

Ethnobotanical Assessment of Medicinal Plant Use in Diyala Province, Iraq

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Abstract

A comprehensive ethnobotanical investigation was conducted in Diyala Province, central-eastern Iraq, a region recognized for its rich plant biodiversity. The primary aim of this study was to assess community knowledge and the use of medicinal plants. Data were collected from 500 participants through structured interviews and online questionnaires. The majority of respondents were 18–25 years old, held Bachelor's degrees (60.0%), and were female (76.2%). More than half of the participants (51.8%) resided in rural areas and reported using medicinal plants occasionally (53.2%), mainly because they perceived these remedies to be less toxic than conventional medicines (54.0%). Most respondents (42.2%) used medicinal plants for therapeutic care, whereas only 20.0% reported using them for preventive purposes. The Internet, books, and television were the primary sources of information on medicinal plants (37.6%). Although 51.8% of participants recognized the potential interactions between medicinal plants and conventional medications, 61.8% reported that they did not inform their physicians about their use of these remedies. Ethnobotanical analysis identified 30 medicinal plant species belonging to 16 plant families, with Lamiaceae being the most frequently represented family, followed by Rutaceae and Apiaceae. This study represents the first comprehensive ethnobotanical survey of medicinal plant use in Diyala Province and provides valuable insights into local health practices, traditional knowledge, and the continued reliance on medicinal plants within the community.

Keywords. Diyala, Ethnobotanical, Medicinal plants, Rutaceae.

Introduction

The utilization of medicinal plants is crucial for advancing societies globally, as they significantly contribute to the health and well-being of nations. Throughout history, medicinal plants have played vital roles in the development of modern drugs like vincristine, vinblastine, and Taxol, and have also served as essential chemical scaffolds for synthesizing numerous drug molecules [1,2]. Therapeutic purposes have been served by almost 13,000 plant species worldwide [3]. The World Health Organization (WHO) states that a staggering 80% of the world's population continues to rely on medicinal plants as their primary source of healthcare [4]. Iraq's diverse terrain and climate have given rise to a wide variety of flora, which has been used for medicinal purposes since ancient times. The people of Iraq have inherited a wealth of knowledge about medicinal plants through oral traditions that date back to the Sumerian era (3000-1970 B.C.) and further developed during the Babylonian and Assyrian periods (1970-589 B.C.). Hammurabi himself issued numerous mandatory announcements on medicine and medicinal plants. Unfortunately, this valuable knowledge is slowly disappearing in modern times, as Al-Douri [5] noted. In the central-eastern region of Iraq lies the province of Diyala (Figure 1), encompassing an expansive area of approximately 17,685 sq km. Bordered by Sulaymaniyah, Salah al-Din, Baghdad, and Wasit provinces, Diyala is a hub of agricultural activity, with dates and oranges being the primary sources of sustenance for the local population. The region has earned a reputation as the orange capital of the Middle East [6]. The geography of Diyala is incredibly diverse, featuring the towering Himreen mountains in the north and arid deserts in the south [7]. Such a unique environment creates a haven for a wide array of plants, making Diyala a true paradise for nature lovers. The Diyala region boasts a diverse population of Arabs, Kurds, and Turkmen with varying ethnic and religious backgrounds. It is important to note that as of 2016, the population of Diyala was 1,133,627, with a majority of 25.5% to 74.5% residing in rural areas. Thankfully, the percentage of people living below the poverty line of 2.5\$ per day in Diyala is lower than the national average, dropping from 18.5% in 2007 to 10.3% in 2011, according to Relief Web [7]. It is concerning that no survey has been conducted on the usage of medicinal plants in Diyala, despite their historical use. It is essential to explore the traditional phytotherapy practices of the residents, particularly given the area's unique location, vast wilderness, and increasing poverty that has led to a reliance on these plants for healthcare. Evaluating their knowledge of using these plants is necessary to ensure their safety and well-being.

