# Ethnobotanical survey of medicinal plants of Bouira localities (Northern Algeria) to manage Diabetes mellitus

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## Research

## Abstract

*Background*: Diabetes mellitus has drawn the interest of scientists due to its widespread occurrence in the population, and there is a growing need to find novel therapeutic medications derived from natural sources to treat diabetes mellitus. The goal of this study was to document the folk medicinal plant knowledge for the management of diabetes by conducting an ethnobotanical survey in the Bouira district (Algeria).

*Methods*: The research was conducted between January and May 2024. To gather ethnobotanical data, 301 informants (herbalists and members of the general public) who are knowledgeable about and utilize medicinal plants were interviewed. The Plant Part Value, Relative Frequency of Citation and Family Importance Value Index were used to objectively examine the recorded data.

*Results*: A total of 43 plant species from 24 families were traditionally used by the population of Bouira localities to treat diabetes. With nine species, the Lamiaceae family was identified as the primary family, followed by the Astraiceae and Fabaceae, with four and three species, respectively. The most frequently cited species were Olea europaea (RFC = 0.333), Artemisia herba-alba (RFC = 0.214), Moringa oleifera (RFC = 0.158), Centaurium erythraea (RFC = 0.118), Cinnamomum verum (RFC = 0.116), Marrubium vulgare, Trigonella foenum-graecum (RFC = 0.095), and Salvia rosmarinus Spenn (RFC = 0.079). Leaves were the most commonly used plant part (35%), primarily prepared as decoctions (55%), and administered orally (95.03%) for management of diabetes.

*Conclusions*: The data collected provide a valuable foundation for future pharmacological investigations aimed at developing novel therapeutic strategies for diabetes mellitus.

*Keywords*: Ethnobotanical survey, diabetes mellitus, Medicinal plants, Bouira province, Algeria

## Background

For millennia, people have been using plants to treat various ailments, frequently without a comprehensive grasp of their chemical composition or pharmacological effects (Chaachouay *et al.* 2024). This knowledge primarily derived from theories, beliefs, and personal experiences, has been passed down over generations (Nicerine *et al.* 2024).

Traditional medical knowledge is generally transmitted over generations but due to the present generation's disinterest, it is being lost. (Harbane *et al.* 2023; Karaköse 2022). Therefore, precise preservation of cultural knowledge is crucial for its continuity for future generations of humanity (Jenipher *et al.* 2023). Many indigenous people throughout the world rely heavily on plants for their healthcare since they are believed to be the most promising remedies for the control and therapy of illnesses, such as diabetic mellitus (Mechaala *et al.* 2021).

Due to the wide range of chemically diverse components that contribute to their pharmacological activity, plants remain a rich source of promising and innovative medicinal molecules, serving as the foundation for numerous natural medicines (Atanasov *et al.* 2015; Mtewa *et al.* 2021).

Ethnobotanical surveys connect traditional knowledge of medicinal plants with modern drug discoveries. By documenting the ethnomedical use of plants, these surveys can provide valuable leads for further research and drug discovery endeavors. They play a crucial role in documenting native customs regarding medicinal herbs, which helps to preserve cultural heritage (Ohemu *et al.* 2024).

According to Segun *et al.* (2018), it is a key method for choosing plants for pharmacological screening and identifying native therapeutic herbs. Due to its widespread occurrence, diabetes mellitus has drawn the interest of scientists, and there is a growing need to find novel therapeutic medications derived from natural sources to treat the condition.

To our knowledge, no research has been done in the province of Bouira (Algeria) on the use of medicinal plants to treat diabetes mellitus. For this purpose, an ethnobotanical survey was conducted in the Bouira province (Algeria) to document traditional knowledge and practices regarding medicinal plant use for diabetes management.

This study provides valuable data for future research in the fields of phytochemistry and pharmacology, contributing to our understanding of plant-based approaches for diabetes treatment.

