

Ethnobotanical survey of medicinal plants used by Iraqi herbalists practicing in the Middle Euphrates Area to treat Diabetes Mellitus type II and their possible drug-herbal interactions.

Fifth year graduation project by

زهراء مالك عبد الله, ايات عدنان مردان, محمد قاسم خطر, روان محمد شلال, زهراء كريم عيسى

Supervised by Dr. Suhad Sami Humadi

## Abstract

Traditional medicine is being used to treat diabetes, which is gaining popularity in many countries. Iraq, like other countries, showed interest in using traditional medicine to treat diabetes. Limited studies were performed to document herbal remedies used in the treatment of DM type 2 in the southern area of Iraq. Thus, this study is designed to collect ethnobotanical information regarding medicinal plants used in managing DM type 2 in the Middle Euphrates Area. Moreover, a review of their possible drug-herbal interaction and herbalist practice will also be provided.

**Method:** This research was conducted in a cross-sectional design from July 2024 to February 2025, utilizing a rigorously evaluated questionnaire administered to Iraqi herbalists operating in the Middle Euphrates Region. A questionnaire of 12 items divided into three sections was utilized, and the collected data were statistically examined; Chi-square analysis was employed to link certain variables with a significance threshold established at  $P < 0.05$ . The use value (U.V) and informant consensus (Fic) were also calculated.

**Results:** One hundred thirty-two male herbalists from five Iraqi regions participated in this survey, most of whom practice in Al-Najaf. Approximately 51.5% of the participants were aged between 31 and 50 years. Fifty percent possessed more than 11 years of experience, and virtually all held college credentials, with 43.9% attaining a graduate degree. The research recorded the application of fifteen medicinal plants for the treatment of diabetes mellitus, categorized into eleven families: Asteraceae, Apiaceae, Burseraceae, Cucurbitaceae, Lamiaceae, Lauraceae, Leguminosae, Moringaceae, Myrtaceae, Oleaceae, and Urticaceae. Data indicated the prevalent utilization of six medicinal plants: *Artemisia herba-alba*, *Boswellia carterii*, *Cinnamomum zeylanicum*, *Coriandrum sativum*, *Moringa Oleifera*, and *Trigonella foenum-graecum*, which exhibited an approximate frequency of 0.7 and was employed by all participants across the five provinces. Records indicate that 66.6% of herbalists depend on medical diagnoses, and nearly all recommend that patients monitor their blood glucose levels.

**Conclusion:** The study documented the use of fifteen medicinal plants in the five provinces, with six of them being highly utilized.

**Keywords:** DM, conventional medicine, patient adherence, medicinal plants, ethnobotanical surveys, herbalist

## **1. Introduction**

Diabetes mellitus (DM) is a group of heterogeneous disorders characterized by hyperglycemia and glucose intolerance resulting from insulin deficiency, impaired effective insulin action, or both (1). DM is a global health problem, and the number of diabetic patients is on the rise (2); it has been reported that between 1995 and 2025, DM is predicted to increase by 48% in developing countries and 27% in developed countries (3). The current guidelines for managing DM suggest lifestyle modifications as the first-line management, followed by oral hypoglycaemic medications or insulin injections, depending on the severity of the disease (4). Poor control of diabetes is a common concern [5], leading to an increased risk of morbidity, mortality, and disability from complications of DM (6). This may partly be explained by poorer adherence to conventional medicines, lower health literacy (7), and the cost of medication, thus shifting patients to seek other choices like traditional medicine (8).

Recently, there has been an increasing interest in the public consumption of medicinal plants because patients prefer natural products, which are inexpensive and widely available (8,9). According to the WHO statistics, more than 80% of the world's population, particularly in underdeveloped countries, obtain their primary healthcare needs from herbal medicine (10). Iraq has a long history of herbal medicine, dating back to the early stages of human civilization, notably during the Sumerian era (3000-1970 B.C.) and the subsequent periods of Babylonian and Assyrian civilizations (1970-589 B.C.) (8). Research conducted in Iraq has revealed a prevalence ranging from 71.6% to 76.4% in the utilization of herbal products among individuals suffering from various medical conditions (11-13). Some research studies were undertaken in Iraq to examine patient utilization of herbal medicine in managing diabetes. However, limited studies have been performed on

herbalists to identify medicinal plants used, especially in southern Iraq. Since ethnobotanical surveys are effective methods in documenting and identifying medicinal plants used in traditional knowledge systems, this study was designed to document local herbalists' ethnobotanical uses of medicinal plants for managing diabetes in the Middle Euphrates Area. The aim of the study further extends to discussing herbalists' practices and providing a table of possible drug-herbal interactions for the most prescribed herbs.