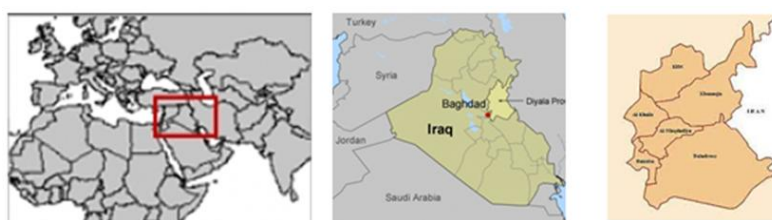


Figure 1. Position of Diyala/Iraq

Methodology

Data collection

Residents in Diyala were surveyed to gather information on their use of traditional medicinal plants. Both interviews and online questionnaires were conducted to collect data on the knowledge of local medicinal plants. The questionnaires included three sections. The first group contained items about participant characteristics: age, gender, marital status, education level, employment history (ever employed, currently employed), and place of residence in Diyala (urban or rural). Monthly income was also included. The second section assessed participants' perceptions of medicinal plants and their attitudes toward using them. The third section identified which specific priority species participants used regularly and the reasons for their use.

Sample size

Data collection for the survey was done either through online distribution on Diyala University's networks or through interviews. The data was gathered for six months, from 1st October 2023 to 1st May 2024. A total of 500 responses were obtained during this period.

Statistical analysis

The analysis was performed using the SPSS v.24.0 (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY, IBM Corp., 2016).

Result and Discussion

Characteristics of the interviewers

Personal information of the interviewers

(Table 1) Presents personal information on the participants, such as gender, age, residence, social status, education level, occupation, and monthly income. Out of the 500 respondents, 76.2% were females, while 23.8% were males. This data strongly suggests that women are more inclined to participate in surveys, which corroborates with past research. A comprehensive analysis of the participants' age revealed that 67.6% were between 18 and 25. Individuals in this age range are more engaged with social media and are more curious about current events and the broader world, which could be a possible explanation. Notably, the location of the participant's residence in Diyala did not significantly impact their interest in medicinal plants. Torres-Aviles proposed in 2016 [8] that the abundance of information on medicinal plants today may be the reason for this occurrence.

Table 1. Demographic profile of participants

Factors	Characteristic	Numbers
Gender	Male	119
	Female	381
Age	>18	10
	18-25	338
	26-34	82
	35-44	49
	55-65	21
	<65	0
Residence	Provincial	259
	Urban	241
Social status	Single	314
	Married	167
	Divorced	8
	Widower	6
Education Level	No certificate	6
	Primary School	11
	Secondary School	25
	High School	129
	Bachelor's degree	300
	Master degree	18
	PhD degree	11
Occupation	School student	24
	University student	242
	Employee	93
	Free business	49
	Retired	4
	Others	88

Monthly income	<300\$	272
	300\$-499\$	61
	500\$-749\$	69
	750\$-999\$	55
	1000\$-1399\$	33
	≥1400\$	10

According to the survey, the majority of participants, 60%, held a bachelor's degree. This level of education is typically considered a first-level higher education, and individuals at this level typically place a high value on surveys. [9]. Nearly half of the participants were university students (48.4%), followed by employees (18.6%), individuals in other occupations (17.6%), those engaged in free business (9.8%), school students (4.8%), and retired individuals (0.8%). The predominance of university students likely reflects greater participation in online surveys and increased awareness of health-related topics. These findings suggest that occupation may influence knowledge and the use of medicinal plants. The findings suggested that monthly income may influence the use of medicinal plants. A majority of participants (56.5%) reported a monthly income of less than USD 300, indicating that financial constraints may limit access to healthcare services and increase reliance on medicinal plants as an affordable alternative [10, 11].

