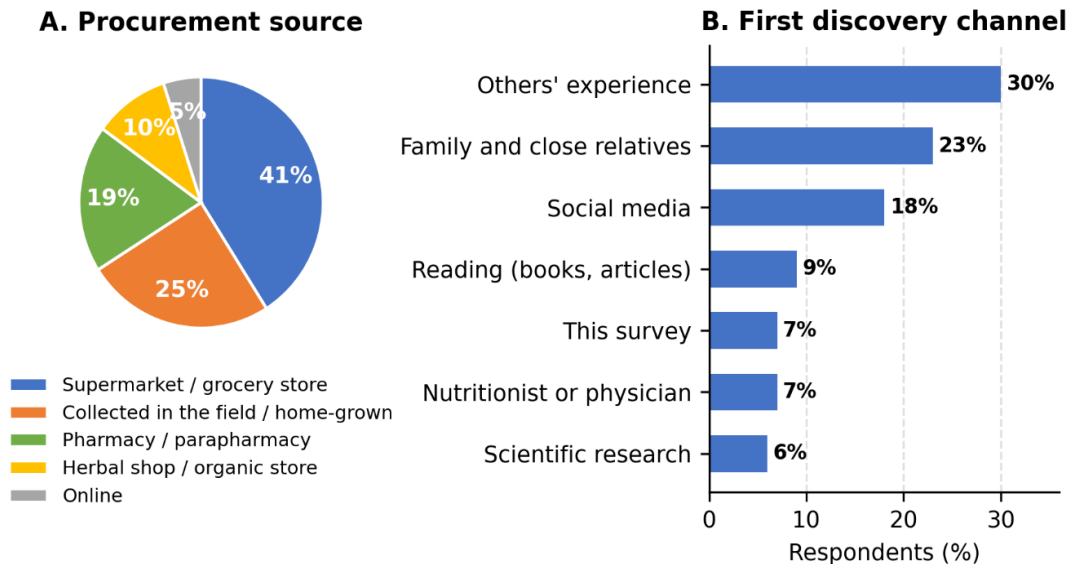


Figure 6. Procurement sources of chamomile (A) and first discovery channels among the surveyed population (B).

Therapeutic Profile of Chamomile: Consumption Determinants, Perceived Benefits, Efficacy, and Safety

Table 6 summarizes the reasons for chamomile consumption among participants. Health benefits were the main driver (79%), followed by medical recommendations (16%), while taste accounted for only a minor share (5%). These results indicate that consumption is primarily motivated by perceived therapeutic value rather than sensory preference.

Chamomile is recognized as a medicinal drug in the pharmacopoeias of 26 countries (Singh *et al.* 2011), and this official status may partly explain why 16% of respondents reported using it on medical recommendation. Consumer choices are shaped by sociodemographic factors, cultural traditions, and perceived health benefits, as highlighted by Ogundijo *et al.* (2022). In the present sample, the influence of sociodemographic variables on chamomile consumption was examined in the association analysis reported above.

Table 6. Reasons for chamomile consumption.

Reason	Percentage (%)
Its health benefits	79
Recommended by doctors	16
Its taste	5

Figure 7 presents the percentage of respondents citing each perceived therapeutic benefit of chamomile. Because all 120 respondents cited at least one benefit, these percentages correspond to the Fidelity Level (FL = $N_p/N \times 100$; $N = 120$). Calming and sedative effects exhibited the highest FL (61.7%; $N_p = 74$), indicating that this was the most widely recognized therapeutic application of chamomile. Anti-inflammatory properties (32.5%; $N_p = 39$) and hormonal balance (30.0%; $N_p = 36$) ranked next, followed by skin and hair health (21.7%; $N_p = 26$), anti-obesity effects (18.3%; $N_p = 22$), antidiabetic effects (15.8%; $N_p = 19$), digestive disorders (13.3%; $N_p = 16$), and immune system strengthening (6.7%; $N_p = 8$), which showed progressively lower levels of agreement. Notably, the 34 respondents who never consume chamomile also attributed benefits to it, which reflects the plant's perceived reputation rather than personal experience. The high FL associated with stress relief and relaxation reflects a strong consensus among participants and further supports the traditional reputation of chamomile as a natural remedy for anxiety, nervousness, and sleep-related disorders.