## Materials and Methods

**Ethnobotanical Survey**

An ethnobotanical survey was carried out in the Bouira region of Algeria. In order to inventory plants used by herbalists and the general population in the area for the management of diabetes mellitus.

**Ethnogeography of the study area**

This study was conducted in the Bouira region of Algeria (Fig. 1), Situated in the north-central region (36°22'N, 3°53'E), approximately 120 km southeast of Algiers, Bouira encompasses both rural and urban areas, covering a total area of 4439 km².

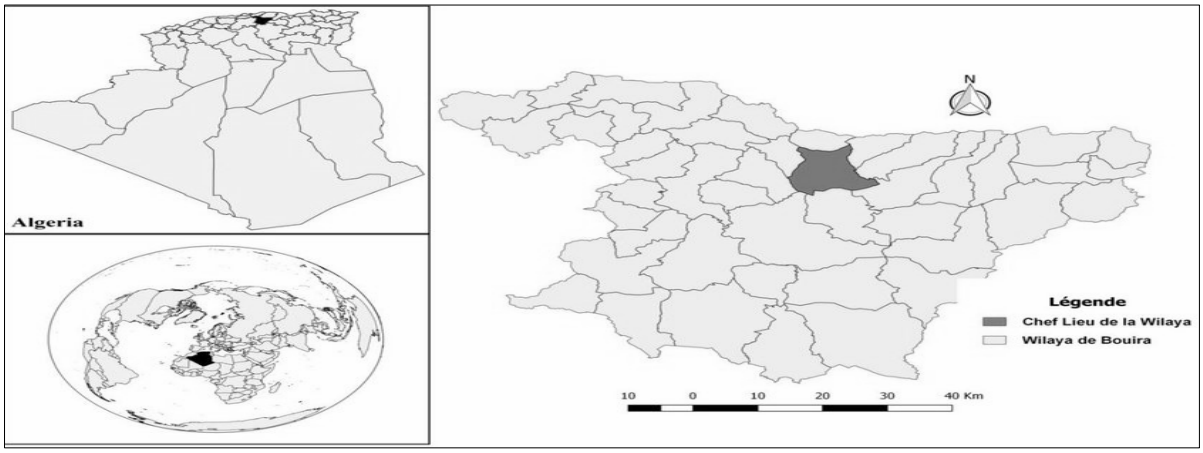


Figure 1. Geographical location of the study area, Bouira– Algeria

**Data collection and field survey**

Between January and May 2024, we conducted an ethnobotanical survey involving 301 individuals from the general population and herbalist communities in Bouira.

A semi-structured questionnaire was used to translate the data from the original language into English. The age, gender, and educational status of the informants are included in the demographics part of the questionnaire. The remaining portion of the questionnaire focused on traditional knowledge of medicinal plants used for management of diabetes. Participants were asked to provide the vernacular name, mode of preparation, plant part used, and mode of administration. The botanical identification of the medicinal species inventoried during the ethnobotanical survey was carried out by Professor Wafa Nouioua from the Laboratory of Phytotherapy Applied to Chronic Disease, Faculty of Nature and Life Sciences, University Ferhat Abbas Setif 1, Algeria, a specialist in plant taxonomy.

**Ethnobotanical indices**

The quantitative indicators utilized to assess the ethnobotanical data were frequency of citation (FC), relative frequency of citation (RFC), family importance value (FIV), and plant part value (PPV).

***Frequency of Citation***

The number of informants who mentioned utilizing each plant for ethnomedical reasons is known as the frequency of citation (FC).

***Relative frequency of citation***

According to Tardío et Pardo-de-Santayana (2008), the relative frequency of citation (RFC) indicates the relative importance of each medicinal plant in a certain research area at the local level. The formula used to calculate it is as follows: RFC = FC/N. N is the total number of informants in the survey, and FC is the number of informants who cited a helpful species.