## **2. Materials and Methods**

### **➤ The Study Design**

An ethnobotanical survey, executed as a questionnaire-based cross-sectional descriptive study, was conducted from July 2024 to February 2025 via face-to-face interviews with local herbalists practicing in the Middle Euphrates Area. Semi-structured questionnaires were employed to interview herbalists at their herbal stores. Plant specimens were gathered utilizing the finalized questionnaires from each herbalist.

### **➤ The Studied Area**

The Middle Euphrates Area, comprising five governorates, Karbala, Al-Najaf, Babylon (Hilla), Al-Muthanna, and Al-Diwaniya, was selected for this study. This region is recognized for its rich cultural and spiritual contributions, which enhanced herbalist knowledge, especially during religious rites.

### **➤ Questionnaire**

The form used in this investigation was developed after a thorough review of relevant literature and subsequently adapted to align with the objectives of this study (14-20). The survey comprised twelve closed-ended questions categorized into three sections. The initial component shall consist of five questions regarding

demographic information: name, gender, age, educational qualifications, and years of professional experience. The following section included six questions regarding herbal practitioners' diagnostic and practice methods. The final stage of the study entailed compiling a list of herbal products utilized by participants for managing DM. The provided documentation included essential details about each medicinal plant, such as its scientific nomenclature, commonly used name, the specific plant portion utilized for medicinal purposes, and the supporting documentation. Data were considered authentic when a plant received recommendations from at least two herbalists.

#### ➤ **Data collection**

The data were gathered from a specific sample of herbalist stores using face-to-face interviews with the herbalists. Each interview lasted approximately 25 to 30 minutes, and participants' consent was inferred from their agreement to complete the questionnaire.

#### ➤ **Plant Identification**

Each plant specimen collected from the informants' store was assigned a unique numerical identifier, and the gathered samples were securely stored within the premises of the pharmacognosy laboratory at the Pharmacy Department of Al-Zahrawi College University. Subsequently, these samples underwent taxonomic evaluation, confirmation, and identification by Associate Prof. Sukeyna Abbas Aliwy/Baghdad University Herbarium/College of Science.

#### ➤ **Statistical Analysis**

The data analysis in this study utilized SPSS Version 26, a statistical software commonly employed in social sciences, developed in Chicago, United States. Demographic characteristics and components of the practice questions were

determined through descriptive statistics. Simultaneously, the Chi-square test was employed to assess the statistical significance of the correlation between specific variables, with a significance level set at  $P < 0.05$ .

Furthermore, the UV index (use value) was employed during the interviews to assess plant citations. The calculation follows (21-23).

$$UVc = \sum U / N_s,$$

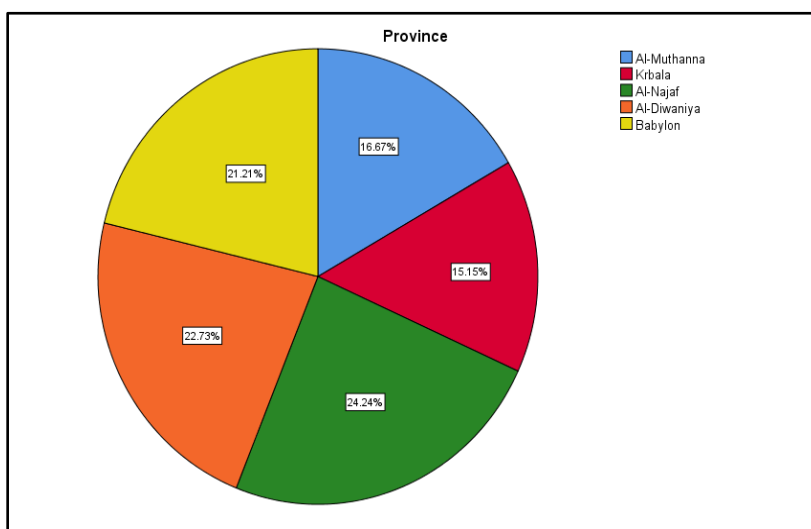
where U represents the cumulative count of use citations for a particular species across all informants, and ns is the total number of informants. Moreover, the factor of informant consensus (Fic) was also calculated following the formula (23,24)

$$Fic = N_{ur} - N_t / N_{ur} - 1$$

$N_{ur}$  is the number of used citations, and  $N_t$  is the number of used species.

### 3. Results

The total number of participants in all governance was 132, distributed in the five areas, as Figure 1 shows the highest participation of herbalists in Al-Najaf province.



**Figure 1. Distribution of participants in the studied area**

The study analyzed the demographic characteristics of participants. All herbalists were male, with a significant absence of female participation. About half the participants (51.5%) were aged between 31 and 50. Fifty percent had more than 11 years of experience, and nearly all had educational backgrounds, with 43.9% holding a graduate degree. Detailed results are presented in Table 1.