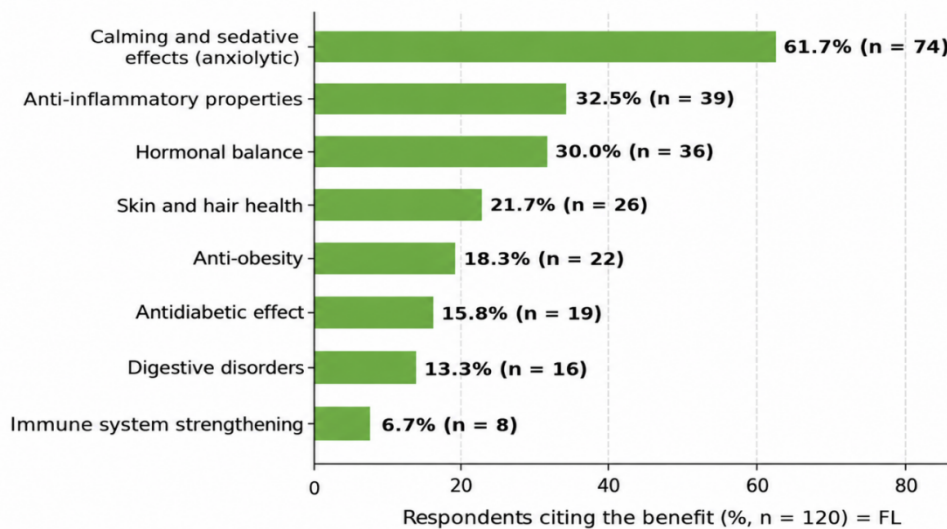


Figure 7. Perceived therapeutic benefits of chamomile: percentage of respondents citing each benefit (n = 120), equivalent to the Fidelity Level (FL).

Scientific evidence highlights the beneficial role of medicinal plants in preventing chronic diseases, lowering cardiovascular risk, and supporting mental well-being through their relaxing properties (Talib *et al.* 2020, He *et al.* 2024).

The strong consensus on calming effects in our sample is consistent with clinical evidence of an anxiolytic effect of chamomile extract (Keefe *et al.* 2016; Mao *et al.* 2016; Amsterdam *et al.* 2020). However, these trials used standardized extracts at defined doses, whereas most of our respondents consumed low, occasional doses of decoctions or infusions (Table 4). The calming benefit perceived by users may therefore also involve expectancy effects and the relaxing ritual of drinking a warm herbal beverage (Keefe *et al.* 2017) and cannot be equated with pharmacological efficacy. Similarly, the use of chamomile for skin and hair care (FL = 26.7%), consistent with the 26% of respondents applying it topically (Figure 5), is consistent with its documented use for inflammatory skin conditions (El Mihaoui *et al.* 2022; Melnyk *et al.* 2024).

The relatively high FL values for “Hormonal balance” (30%) and “Anti-obesity” (18.3%) are noteworthy, because these uses are not part of the classical ethnomedicinal profile of chamomile. Contrary to the expectation that they would mainly reflect the wellness discourse of younger respondents, hormonal balance was cited more often by respondents aged ≥ 31 years than by those aged 18-30 years (51.1% vs. 27.4%; $\chi^2 = 6.896$, $p = 0.009$), and the anti-obesity use did not differ by age (21.3% vs. 20.5%; $p = 0.924$). Traditionally, *M. chamomilla* L. has been used mainly for its digestive, anti-inflammatory, and sedative properties. However, pharmacological studies suggest that its flavonoids and phytoestrogens may interact with hormonal pathways, which could partly explain the reported use for hormonal balance. Chamomile extract has also been shown to improve reproductive function by regulating sex hormones, leptin, and blood lipids, and by reducing inflammation in PCOS rats (Lai *et al.* 2016; Farideh *et al.* 2010). Its interaction with the GABA system may further regulate LH secretion and promote follicular development, supporting a role in hormonal equilibrium (Farideh *et al.* 2010). Similarly, preliminary studies indicate that chamomile extracts can influence lipid and glucose metabolism, providing partial justification for the anti-obesity use. In line with this, chamomile extracts have demonstrated protective effects against oxidative damage associated with obesity (Jabri *et al.* 2016; Zemestani *et al.* 2016). The therapeutic effects of chamomile are largely attributed to its bioactive constituents, particularly flavonoids such as apigenin and terpenoids such as α -bisabolol (Gentile *et al.* 2018). Nevertheless, experimental data do not demonstrate efficacy at the doses consumed by respondents, and whether these uses derive from local tradition or from contemporary health information, including social media (18% of first discovery channels; Figure 6), cannot be established from the present data. Collectively, these findings underscore the alignment between traditional knowledge and modern scientific research regarding chamomile’s therapeutic potential.