***Family importance value***

The significance of medicinal plant families is indicated by the Family Importance Value (FIV). It is determined by dividing the total number of species (Ns) in the RFC family by the relative frequency of citations in that family (Phillips *et al.* 1993; Ralte *et al.* 2024). Family importance value (FIV) = RFC Family/Ns

***Plant Part Value***

The Plant Part Value (PPV), which is the total of the reported uses for each plant component ( plant part) divided by the total number of reported uses for all plant parts (RU), is used by the respondents to assess the significance of each part of the plant that they use (Umair *et al.* 2020). Plant part value (PPV) = RU plant part/RU

## Results and Discussion

**Sociodemographic characteristics of the respondents**

Three hundred and one individuals aged between 25 and 75 years participated in the study. Variations in age, gender, and educational background among respondents likely impacted their understanding of medicinal plants (Table 1).

Table 1. Sociodemographic profile of informants interviewed (N = 301)

| Characteristic | | N | N(%) |
|---|---|---|---|
| Gender | Women | 180 | 59.80 |
| | Men | 121 | 40.20 |
| Age | < 30 | 30 | 09.96 |
| | [30–40] | 63 | 20.93 |
| | [40–50] | 62 | 20.59 |
| | [50–60] | 83 | 27.57 |
| | >60 | 60 | 19.93 |
| Academic level | Illiterate | 25 | 08.30 |
| | Primary | 37 | 12.29 |
| | Average | 61 | 20.26 |
| | Secondary | 102 | 33.88 |
| | University | 76 | 25.25 |

N: number of individuals

When it came to knowledge of medicinal plants, women scored substantially higher than men (40.20%; 59.80%). These figures align with the research conducted by Hamdani *et al.* (2020) and Brahmi *et al*. (2023), which revealed that 74% and 80% of Algerian women, respectively, used plants, compared to 20.79% and 20% of men. Women demonstrated a higher level of knowledge and involvement in the use of medicinal plants compared to men. This finding aligns with previous research conducted in neighboring Morocco, where similar trends in gender-based plant usage have been observed (Eddouks *et al.* 2002).

Most participants (27.57%) were in the 50-60 age, followed by the 30-40 (20.93%) and 40-50 (20.59%) age groups. Less than 10% of participants were under 30 years old. Most of the participants (33.88%) held a secondary education, followed by those with university degrees (25.25%). Individuals with an average education level comprised 20.26% of the sample, while primary education and below accounted for 12.29% and 8.30%, respectively.

**Diversity of Medicinal Plants**

The ethnobotanical survey has identified twenty-four families and forty-three species of medicinal plants. With nine species (20.93%), Lamiaceae was the most abundant family, followed by Asteraceae (four species; 9.30%) and Fabaceae (three species; 6.97%). There are two species (4.65%) in each of the families Myrtaceae, Lauraceae, Brassicaceae, Rosaceae, and Zingiberaceae, and one species in each of the remaining families (Figure 2).