Identify the plants used by the community consistently and why

The second part of our survey focused on the knowledge and use of therapeutic herbs within the Diyala community. The diverse cultures present in Diyala, including Arab, Kurd, and Turkmen, offer valuable insights [12]. The findings indicated that the primary purpose of using medicinal plants was for therapeutic care rather than disease prevention. As shown in Table 2, 42.2% of participants reported using medicinal plants for treatment and recovery, whereas only 20.0% used them as a preventive measure (protection). Additionally, 37.8% of respondents reported using medicinal plants for other reasons. These findings suggest that medicinal plants are predominantly perceived as therapeutic remedies rather than as preventive healthcare measures. [7, 13, 14].

According to the collected data, over fifty percent of respondents occasionally used medicinal plants. 34.4% of them utilized these plants infrequently, 5% always had them on board, and 7.4% utilized them daily (see Table 2). The need for people to reconnect with nature is the most significant, particularly since the medicinal revolution of the eighteenth century [15]. The majority of participants (54%) who were asked why they used medicinal herbs said that they thought these plants had lower toxicity levels. Moreover, a significant percentage (17.8%) of respondents characterized medicinal plants as having a favourable cost-effectiveness, as seen in (Table 2). The findings of this study confirm the long-held notion among persons regarding the safe use of plants. Furthermore, the data presented in the study by Ekor [16] suggest a notable correlation between income level and the extent to which medicinal plants are utilized. The outcome of the study revealed a diverse array of sources from which individuals obtained information regarding the therapeutic attributes of plants. Specifically, 37.6% of participants relied on online databases, books, and media, while 27% sought knowledge from Attar. Additionally, 20% of respondents obtained information from medical professionals and/or chemists, whilst 15% relied on family and friends as their information source (Table 2). Furthermore, many commonly believe that there is an inexhaustible amount of information about the medicinal properties of herbal remedies. Our research revealed that internet databases, books, and television emerged as the primary and valuable sources of information about medicinal plants. This finding aligns with the assertion made by Msomi and Simelane [17] that there exist over 100 websites dedicated to this subject matter. In response to this question, it was discovered that 16.6% of participants had used medicinal plants in combination with other medications, while 67% had answered "No" and 16.4% had chosen "Maybe" (Table 2).

The analyses conducted herein provide insight into the perceptions of participants regarding interactions between plant medicines. A majority of participants (51.8%) agreed with this concept, while 35.8% were uncertain about any potential interference, and only 12.4% expressed a belief that there was no interference, as depicted in (Table 2). This data highlights the fact that individuals are cognizant of the potential side effects that may arise from such interactions, in line with the findings of Owens [18]. Based on the findings presented in (Table 2), it is evident that a significant proportion of study participants, specifically over 50%, did not disclose their use of medicinal plants to their healthcare providers. In contrast, approximately 26.6% of participants reported informing their doctors about their use of medicinal plants. This trend is concerning, as previous studies have indicated potential adverse drug interactions between medicinal plants and conventional medications. It is crucial to raise awareness among patients about the importance of disclosing their complementary and alternative medicine (CAM) usage to their healthcare providers to ensure optimal treatment outcomes and patient safety.

Table 2. Assess the knowledge of participants about herbal medicine

Question	Answer	Frequency(n)	Percentage
The distribution of participants who use medicinal plants	Urban	241	48%
	Rural area	259	52%
The purpose of using medicinal plants?	Protection	100	20%
	Care	211	42.2%
	Other reasons	189	37.8%
Frequency of using medicinal plants	Daily	37	7.4%
	Often	25	5%
	Sometimes	266	53.2%
	Rarely	172	34.4%
The reason behind using the medicinal plants	Inexpensive	89	17.8 %
	Less toxic	270	54%
	Other reasons	141	28.2%
Derived information on medicinal plants	Doctor/ pharmaceuticals	102	20.4%
	Family/friends	75	15%
	Attar	135	27%
	Online/Book/ T.V	188	37.6%
	Others	34	7%
Taking any medicine in addition to herbs	Yes	83	16.6%
	No	335	67%
	Maybe	82	16.4%
The interaction between medicinal plants and medicine	Yes	259	51.8%
	No	62	12.4%
	Maybe	179	35.8%
Inform doctors on the use of medicinal plants	Yes	133	26.6%
	No	309	61.8%
	Maybe	58	11.6%