When chamomile is considered alone across all uses, ICF equals 1.000 by definition ($N_t = 1$) and is therefore not informative; ICF values are discussed only for the multi-species categories in Table 7. These results show that knowledge of the medicinal plants cited is highly consistent, with six of the eight categories exceeding 0.90. The highest agreement was observed for anti-inflammatory properties (0.974), followed by antidiabetic effects (0.944) and hormonal balance (0.943). In these cases, only a few species were repeatedly cited, underscoring their cultural importance and reliability. Categories such as skin and hair

health (0.920) and calming/sedative effects (0.918) involved more species and reports, yet consensus remained strong, highlighting their broad recognition within the community. Immune system strengthening (0.857) and anti-obesity effects (0.905) also showed good agreement, while digestive disorders (0.867) presented slightly lower consensus, likely due to the diversity of symptoms treated.

Shen *et al.* (2026) reported that the average ICF value across disease categories was 0.84. In comparison, Ssenku *et al.* (2022) found consistently high values, with an overall mean approximately 0.93, whereas the meaning of the category-specific values obtained here is 0.92. Such values indicate strong agreement among informants regarding the plant species used to treat diverse ailments, supporting the view that these species are culturally important and perceived as effective (Cakilcioglu *et al.* 2011). It should be noted, however, that the small number of taxa per category in the present survey (two to seven), which focused on chamomile and on plants used for stress, mechanically favors high ICF values; these results should therefore not be compared directly with those of multi-species ethnofloristic inventories.

High-consensus categories correspond to domains where cultural models are strongly stabilized, likely due to a combination of high disease prevalence, frequent experiential feedback, and repeated intergenerational validation (Ghabbour *et al.* 2023). These conditions foster strong cognitive alignment among informants, consistent with the predictions of Cultural Consensus Theory (CCT), which posits that domains with high agreement reflect elevated cultural competence and well-defined shared knowledge structures (Ghabbour *et al.* 2023).

Table 7. Consensus and use reports by therapeutic category.

Category	Nur	Nt	ICF	Interpretation
Immune system strengthening	8	2	0.857	Moderate number of reports, two species used, strong consensus among informants.
Digestive disorders	16	3	0.867	Several species used, consensus is good but slightly lower compared to other categories.
Anti-obesity	22	3	0.905	Good consensus, three species identified, relatively frequent use reports.
Antidiabetic effect	19	2	0.944	Very strong consensus, few species but widely recognized for this use.
Skin and hair health	26	3	0.920	Strong agreement, three species commonly cited for dermatological benefits.
Hormonal balance	36	3	0.943	High consensus, three species consistently reported for hormonal regulation.
Anti-inflammatory properties	39	2	0.974	Extremely strong consensus, nearly unanimous agreement on two species.
Calming and sedative effects (anxiolytic)	74	7	0.918	Largest number of reports, wider diversity of species, but still strong consensus.

Nur (Use Reports), *Nt* (Taxa Used), *ICF* (Informant Consensus Factor). Each citation was considered one use report; therefore, Nur = Np for all therapeutic categories.

In terms of perceived effectiveness, moderate efficacy (level 3) was most frequently reported (46%), followed by high efficacy (level 4) at 27%. When combining levels 3, 4, and 5, most evaluations were positive, reflecting an overall favorable perception of chamomile's therapeutic potential among the surveyed population (Figure 8). The predominance of moderate (level 3) rather than high ratings suggests that respondents regard chamomile as a mild, supportive remedy rather than a potent treatment, which is consistent with the low and occasional doses reported (Table 4). These perceptions are self-reported and were not clinically verified, but they are reinforced by experiential feedback and social transmission of knowledge, which keeps chamomile relevant both as a household remedy and as a candidate for pharmacological research. The recognition of chamomile by the World Health Organization (WHO), which includes it in its definition of traditional, complementary, and integrative medicine (TCIM), further reinforces this legitimacy (WHO 2019, 2024). Comparable traditional uses of chamomile have been documented elsewhere in the Mediterranean region (Benítez *et al.* 2010; Menale *et al.* 2022).