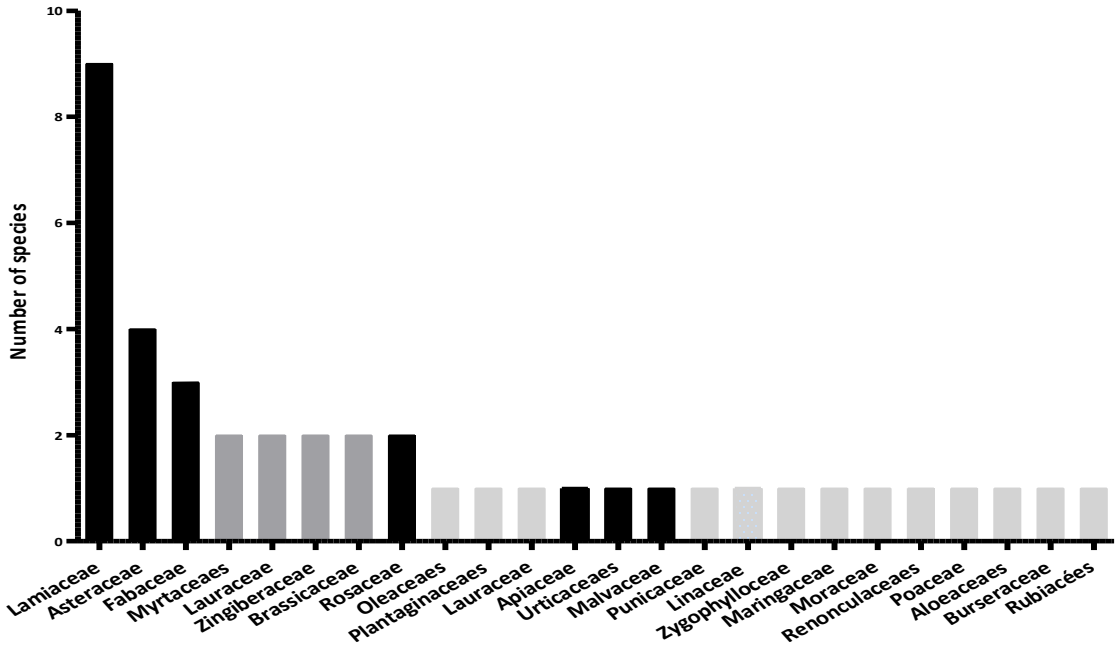


Figure 2. Number of total species per botanical family

As indicated by the Family Importance Value (FIV) in Table 2, Oleaceae emerged as the most prominent family with FIV=0.305, followed by Lauraceae (FIV=0.091), Asteraceae (FIV=0.068), Plantaginaceae (FIV=0.059), Fabaceae (FIV=0.0476), and equally important, Lauraceae and Lamiaceae (both with FIV=0.043). These families are considered predominant in diabetes management based on their high FIV scores.