**Table 1. Demographic Characteristics of Participants**

| Characteristics    |             | N (132) | %      | M    | P Value |
|--------------------|-------------|---------|--------|------|---------|
| Gender             | Male        | 132     | 100.0% | 0.0  | 0.000   |
|                    | Female      | 0       | 0.0%   |      |         |
| Age Group          | > 30 years  | 8       | 6.1%   | 2.37 | 0.000   |
|                    | 31-50 years | 68      | 51.5%  |      |         |
|                    | 51-70 years | 55      | 41.7%  |      |         |
|                    | <70 years   | 1       | 0.8%   |      |         |
| Level of Education | Illiterate  | 2       | 1.5%   | 2.03 | 0.000   |
|                    | Primary     | 49      | 37.1%  |      |         |
|                    | Secondary   | 23      | 17.4%  |      |         |
|                    | Graduate    | 58      | 43.9%  |      |         |
| Years of Expertise | >5 years    | 2       | 1.5%   | 2.16 | 0.000   |
|                    | 5-10 years  | 22      | 16.7%  |      |         |
|                    | 11-20 years | 66      | 50.0%  |      |         |
|                    | 21-30 years | 36      | 27.3%  |      |         |
|                    | < 30years   | 6       | 4.5%   |      |         |

In the second part of analyzing herbalists' practices regarding diabetes diagnosis and management, findings indicated that 66.6% of herbalists rely on physician diagnoses rather than patient-reported symptoms. Nearly all herbalists recommend that patients frequently monitor their blood glucose levels; approximately 65.1% suggest that patients return for follow-up consultations, while 43.9% advise patients to consult their healthcare providers if they cannot regulate their blood sugar levels. Notably, forty-nine percent of the participants advocated for

discontinuing the existing prescription in favor of persisting with the prescribed herbal medicines; the complete results are shown in Table 2

**Table 2: Analysis of herbalists' practice toward DM.**

| <b>Practice Question</b>                                                                                                                              | <b>Response</b> | <b>F (%)</b> | <b>P Value</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|
| Do you depend on the patient's symptoms when making a diagnosis?                                                                                      | Yes             | 44 (33.3%)   | 0.00           |
|                                                                                                                                                       | No              | 88 (66.7%)   |                |
| Do you depend on the doctor's diagnosis?                                                                                                              | Yes             | 88 (66.6%)   | 0.00           |
|                                                                                                                                                       | No              | 44 (33.3%)   |                |
| Do you advise patients to stop their medication and use the herbal remedy?                                                                            | Yes             | 65 (49.2%)   | 0.862          |
|                                                                                                                                                       | No              | 67 (50.8%)   |                |
| Do you advise patients to use their medication together with herbal remedies?                                                                         | Yes             | 72 (54.5%)   | 0.296          |
|                                                                                                                                                       | No              | 60 (45.5%)   |                |
| Do you tell the patient to measure their blood sugar while on herbs?                                                                                  | Yes             | 131 (99.2%)  | 0.00           |
|                                                                                                                                                       | No              | 1 (0.8%)     |                |
| If the blood sugar test is off range (high or low), Do you advise the patient to check with their doctor or return to you to alter the herbal remedy? | Doctor          | 58 (43.9%)   | 0.164          |
|                                                                                                                                                       | Herbalist       | 74 (65.1%)   |                |

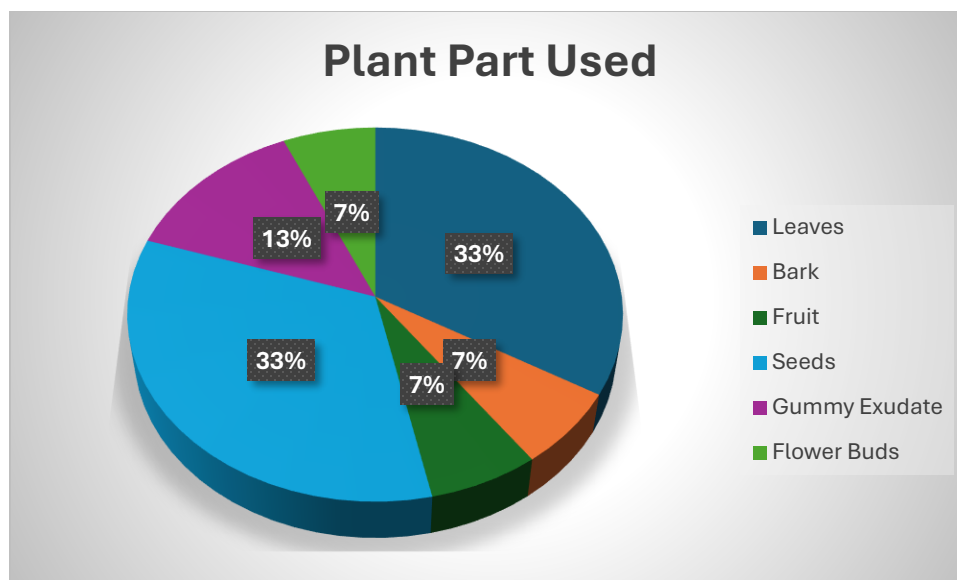
The final section of the survey illustrates the extensively recommended herbal remedies by herbalists in the studied region. All used herbs were administered by decoction. The informant consensus factor (Fic) is computed as a quantitative analytical metric to assess the level of agreement among informants' knowledge. It is essential for categorizing plants based on their utility. Moreover, the used plants in each province are also demonstrated in the comprehensive list in Table 3. Figure 2 represents the plant parts used, and seeds were the main plant parts used by herbalists.