Regarding safety, most respondents (87%) reported no side effects, while 13% experienced adverse events, a minority but relevant proportion from a pharmacovigilance perspective consistent with the overall good tolerability and cultural acceptability of chamomile (Figure 9). Ostovar *et al.* (2025) found that 34 trials reported no complications, while 10 documented minor adverse events, most commonly gastrointestinal disturbances and drowsiness, both self-limiting. Keefe

et al. (2017) further showed that patient expectations can influence side effect reporting, with those anticipating more adverse events experiencing them more frequently.

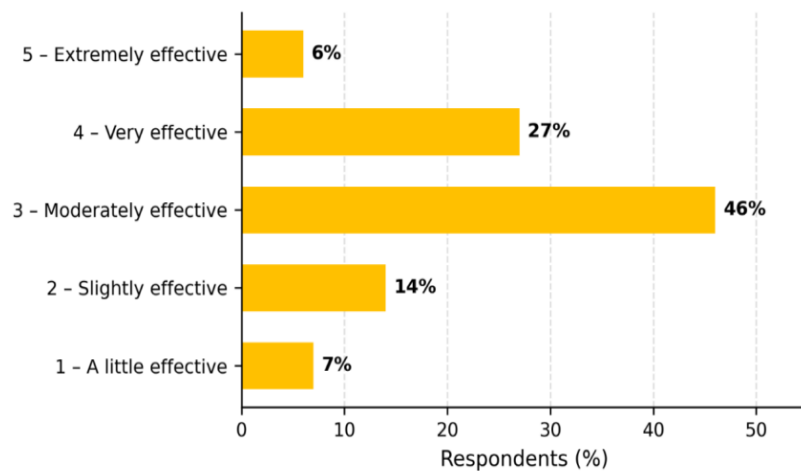


Figure 8. Perceived effectiveness of chamomile on a five-point rating scale (% of respondents).

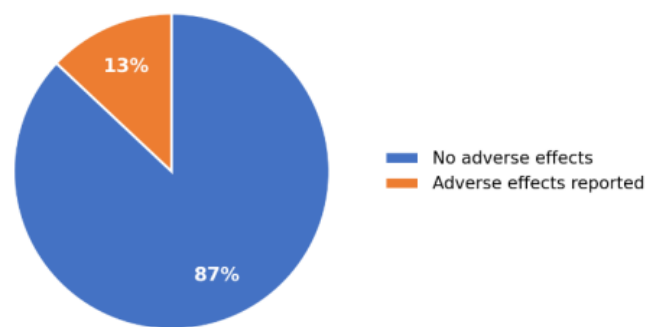


Figure 9. Adverse effects reported by chamomile users.

Despite chamomile's reputation for safety, adverse effects may still occur due to inappropriate use, drug interactions, or variability in plant extract composition (Gouws *et al.* 2020). These findings highlight the need for rational use of medicinal plants, supported by reliable scientific evidence and clear public information, to maximize therapeutic benefits while minimizing risks.

From a pharmacological standpoint, the minor adverse events reported here are consistent with the known safety profile of chamomile: mild gastrointestinal discomfort can result from its essential-oil and sesquiterpene lactone content, while, as an Asteraceae species, chamomile carries a recognized risk of contact or IgE-mediated allergic reactions in individuals sensitized to other plants of the same family (e.g., ragweed, chrysanthemum). This cross-reactivity is a plausible explanation for a subset of the adverse events reported by participants, although the present survey did not specifically screen for Asteraceae sensitization. Locally, the absence of standardized dosing or quality control for chamomile sold in informal markets in the Béja region may further contribute to variability in tolerability between preparations, underscoring the pharmacovigilance relevance of these findings for community-level herbal use in Tunisia.