Table 2. A list of medicinal plants that are used to treat diabetic mellitus

| Family | Botanical Name | Local Name | Part used | Part used | Fc | RFC | FIV |
|---|---|---|---|---|---|---|---|
| Lamiaceae | *Marrubium vulgare* L | Marriwa | Aerial part | Infusion | 26 | 0.086 | 0.041 |
| | *Salvia rosmarinus* Spenn | Iklil el-djabel | Aerial part Leaves | Maceration | 23 | 0.076 | |
| | *Salvia officinalis* L | Miramia | Aerial part | Infusion | 14 | 0.046 | |
| | *Teucrium polium* L. | Jaada | Aerial part | Decoction | 13 | 0.043 | |
| | *Ajuga iva* (L.) Schreb | Chandgoura | Leaves | Infusion | 11 | 0.036 | |
| | *Origanum majorana* L | Bardakouche | Leaves | Decoction | 9 | 0.029 | |
| | *Thymus vulgaris* L | Zaater | Leaves | Infusion | 8 | 0.026 | |
| | *Mentha viridis* L. | Naanaa | Seeds | Infusion | 4 | 0.013 | |
| | *Salvia hispanica* L | chia | Leaves | Infusion | 4 | 0.013 | |
| Asteraceae | *Artemisia herba-alba* Asso | Chih | Aerial part | Decoction | 64 | 0.212 | 0.068 |
| | *Saussurea costus* (Falc.)Lipsch | Quist elhindi | Rhizomes | Powder | 7 | 0.023 | |
| | *Cynara Carduculus* L | Kharchouf | Root | Maceration | 6 | 0.019 | |
| | *Artemisia absinthium* L | Chejret meriem | Leaves | Infusion | 6 | 0.019 | |
| Fabaceae | *Trigonella foenum-graecum* L | Halba | Seeds | Decoction | 24 | 0.079 | 0.047 |
| | *Lupinus albus* L | Tirmes elmor | Leaves | Infusion | 12 | 0.039 | |
| | *Ceratonia siliqua* L | Kharoub | Fruits | Powder | 7 | 0.023 | |
| Myrtaceaes | *Syzygium aromaticum* (L.) Merr. & L.M.Perry | Kronfel | Fruits | Decoction | 7 | 0.023 | 0.024 |
| | *Myrtus communis* | Halmouche | Aerial part | Infusion | 8 | 0.026 | |
| Lauraceae | *Cinnamomum verum* J.Presl | Lqerfa | Bark | Decoction | 42 | 0.139 | 0.091 |
| | *Laurus nobilis* L | Rand | Leaves | Infusion | 13 | 0.043 | |
| Zingiberaceae | *Zingiber officinale* Roscoe | Zanjabil | Rhizomes | Decoction | 8 | 0.026 | 0.028 |
| | *Curcuma alismatifolia* Gagnep | Korkom | Root | Decoction | 9 | 0.029 | |
| *Brassicaceae* | *Lepidium sativum* L | Hab rechad | Seeds | Decoction | 7 | 0.023 | 0.018 |
| | *Anastatica hierochuntica* L | Chajret mareim | Leaves | Decoction | 4 | 0.013 | |
| Rosaceae | *Prunus dulcis* (Mill.) D.A.Webb | Loz mor | Fruits | Powder | 6 | 0.019 | 0.014 |
| | *Crataegus azarolus* L | Zaarour | Leaves | Maceration | 3 | 0.009 | |
| Oleaceaes | *Olea europea* L | Azemour | Leaves | Decoction | 92 | 0.305 | 0.305 |
| Plantaginaceaes | *Globularia alypum* L | Taselgha | Leaves | Decoction | 18 | 0.059 | 0.059 |
| Lauraceae | *Laurus nobilis* L | Rand | Leaves | Decoction | 13 | 0.043 | 0.043 |
| Apiaceae | *Coriandrum sativum* L | Kosbor | Seeds | Decoction | 12 | 0.039 | 0.039 |
| *Urticaceaes* | *Urtica dioica* L | Herayeg | Leaves | Decoction | 7 | 0.023 | 0.023 |
| *Malvaceae* | *Hibiscus sabdariffa* L | Korkodia | Leaves | Decoction | 7 | 0.023 | 0.023 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Punicaceae* | *Punica protopunica* Balf.f. | Qchour roman | Fruits | Maceration | 4 | 0.013 | 0.013 |
| *Linaceae* | *Linum usitatissimum* L | Bodhor ketan | Seeds | Decoction | 4 | 0.013 | 0.013 |
| Zygophylloceae | *Zygophyllum cornutum Coss* | Agaya | Aerial part | Infusion | 4 | 0.013 | 0.013 |
| Maringaceae | *Moringa oleifira* Lam | Moringa | Seeds | Decoction | 4 | 0.013 | 0.013 |
| Moraceae | *Morus nigra* L | Toute lkhal | Leaves | Infusion | 3 | 0.009 | 0.009 |
| Renonculaceaes | *Nigella sativa* L | Haba sawda | Seeds | Decoction | 2 | 0.006 | 0.006 |
| Poaceae | *Hordeum vulgare* L | Chaair | Seeds | Decoction | 2 | 0.006 | 0.006 |
| Aloeaceaes | *Aloe arborescens* Mill | Sabbar | Leaves | Decoction | 2 | 0.006 | 0.006 |
| Burseraceae | *Commiphora myrrha* (T.Nees) Engl | Simgh mor | Leaves | Infusion | 1 | 0.003 | 0.003 |
| Rubiacées | *Rubia tinctorum* L | *Fowa* | Leaves | Infusion | 1 | 0.003 | 0.003 |

**Relative frequency of citation**

Relative frequency of citation **(**RFC) is a quantitative index that measures the importance of a plant species in ethnobotanical surveys. A higher RFC value signifies greater familiarity and utilization among informants. Regarding the overall frequency of citations, the most cited plants were *Olea europea, which* emerged as the most prominent plant species with an RFC index of 0.305, followed by *Artemisia herba-alba* (0.212)*, Cinnamomum verum* (0.139), *Marrubium vulgare* (0.086), *Trigonella foenum-graecum* (0.079), and *Rosmarinus officinalis* (0.076). The least RFC was observed for *Commiphora myrrha* and *Rubia tinctorum* (0.003) (Table 2). The ethnobotanical survey conducted in Benimellal (Morocco) in 2019 revealed the predominant use of *Olea europaea*, which has the highest RFC at 0.24 (Wahid *et al.* 2019).