The ethnobotanical usage of participants

The investigation involved the determination of ethnobotanical utilisation of 30 plant species belonging to 16 distinct families. This assessment was based on responses from a sample of 500 participants. Among the families studied, Lamiaceae had the highest number of used plant species, followed by Rutaceae and Apiaceae in second and third place, respectively. The families Amaryllidaceae, Fabaceae, Lauraceae, Myrtaceae, and Zingiberaceae each contributed two plant species. Asteraceae, Asphodelaceae, Cucurbitaceae, Euphorbiaceae, Lythraceae, Ranunculaceae, Rhamnaceae, and Theaceae each contributed one plant species. Table 3 has a comprehensive summary of these findings. A plethora of research studies have provided robust evidence in support of the utilization of the most commonly utilized botanical entities belonging to the Lamiaceae family. This has been ascertained by the extensive research conducted by Akbulut [19], Kahraman [20], and Uritu [21]. These botanical entities encompass a range of everyday species, including basil (*Ocimum basilicum* L.), chia (*Salvia hispanica* L.), lavender (*Lavandula* sp.), mint (*Mentha* sp.), oregano (*Origanum vulgare* L.), sage (*Salvia officinalis* L.), and thyme (*Thymus vulgaris* L.) [20]. The flora of Diyala, Iraq, includes a wide variety of plant families, with Rutaceae and Apiaceae as the second most common.

The Rutaceae family features plants like Ruta and Citrus, which are known for their citrus fruits, such as lemon, orange, tangerine, grapefruit, and black lime [22, 23, 24]. The Apiaceae family includes a wide variety of flowering plants. It has about 450 genera and 3,500 species. This family contains important aromatic plants such as celery (*Apium graveolens* L.), parsley (*Petroselinum crispum*), anise (*Pimpinella anisum* L.), dill (*Anethum graveolens* L.), fennel (*Foeniculum vulgare* Mill), coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), caraway (*Carum carvi* L.) and carrot (*Daucus carota* L.) [25]. The largest genus in the Amaryllidaceae family is *Allium*, which includes two important food crops: onion (*Allium cepa* L.) and garlic (*Allium sativum* L.). These plants have been used for medicinal purposes for centuries. They contain bioactive compounds such as cysteine sulfoxides, allicin, flavonols, myricetin, quercetin, vinylthiophene, alliin, and ajoene, all identified through research [26, 27, 28, 29]. This research focuses on a selection of plants celebrated in traditional medicine for their healing potential. Begin with the Zingiberaceae family, which gives both turmeric (*Curcuma longa* L.) and ginger (*Zingiber officinale*). Turmeric, in particular, has a strong reputation, with studies pointing to its critical role as an antibacterial, antioxidant, anticancer, and anti-inflammatory agent [30, 31, 32]. The study also incorporated a diverse range of medicinal plants, each selected for its unique phytochemical profile and therapeutic potential.

Chamomile (*Matricaria chamomilla* L.), a member of the Asteraceae family, has long been valued across cultures, with research identifying more than 120 bioactive compounds that make it a prime candidate for therapeutic exploration [33]. *Aloe vera*, belonging to the Asphodelaceae family, has been widely applied in dermatology since the 1930s, particularly for radiation burns, owing to its rich composition of vitamins, saccharides, and bioactive compounds such as arachidonic