**Table 3. Detailed list of medicinal plants used in managing diabetes in the studied area**

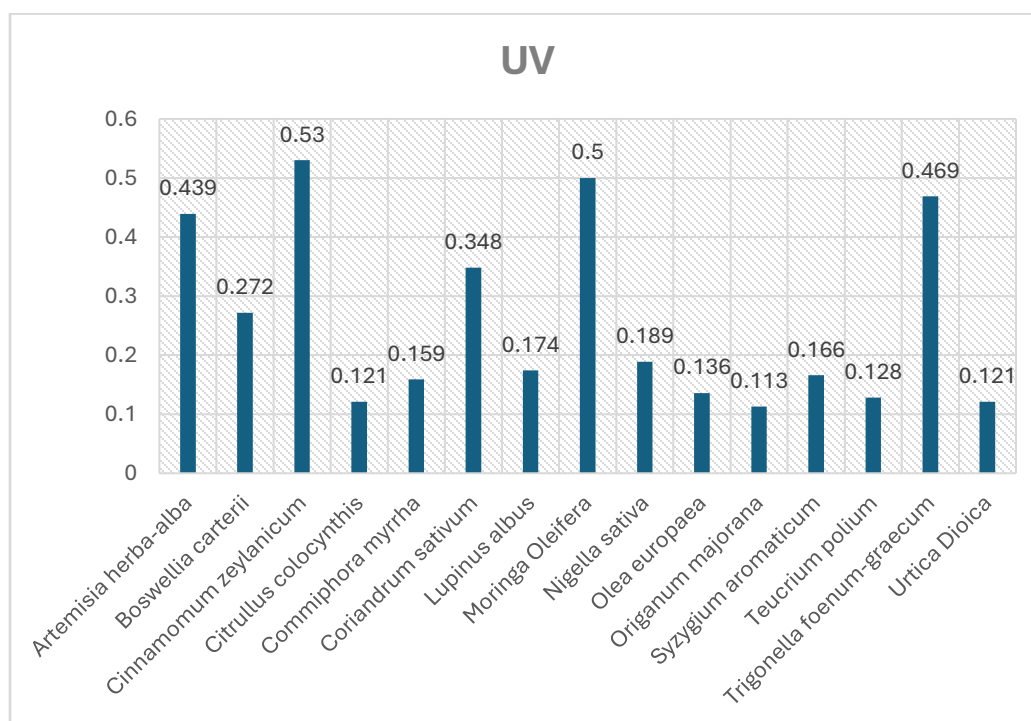
| Voucher No. | Scientific Name                  | Family        | Common Name                           | Part Used     | Prov.         | Fic   | Studies supporting use in DM |
|-------------|----------------------------------|---------------|---------------------------------------|---------------|---------------|-------|------------------------------|
| H-01        | <i>Artemisia herba-alba</i>      | Asteraceae    | Al-Sheeh                              | Leaves        | K, B, N, D, M | 0.754 | 25                           |
| H-02        | <i>Boswellia carterii</i>        | Burseraceae   | Frankincense, Luban                   | Gummy exudate | K, B, N, D, M | 0.784 | 25,26                        |
| H-03        | <i>Cinnamomum zeylanicum</i>     | Lauraceae     | Cinnamon                              | Bark          | K, B, N, D, M | 0.797 | 25,27,28                     |
| H-04        | <i>Citrullus colocynthis</i>     | Cucurbitaceae | Bitter apple, bitter cucumber, Hanzal | Fruit         | K, B, M       | 0.066 | 25, 29,31                    |
| H-05        | <i>Commiphora myrrha</i>         | Burseraceae   | Myrrha                                | Gummy exudate | K, N, M       | 0.3   | 25                           |
| H-06        | <i>Coriandrum sativum</i>        | Apiaceae      | Coriander, Kozbara                    | Seeds         | K, B, N, D, M | 0.688 | 25                           |
| H-07        | <i>Lupinus albus</i>             | Leguminosae   | Lupin Beans                           | Seeds         | K, B, D, M    | 0.363 | 30                           |
| H-08        | <i>Moringa Oleifera</i>          | Moringaceae   | Drumstick                             | Seeds         | K, B, N, D, M | 0.784 | 26, 28                       |
| H-09        | <i>Nigella sativa</i>            | Ranunculaceae | Black seeds, Habat Soda'a             | Seeds         | K, B, D, M    | 0.416 | 25,27,28                     |
| H-10        | <i>Olea europaea</i>             | Oleaceae      | olive                                 | Leaves        | K, B, N, D, M | 0.176 | 25, 27                       |
| H-11        | <i>Origanum majorana</i>         | Lamiaceae     | Sweet marjoram                        | Leaves        | B, M          | 0.0   | 31                           |
| H-12        | <i>Syzygium aromaticum</i>       | Myrtaceae     | Clove                                 | Flower buds   | B, D, M       | 0.333 | 32                           |
| H-13        | <i>Teucrium polium</i>           | Lamiaceae     | Germander                             | Leaves        | K, B, D, M    | 0.125 | 25,29,32                     |
| H-14        | <i>Trigonella foenum-graecum</i> | Leguminosae   | Fenugreek, Helba                      | Seeds         | K, B, N, D, M | 0.77  | 25, 27,28,31                 |
| H-15        | <i>Urtica Dioica</i>             | Urticaceae    | Common nettle                         | Leaves        | N             | 0.066 | 31,33                        |