**Plant parts used**

Recipes for managing diabetes were prepared by respondents in the BOUIRA region using various parts of specified plant species, including leaves, fruits, bark, seeds, rhizomes, and roots (Figure 3). Out of all the plant components that have been documented as medicinal, leaves are the most frequently used, with a PPV index of 0.41, followed by the aerial parts of the plant (PPV = 0.28), seeds (PPV = 0.11), bark (PPV = 0.080), and fruits (PPV = 0.046) in that order. The rhizomes and roots are utilized to a lesser degree, with a PPV index of 0.028. Aerial plant parts,
predominantly leaves, were the most commonly used components in the preparation of medicinal remedies.
This result is consistent with earlier studies conducted by Benarba *et al.* (2015), who reported a similar trend in Mascara (North West of Algeria), and by El Khomsi *et al.* (2022), Keter *et al.* (2012), Kpodar *et al.* (2015), and Aabdousse *et al.* (2020) which suggested that leaves are the plant component most commonly used. The utilization of leaves in traditional medicine can be attributed to their accessibility and potential therapeutic properties, making them a more convenient choice compared to rhizomes, roots, bark or flowers.

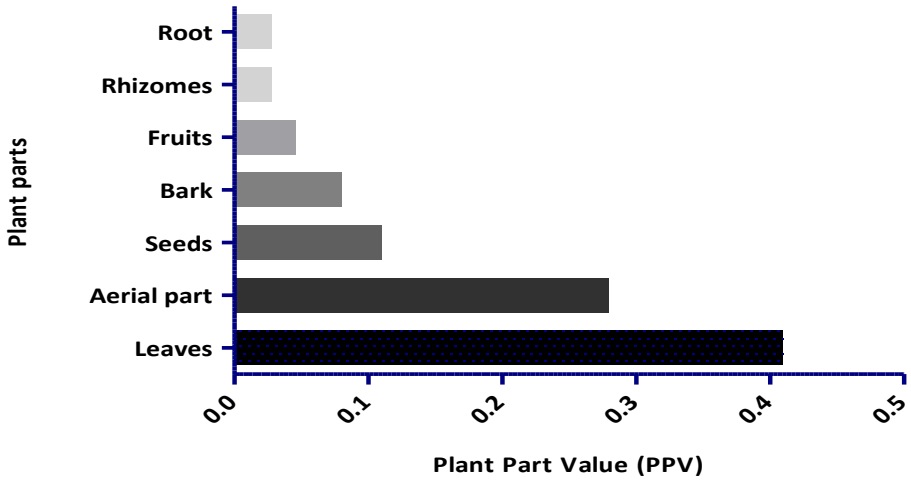


Figure 3. Plant part used for the management of diabetes mellitus is by the population of Bouira localities from Algeria

**Method of preparation and administration**

Several medicinal plant preparation methods, including decoction, infusion, maceration, and powder, are employed in traditional diabetes management. Data analysis revealed decoction as the most prevalent method (76.18%), followed by infusion (22.08%) and maceration (6.78%) (Figure 4). The powder method was less commonly used, representing only 3.83% of preparations. Decoction and infusion emerged as the primary preparation methods. This prevalence can be attributed to their simplicity and ease of administration, findings consistent with previous research (Hammiche & Maiza 2006; Benítez *et al.* 2010; Sargin *et al.* 2015; Makhlouf *et al.* 2023).

These findings are consistent with those of another ethnobotanical study carried out in Mascara (North West Algeria), which shows that decoction is typically used for preparations (89.23% of cases), as previously noted in other studies (Benarba *et al.* 2015).