acid, cholesterol, and salicylic acid [34,35]. *Citrullus colocynthis* L. (colocynth), from the Cucurbitaceae family, produces a bitter fruit due to compounds such as colocynthin and pectin, whose bioactivity has been documented in recent studies [36, 37]. *Ricinus communis* L. (castor oil plant), native to Africa and part of the Euphorbiaceae family, contains ricinoleic acid and ricinine; its oil has a long history in hair care, with modern evidence supporting its role in revitalizing damaged hair [38, 39]. Pomegranate (*Punica granatum* L.), a resilient fruit of the Lythraceae family, is both commercially and pharmacologically significant, with extracts demonstrating antibacterial, anti-inflammatory, antioxidant, and anticancer activities due to its high phytochemical content [40, 41, 42]. *Nigella sativa* L. (black seed), from the Ranunculaceae family, is a cornerstone of traditional Middle Eastern medicine, valued for its wide array of secondary metabolites with diverse pharmacological potential [43, 44, 45]. *Ziziphus spina-christi* (sidr tree), a member of the Rhamnaceae family, is used in Iraqi traditional medicine for respiratory, digestive, and urinary ailments. It contains saponins, flavonoids, alkaloids, and the distinctive compound christinin-A, noted for its unusual chemical structure [46, 47, 48]. Finally, green tea (*Camellia sinensis* L.) is renowned for its antioxidant properties, largely attributed to polyphenolic catechins, and has shown promise in the treatment of arthritis and skin conditions [49, 50, 51].

Medicinal plants have long been essential in traditional healthcare systems in Diyala. Local populations rely on plant-based remedies for various health issues (Figure 2). A review of how plants are used for different diseases shows clear patterns that reflect the community's health priorities and knowledge of local plants. This study finds that the main use of medicinal plants is to treat digestive disorders, followed by respiratory illnesses, skin issues, fevers, and pain relief. These results suggest that gastrointestinal and respiratory problems are among the most common health concerns addressed within the region's traditional medicine. This observation matches existing ethnobotanical studies in the Middle East and worldwide, where digestive and respiratory health issues often feature prominently in plant-based treatments [52]. These findings highlight the need to protect traditional knowledge and offer direction for pharmacological studies aimed at identifying beneficial compounds in commonly used plant species.

Table 3. Medicinal plants used by the Diyala community

Family name	Scientific name	Medicinal uses
Amaryllidaceae	<i>Allium cepa</i> L.	Energy source, protect teeth, and liver infection
	<i>Allium sativum</i> L.	Increased immunity, reduced cholesterol, and reduced hypertension
Apiaceae	<i>Cuminum cyminum</i> L.	chronic diarrhea, dyspepsia, and acute gastritis
	<i>Pimpinella anisum</i> L.	Cold and flu, Relaxing, Stomach pain
	<i>Petroselinum crispum</i> (Mill.) Fuss	Hypertension, Digestive system, and liver
Asteraceae	<i>Matricaria chamomilla</i> L.	Cough and flu, treat the skin, wash hair
Asphodelaceae	<i>Aloe vera</i> L.	Healthy hair, brighter skin
Cucurbitaceae	<i>Citrullus colocynthis</i> L.	Diabetes
Euphorbiaceae	<i>Ricinus communis</i> L.	Hair treatment
Fabaceae	<i>Senna</i> sp.	Treat constipation, colon cleanse
	<i>Trigonella foenum-graecum</i> L.	Urinary tract infection, Anorexia treatment
Lamiaceae	<i>Lavandula</i> sp.	Help regulate digestion, treat constipation and stomach ulcers, insomnia, calm nerves, and heal nervous spasms
	<i>Mentha</i> sp.	Stomach pain and Tonsils inflammation
	<i>Origanum majorana</i>	Regulating hormones in women
	<i>Thymus vulgaris</i> L.	Treat chest congestion and stimulate saliva
	<i>Salvia officinalis</i> L.	Digestive problems, diarrhea
	<i>Salvia rosmarinus</i>	Headaches, rheumatism, relaxing
Lauraceae	<i>Cinnamomum</i> sp.	Relaxing, reducing stomach ache, reducing menstrual pain, cold and flu
	<i>Laurus nobilis</i> L.	Cooking, sinus problem
Lythraceae	<i>Punica granatum</i> L.	Reduce inflammation and gums pain, and bleeding
Myrtaceae	<i>Syzygium aromaticum</i> L.	Teeth pain
	Eucalyptus	Cold and flu, sinuses, antibacterial properties
Ranunculaceae	<i>Nigella sativa</i> L.	Asthma, diabetes
Rhamnaceae	<i>Ziziphus spina-christi</i> L.	Heal kidney pain
Rutaceae	<i>Citrus limon</i>	Losing weight, clean body