Footnote: K=Karbala, B= Babil, N= Najaf, D= Diwanyia M= Muthanna

The Use value index (UV) assesses the relative significance of each medicinal species by considering its relative utilization among informants. Figure 3 demonstrates this result.



**Figure 2. Plant parts used by herbalists**



**Figure 3. UV index for the studied medicinal plants**

#### **4. Discussion**

Plant extracts have been cited in several ethnic and traditional practices, including Western, Middle Eastern, and Ayurvedic herbalism, acknowledging their considerable antidiabetic potential (34). These herbal extracts operate via various phytochemicals, each employing a unique mechanism to reduce or regulate blood glucose levels (35). Numerous ethnobotanical research studies have been conducted in several regions of Iraq, cataloging the utilization of medicinal plants to treat diverse ailments (8,37-39). No research has yet been conducted in the Middle Euphrates region concerning the herbalist practices related to antidiabetic herbs. This study aimed to identify the primary medicinal plant recommended by herbalists for diabetes management. This study will elucidate the fundamental herbs utilized in the treatment of diabetes. This will establish a foundation for subsequent research examining their clinical efficacy and the potential risk of herbal medication interactions. Furthermore, the study will emphasize herbal techniques in the management of diabetes.

The initial section of the study elucidated the herbalist approach to diabetes patients, which is crucial for comprehending the potential deficiencies in patient treatment and the risk of harm to patients. The study data indicated that over seventy-five percent of participants rely on the physician's diagnosis to assess the patient's condition, a critical factor in preventing any misdiagnoses that may arise from herbalists who base their assessments only on the patient's symptoms. The survey revealed a notable finding, indicating that approximately fifty percent of participants recommended that patients discontinue their prescribed medication from their primary healthcare provider in favor of a regimen suggested by an herbalist. Furthermore, patients were advised to consult their herbalist rather than their physician when blood glucose levels remained inadequately controlled by the herbal

treatment. This practice aligns with past research on herbalist practices in Iraq (40-42) and various nations (43-47), which revealed potential risks to patients and highlighted the need for enhanced education for healthcare professionals regarding inquiries about herbal medicines and supplements utilized by patients.

The second and central part of the study documented the use of fifteen medicinal plants for treating DM distributed in eleven families: Asteraceae, Apiaceae, Burseraceae, Cucurbitaceae, Lamiaceae, Lauraceae, Leguminosae, Moringaceae, Myrtaceae, Oleaceae, and Urticaceae. These medicinal plants are all supported by references documenting their use in treating DM and are traditionally used by different nations and countries, as demonstrated in Table 3. Interestingly, the study showed that the Middle Euphrates Area shares the traditional knowledge of some herbs, namely *Syzygium aromaticum* and *Teucrium polium*, with the Iranian culture (32) and *Lupinus albus* with the Egyptian culture (33). These herbs were not reported to be used for diabetes in several reviews regarding Middle Eastern herbs (26,27,29). On the other hand, Asia A.S et al.. (25) performed a study in Al-Basra, the southern area of Iraq. They confirmed the use of eight of the mentioned herbs, namely *Artemisia herba-alba*, *Boswellia carterii*, *Citrullus colocynthis*, *Commiphora myrrha*, *Coriandrum sativum*, *Nigella sativa*, *Olea europaea*, *Trigonella foenum-graecum*.

The informant consensus factor (Fic) computed in this study emphasized plants of cultural significance and agreement regarding their utilization among herbalists. The magnitude of this component varies between 0 and 1. A high Fic value signifies consistency among participants regarding the utilization of taxa within a therapeutic category. Data showed the high usage of six medicinal plants, namely *Artemisia herba-alba*, *Boswellia carterii*, *Cinnamomum zeylanicum*, *Coriandrum sativum*, *Moringa Oleifera*, and *Trigonella foenum-graecum*, which had

about Fic 0.7 and was used among all participants in the five provinces. In contrast, the other herbs were less used, and their utilization differs among the studies. These results were also supported by the UV index, which showed the high use of the six herbs in the studied area. Data also showed that all herbs were administered orally via decoction, and seeds were the most used plant parts.