Satisfaction Degree and Motivation to Deepen Knowledge of Chamomile

Table 8 indicates that most respondents were satisfied with the therapeutic effects of chamomile. The most frequent response was "Satisfied" (69.2%), followed by "Very satisfied" (18.3%), yielding an overall positive satisfaction rate of 87.5%. Only 12.5% reported being "Less satisfied." Furthermore, 81.7% stated that the survey encouraged them to seek additional information about chamomile, reflecting strong interest and engagement. This high satisfaction should, however, be

interpreted with caution, as satisfied users are more likely to take part in a survey devoted to chamomile. Chamomile, a member of the Asteraceae family, is cultivated for dietary, cosmetic, and medicinal purposes (Dai *et al.* 2022). Its long history of traditional use includes managing digestive disorders, promoting wound healing, encouraging sedation, and alleviating pain associated with arthritis and back injuries (Srivastava *et al.* 2010). In a clinical context, Saidi *et al.* (2020) likewise reported greater satisfaction with pain management in patients receiving *Melissa officinalis* L. and *M. chamomilla* L. than in controls, although the difference was transient.

Table 8. Satisfaction and motivation regarding chamomile survey.

Variable	Category	Percentage (%)
Satisfaction level	Little satisfied	12.50
	Satisfied	69.20
	Very satisfied	18.30
Survey motivation	Not motivated	18.33
	Motivated	81.67

Conclusion

This study provides valuable insights into the ethnopharmacological use of *M. chamomilla* L. in the Béja Governorate, northwestern Tunisia. Within the surveyed sample, chamomile was widely known and used, particularly for stress relief and relaxation. Participants frequently associated its use with calming, sedative, anti-inflammatory, digestive, and hormonal balance effects. The flowers were the most used plant part, typically prepared as infusions or decoctions. The high level of user satisfaction, combined with the low incidence of reported adverse effects, further supports its cultural acceptance and perceived safety.

The relatively high Relative Frequency of Citation (RFC = 0.33) underscores the widespread recognition and cultural significance of *M. chamomilla* L. among the surveyed population. Nevertheless, these results should be interpreted with caution due to the cross-sectional design, the convenience sampling strategy, reliance on self-reported data, and the predominance of young, university-educated respondents. Moreover, perceived therapeutic benefits do not necessarily equate to clinically validated efficacy. Overall, this study highlights the importance of preserving traditional knowledge related to chamomile use and provides a scientific foundation for future phytochemical, pharmacological, and clinical investigations. Integrating chamomile into evidence-based complementary healthcare approaches may help strengthen the link between traditional ethnomedicine and modern healthcare systems.

Concretely, such integration could include: (i) developing standardized preparation and dosing guidance for community pharmacists and primary care providers in the Béja region, so that patient-reported chamomile use can be documented and monitored alongside conventional treatment; (ii) conducting phytochemical quality control of locally sold chamomile to characterize the apigenin, chamazulene, and α -bisabolol content of Tunisian ecotypes, given that potency may vary by growing conditions; and (iii) designing targeted clinical trials evaluating chamomile's anxiolytic effect in Tunisian populations, particularly given the strong local perception of calming benefit identified in this survey. Remaining evidence gaps include dose-response data for oral chamomile preparations as consumed locally (decoctions and infusions rather than standardized extracts), and information on potential interactions with the hormonal and anti-obesity treatments that a subset of participants reported combining with chamomile use.

Limitations of the Study

Several limitations must be acknowledged. First, the convenience sampling strategy and the partly online administration of the questionnaire produced a sample dominated by young (61% aged 18-30 years) and university-educated (59%) respondents, whereas farmers (2%), housewives (4%) and people over 65 years (1%), who are typically the main custodians of traditional knowledge, were underrepresented. The results therefore describe chamomile knowledge and use within this sample and cannot be extrapolated to the whole population of the Béja Governorate, let alone to northern Tunisia. Second, all data were self-reported and may be affected by recall and social-desirability bias; perceived efficacy and adverse effects were not clinically verified. Third, the survey focused on chamomile and on plants used for stress, so the small number of taxa per therapeutic category limits the interpretation of ICF values. Future studies should use stratified or snowball sampling targeting elderly and rural informants, herbalists and traditional healers through face-to-face interviews, in order to document ancestral uses more completely.

Declarations

Ethics approval and consent to participate: The survey was conducted in accordance with the International Society of Ethnobiology (ISE) Code of Ethics (2006). The study was anonymous and non-interventional and did not collect any identifying or clinical data. Under the applicable Tunisian regulations, surveys of this nature do not require full review by a biomedical research ethics committee. Nevertheless, the study protocol was submitted to the Ethics Committee of Biomedical Research (CEBM), which granted a formal exemption from full ethical review (Reference No. 25.L54, 2026).

Consent for publication: Not applicable.

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