	<i>Citrus sinensis</i>	Source of vitamins and minerals, increases immunity, smooth skin
	<i>Ruta chalepensis</i> L.	Eliminate hair lice, ear pain
Theaceae	<i>Camellia sinensis</i> L.	Improve the immune system, diet
Zingiberaceae	<i>Curcuma longa</i> L.	Food additives, fresh skin, acne
	<i>Zingiber officinale</i> Roscoe	Nausea, dysentery, heartburn, flatulence, diarrhea, loss of appetite, infections, cough, and bronchitis

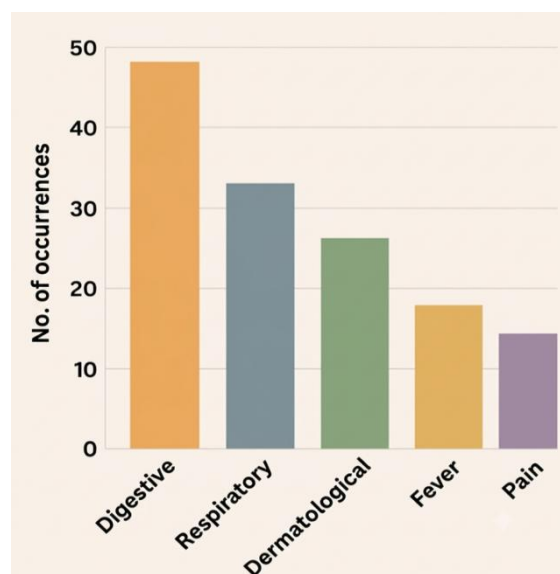


Figure 2. Medicinal plant use frequency

Discussion

Analysis of the survey data indicated that women were more likely to participate than men, consistent with previous studies. The survey also attracted a high proportion of participants with Bachelor's degrees, suggesting that individuals with higher educational attainment may be more willing to participate in research and contribute reliable information [53, 54]. Nearly half of the respondents were university students, indicating that occupation and educational background may influence awareness and knowledge of medicinal plants. Furthermore, the findings suggested that limited financial resources may encourage the use of medicinal plants, as 56.5% of participants reported a monthly income below USD 300, supporting the view that medicinal plants represent an affordable healthcare alternative [10, 11].

Diyala's strategic geographical location and its cultural diversity provide a favorable environment for preserving and transmitting traditional ethnobotanical knowledge [12]. The survey demonstrated that medicinal plants were used primarily for therapeutic care (42.2%), whereas only 20.0% of participants reported using them for disease prevention. These findings are consistent with previous reports indicating that medicinal plants are more commonly used to treat existing health conditions than as preventive healthcare measures [15, 55, 56]. More than half of the participants (53.2%) reported using medicinal plants only occasionally, while only 7.4% used them daily, indicating that medicinal plant use remains largely complementary rather than routine. Similar observations have been reported in studies conducted in Saudi Arabia [57]. The majority of respondents (54.0%) considered medicinal plants to be less toxic than conventional medicines, reflecting the widespread belief that natural remedies are inherently safer, a perception also documented in previous studies [55, 16].