The last part of the study focuses on the possible drug-herbal interaction, which was reviewed for the six most used herbal products. It revealed that, besides lowering blood sugar and interacting with hypoglycemic medication, *Cinnamomum zeylanicum* and *Trigonella foenum-graecum* are possible enzyme inhibitors and, thus, may interact with other medications and increase their toxicity (48,49).

## **5. Conclusion**

The current understanding of medicinal plant use for treating diverse diseases is derived from indigenous knowledge that has been conserved and passed down through generations. Documenting this knowledge is crucial for preserving traditional knowledge and establishing a baseline for future research. The survey documented fifteen medicinal plants and their common names used by local herbalists in the Middle Euphrates Area to manage DM. The six most widely used herbs were *Artemisia herba-alba*, *Boswellia carterii*, *Cinnamomum zeylanicum*, *Coriandrum sativum*, *Moringa Oleifera*, and *Trigonella foenum-graecum*. These herbs are also used by other nations and supported by many references, which shed light on the potential for developing novel herbal remedies based on further studies to support its clinical significance. The survey also recognized herbalist practice toward managing diabetic patients and possible patient care risks, highlighting the need for an in-depth evaluation of current practice guidelines.

## **6. Recommendations**

The study emphasizes the need to thoroughly evaluate existing practice guidelines, establish nationally standardized guidelines by the Ministry of Health, and implement a system to monitor herbalist practices for public safety. Other recommendations are to pursue further research on the identified medicinal plants and examine them clinically, reporting their adverse effects.

## **7. Acknowledgment**

The authors would like to thank the help and assistance of Assistant Prof. Suhad S Humadi for her guidance throughout this work. Our appreciation also goes to our families, who supported us through all difficult times.

## **8. Compliance with ethical standards**

- Conflict of interest: The author has no conflict of interest to declare.
- Ethical issues: No ethical issues were involved in this work, and the study was approved by the Research Ethical Board of Al Zahrawi College University (REBZ Ref No. 08/6/2024).

## **9. Inclusion and exclusion criteria**

The completion of the questionnaire was the inclusion criteria; The exclusion criteria were newly practiced participants, incomplete questionnaire form, and plants mentioned by less than three herbalists.

## **10. References**

1. Ozougwu, O. The pathogenesis and pathophysiology of type 1 and type 2 diabetes mellitus. *J. Physiol. Pathophysiol.* 203;4 (4), 46–57
2. C.D. Mathers, D. Loncar, Projections of global mortality and burden of disease from 2002 to 2030, *PLoS Med.* 2006, 3: e442.
3. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. *Diabetes Care* 1998; 21: 1414-2431.
4. NICE, Overview Type 2 Diabetes in Adults: Management | Guidance | NICE, 2022.