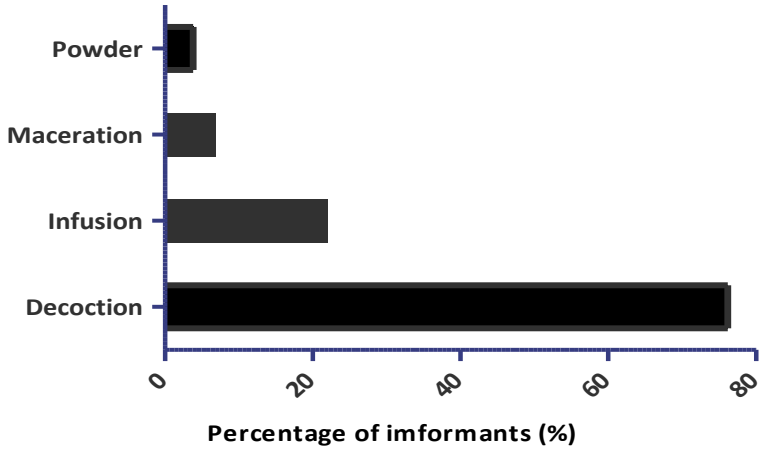


Figure 4. Methods of preparation of herbal remedies

**Medicinal plant origin information**

Traditional knowledge transfer played a significant role, with 68.4% of respondents acquiring information about medicinal herbs from family members. Online resources, books, and media contributed to knowledge acquisition for 21% of participants, while 10.6% sought guidance from herbalists (Figure 5). These findings complement those of Makhlouf *et al.* (2023), who observed medicinal plant usage in northern Algeria and found that 65% of users obtained their knowledge through family transmission.

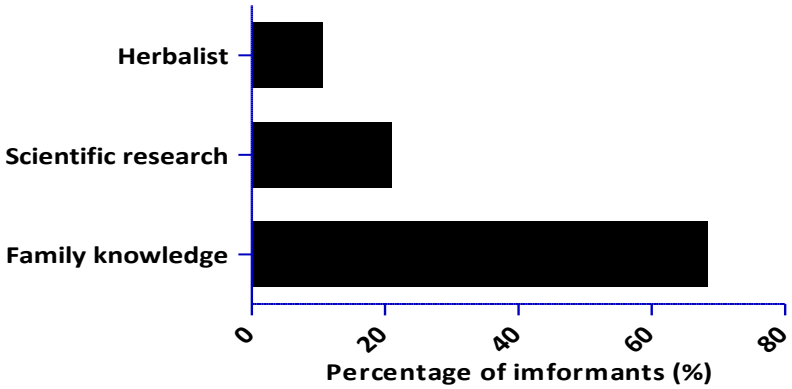


Figure 5. medicinal plants origin information

## Conclusion

The ethnobotanical survey revealed the enormous richness of medicinal plants in the study area, highlighting the need for further research. Analysis of the collected data revealed a high level of local knowledge regarding the therapeutic properties of these plants, as evidenced by quantitative indices like RFC. This valuable information can serve as a springboard for future biological and pharmacological investigations. Prioritizing plants with a high relative frequency of citation values for further analysis would expedite the identification of their active constituents, potentially leading to the development of novel therapeutic strategies for diabetes management.

## Declarations

**Ethics approval and consent to participate:** This study did not require official ethical approval, as it did not involve any clinical procedures or vulnerable populations. However, the research followed known ethical norms for ethnobotanical studies. Prior informed consent was obtained verbally from all participants after explaining the aims of the study. Participation was voluntary, and all data obtained were treated with confidentiality and respect for local cultural norms and customs.

**Consent for publication:** Not applicable
**Availability of data and materials:** Not applicable
**Funding:** Not applicable
**Conflict of interest statement:** We declare that we have no conflict of interest.
**Author contributions**
Allaoua NOURI: Methodology, Data curation, Writing – original draft. Reguia NOURI : Visualization, Conceptualization, Formal analysis. Khadidja DRABLI: Formal analysis, Methodology, Data curation. DAHAMNA Saliha, Supervision, Writing – review & editing.

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