Regarding sources of information, 37.6% of participants relied primarily on the Internet, books, and television. This finding is likely related to the predominance of young adults (18–25 years), who generally have greater access to digital media and online health information [17]. In addition, 67.0% of respondents reported that they did not use medicinal plants together with conventional medicines. Nevertheless, 51.8% recognized the possibility of herb–drug interactions, while 61.8% admitted that they did not inform their physicians about their use of medicinal plants. This lack of communication is concerning because medicinal plants contain biologically active compounds that may interact with prescribed medications and compromise treatment safety. Therefore, healthcare professionals should encourage patients to disclose their use of herbal products to minimize potential adverse interactions and optimize patient care [18, 58].

Future Research Directions

Future research on Diyala's ethnobotanical landscape should focus on several critical domains to advance both scientific understanding and practical application of medicinal flora. The primary objective is to conduct rigorous pharmacological and phytochemical studies that validate the efficacy and safety of documented plant species, which is essential for drug development. In addition, comprehensive ethnographic research into the socio-cultural factors influencing plant use is

necessary to preserve intangible cultural heritage and clarify its role within local knowledge systems [52, 59]. Due to ongoing threats from habitat loss and climate change, conservation biology initiatives targeting threatened species are required to maintain resource sustainability. Furthermore, implementing community-based educational programs on the safe use of medicinal plants, including awareness of potential interactions with pharmaceutical drugs, is vital for public health. Progress in these areas will depend on interdisciplinary collaboration among local universities, healthcare professionals, and traditional practitioners, which will facilitate the integration of validated ethnobotanical knowledge into contemporary healthcare systems and improve health outcomes in the region [06].

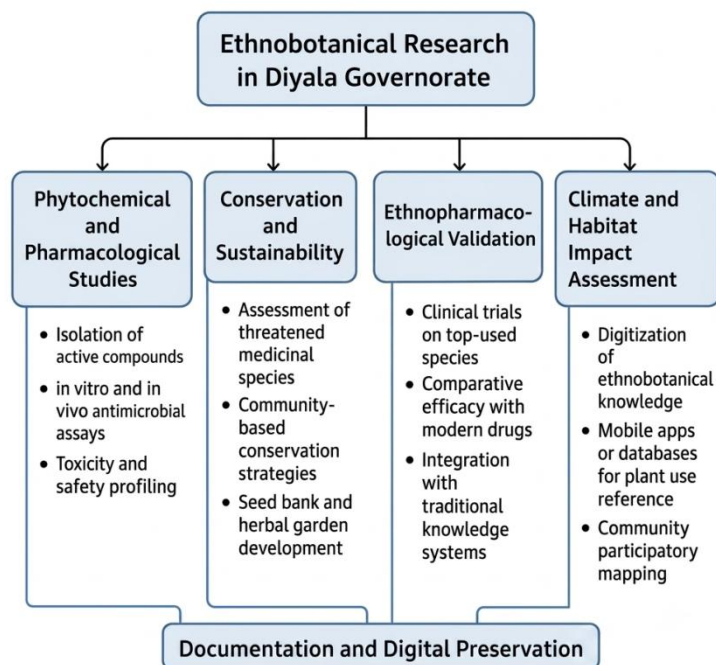


Figure 3. Future research directions

Conclusions

This study represents the first comprehensive ethnobotanical survey of medicinal plant use in Diyala Province, Iraq. The findings demonstrated that medicinal plants remain an important component of healthcare practices, particularly for therapeutic purposes rather than disease prevention. Most participants perceived medicinal plants as less toxic than conventional medicines and obtained information primarily from digital media, books, and television. However, many participants did not inform healthcare professionals about their use of medicinal plants despite recognizing the potential for herb–drug interactions. These findings highlight the need for public education programs that promote the safe and evidence-based use of medicinal plants and encourage communication between patients and healthcare providers. Furthermore, documenting traditional ethnobotanical knowledge contributes to preserving the cultural heritage of the Diyala community and provides a valuable foundation for future pharmacological and ethnobotanical research on the region's medicinal flora.

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