5. B.L. Smalls, T.D. Ritchwood, K.G. Bishu, L.E. Egede, Racial/ethnic differences in glycemic control in older adults with type 2 diabetes: United States 2003–2014, *Int. J. Environ. Res. Publ. Health*, 2020, 17: 950
6. Y. Ezzatvar, R. Ramírez-V'elez, M. Izquierdo, A. García-Hermoso, Racial differences in all-cause mortality and future complications among people with diabetes: a systematic review and meta-analysis of data from more than 2.4 million individuals, *Diabetologia* 2021,64
7. Shraddha Sriraman, Devika Sreejith, Evie Andrew, Immaculate Okello, and Merlin Willcox; Use of herbal medicines for the management of type 2 diabetes: A systematic review of qualitative studies *Complementary Therapies in Clinical Practice*, 2023, 53: 101808
8. Humadi SS. Ethnobotanical study of medicinal plants used by Iraqi herbalists in the management of Nephrolithiasis: A cross-sectional survey conducted in Southern Iraq “Karbala”. *Plant Science Today*. 2024; 11(2): 117–124.
9. Souad Skalli, Rachida Hassikou, Moustapha Arahou. An ethnobotanical survey of medicinal plants used for diabetes treatment in Rabat, Morocco. *Heliyon*, 2019,5: e01421
10. Rouf Ahmad Bhat, Khalid Rehman Hakeem, and Moonisa Aslam Dervash; Medicinal plants and their traditional uses in different locations- *Phytomedicine*, AcademicPress,2021, 207-223,
11. Samira Muhammed Ebrahim, Utoor Talib Jassim. Herbal use among hypertensive patients in Basra, Iraq. *International Journal of Advanced Scientific and Technical Research*. 2020;6-10.
12. Kadhimi Ali Kadhimi, Ashwaq Najemaldeen Abbas, Saad Abdulrahman Hussain. Use of herbal drugs as alternative medicine: Experience of Iraqi patients. *Spatula DD* 2016; 5(4):1-7
13. Kadhimi Ali Kadhimi, Zena M Qaragholi, Ghofran Khudair Hamad, Safa Omran, Ayat Hamid. A cluster survey on the use of herbs in the Iraqi society. *Plant Cell Biotechnology and Molecular Biology*. 2021;22(33-34):54-60.
14. Faiz H. Al Merib, and Imad Habeeb Obeid. Trends characterization for rainfall time series in middle Euphrates region, Iraq; *Ecological Engineering and Environment*, 2024, 25(10):347-358
15. Abdullah S. Asia, Kadhimi N. Sheima, and Ahmed S Sabah -Traditional Use of Medicinal Plants for the Treatment of Diabetes Mellitus in Basra-Am. *J. Pharm Health Res* 2015;3(9)
16. Suhad S Humadi -Ethnobotanical study of medicinal plants used by Iraqi herbalists in the management of Nephrolithiasis: A cross sectional survey conducted in Southern Iraq “Karbala” *Plant Science Today*. 2024; 11(2): 117–124
17. Souad Skalli, Rachida Hassikou, Moustapha Arahou-An ethnobotanical survey of medicinal plants used for diabetes treatment in Rabat, Morocco; *Heliyon* 2019,5: e01421.
18. Hanae NaceiriMrabti,Abdelhakim Bouyahya , Nidal NaceiriMrabti,Nidal Jaradat , Latifa Doudach, and My El Abbes Faouzi -Ethnobotanical Survey of Medicinal Plants Used by Traditional Healers to Treat Diabetes in the Taza Region of Morocco, *Evidence-Based Complementary and Alternative Medicine*, 2021;2021:5515634.

19. Keddagoda Gamage P. Wasana; Anoja P. Attanayake, and Liyanage Dona Ashantj M. Arawwawala- Ethnobotanical survey on medicinal plants used for the treatment of diabetes mellitus by Ayurveda and traditional medicine practitioners in Galle district of Sri Lanka, *European Journal of Integrative Medicine*, 2022, 55(2):102177
20. Uwimbabazi, M., Kabonesa, B., Ongarep, S., Omujal, F. & Agaba, H. Ethnobotanical survey of medicinal plants used for the treatment of diabetes in Uganda. *Ethnobotany Research and Applications*, 2023,26: 1–14
21. Hoffman B, Gallaher T. Importance Indices in Ethnobotany. *Ethnobotany Research and Applications*,2007, 5: 201-218.
22. Phillips A., Gentry AH. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. *Economic Botany*, 1993, 47:15-32.
23. Andrade-Cetto and Heinrich. From the field into the lab: useful approaches to selecting species based on local knowledge; *Front. Pharmacol.* 2011; 2:20
24. Heinrich, M., Ankli, A., Frei, B., Weimann, C., and Sticher, O. Medicinal plants in Mexico: healers' consensus and cultural importance. *Soc. Sci. Med.*1998, 47:1859–1871
25. Asia AS et al. Traditional use of medicinal plants for the treatment of diabetes Mellitus in Basra—*American Journal of Pharmacy and health Research* 2015, 3(9).
26. Alaa M. Abu-Odeh and Wamidh H. Talib. Middle East Medicinal Plants in the Treatment of Diabetes: A Review, *Molecules*, 2021, 26, 742
27. Saad B, Kmail A, Haq SZH. Anti-Diabetes Middle Eastern Medicinal Plants and Their Action Mechanisms. *Evid Based Complement Alternat Med.* 2022; 2022:2276094
28. Alam S, Sarker MMR, Sultana TN, Chowdhury MNR, Rashid MA, Chaity NI, Zhao C, Xiao J, Hafez EE, Khan SA and Mohamed IN. Antidiabetic Phytochemicals from Medicinal Plants: Prospective Candidates for New Drug Discovery and Development. *Front. Endocrinol.*2022, 13:800714
29. Abou-Zekry, S.S., Badawy, M.T., Ezzelarab, N., & Abdellatif, A.A. Phytotherapy for diabetes mellitus; A review of Middle Eastern and North African folk medicinal plants. *Journal of HerbMed Pharmacology* 2021; 10(1): 1-13.
30. Knecht KT, Nguyen H, Auken AD, Kinder DH. Effects of extracts of lupine seed on blood glucose levels in glucose resistant mice: antihyperglycemic effects of *Lupinus albus* (white lupine, Egypt) and *Lupinus caudatus* tailcup lupine, Mesa Verde National Park. *J Herb Pharmacother.* 2006;6(3-4):89-104.
31. Dehghan Shahreza F, Beladi Mousavi SS, Rafieian Kopaei M. Medicinal plants and diabetic kidney disease; an updated review on the recent findings. *Immunopathol Persa.* 2016;2(1):e04
32. Salehi, P.; Asghari, B.; Esmaeili, M.A.; Dehghan, H.; Ghazi, I.  $\alpha$ -Glucosidase and  $\alpha$ -amylase inhibitory effect and antioxidant activity of ten plant extracts traditionally used in Iran for diabetes. *J. Med. Plants Res.* 2013, 7, 257–266.
33. Thamer Mohammed Bashir, Chinar Mustafa Mohammed, Abdulsatar Abduljabar Haji, and Ihsan Husain Mohammed. Study for Evaluation of the Protective Effects of *Urtica Dioica*

- Leaves on Cardiac Function In Alloxan-Induced Diabetic Albino Rat. Egypt. J. Vet. Sci. 2024, 55( 2): 313-323
34. Alam S, Sarker MMR, Sultana TN, Chowdhury MNR, Rashid MA, Chaity NI, Zhao C, Xiao J, Hafez EE, Khan SA, and Mohamed IN -Antidiabetic Phytochemicals from Medicinal Plants: Prospective Candidates for New Drug Discovery and Development. Front. Endocrinol; 2022, 13:800714.
  35. Sara S. Abou Zekry, Marwa T. Badawy, Nada M. Ezzelarab and Ahmed Abdellatif-Phytotherapy for diabetes mellitus; A review of Middle Eastern and North African folk medicinal plants-J Herbmec Pharmacol. 2021; 10(1): 1-13.
  36. Al-Douri, N A. "A survey of medicinal plants and their traditional uses in Iraq." Pharmaceutical biology ,2000, 38(1): 74-9.
  37. Ahmed, H.M. Ethnopharmacobotanical study on the medicinal plants used by herbalists in Sulaymaniyah Province, Kurdistan, Iraq. J Ethnobiology Ethnomedicine,2016, 12(8)
  38. Naqishbandi, A. Plants used in Iraqi traditional medicine in Erbil - Kurdistan region. Zanco Journal of Medical Sciences Zanco J Med Sci, 2014,18(3), 811–815.
  39. Kawarty, Awara Mohammed A.M.A.; Behcet, Lutfi; and Çakirciloglu, Ugur. An ethnobotanical survey of medicinal plants in Ballakayati (Erbil, North Iraq)," Turkish Journal of Botany 2022,44(3): 13.
  40. Humadi, S., Hassan, S. M., & Ahjel, S. W. . Herbal Medicine Between Current Practice and Knowledge Needs: A National Cross-Sectional Survey in Iraq. Iraqi Journal of Pharmaceutical Sciences 2024; 33(4), 208-218.
  41. Nedhal A. Al-Douri; Some important medicinal plant in Iraq. International Journal of Advances in Herbal and Alternative Medicine 2014;2(1): 10 –20
  42. Humadi S, Hassan SM, Ahjel SW. A Cross-Sectional Survey of Iraqi Herbalist Practicing in the Middle Euphrates Area with a Recognition of their Knowledge, Practice and Attitude(Conference Paper )#. Iraqi Journal of Pharmaceutical Sciences Iraqi Journal of Pharmaceutical Sciences, 2022, 31(Suppl.):178–187
  43. Nkeck JR, Tsafack EE, Ndoadoumgue AL, Endomba FT. An alert on the incautious use of herbal medicines by sub-saharan African populations to fight against the COVID-19. Pan Afr Med J. 2020;35(Suppl 2).
  44. Caspi O, Hoxha J. Lack of standards in informed consent in complementary and alternative medicine. Complement Ther Med. 2005;13(2):123–30.
  45. Reem A. Issa and Iman A. Basheti. Herbal medicine use by people in Jordan: exploring believes and knowledge of herbalists and their customer. Journal of Biological Sciences, 2017,17(8):400-409
  46. Jocelyn DeJong. Traditional medicine in Sub-Saharan Africa: Its Importance and Potential Policy; Population and Human Resources Department, The World Bank, July 1991
  47. Addis, Getachew et al. Perceptions and practices of modern and traditional health practitioners about traditional medicine in Shirka district, Arsi zone, Ethiopia. Ethiopian Journal of Health Development.2002;16: 19-23
  48. Ahmmed, S. M., Mukherjee, P. K., Bahadur, S., Kar, A., Mukherjee, K., Karmakar, S., & Bandyopadhyay, A. Interaction potential of Trigonella foenum graceum through

cytochrome P450 mediated inhibition. Indian journal of pharmacology, 2015, 47(5), 530–534.

49. Michael J. Espiritu, Justin Chen, Jaydeep Yadav, Michael Larkin, Robert D. Pelletier, Jeannine M. Chan, Jeevan B. GC, Senthil Natesan and John P. Harrelson. Drug Metabolism and Disposition, 2020, 48 (10):1028-1043