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Ethnobotanical Analysis of Medicinal plants with Antidiabetic Properties within the Population of Kenitra (Morocco)

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ABSTRACT: Phytotherapy is an allopathic discipline that aims to prevent, reduce, and treat certain functional and/or pathological disorders through the use of plants, parts of plants, or preparations derived from them. Diabetes is an example of this. Although chemical and biochemical agents can contribute to diabetes management, there is currently no complete treatment for this disease. Phytotherapeutic remedies represent one of the many alternative methods that can be employed to treat and prevent diabetes as well as its associated complications. This research work focuses on evaluating the place and aspects of this approach among diabetic patients in managing diabetes-related complications. To this end, we conducted a survey of individuals affected by diabetes at the Mouly El Hassan diabetes center in Kénitra. The results obtained show that 23.5% have type 1 diabetes, while 76.3% have type 2. The antidiabetic medications recommended by doctors are 28.4% for insulin injection and 66.7% for oral treatments, while 4.7% follow a diet without medication. 20.8% of diabetics do not use or sometimes use medicinal plants, compared to 78.9% who use them frequently. The most common medicinal plants consist of 31 species, belonging to 21 families. The most represented family is the Lamiaceae. The same result indicates that leaves are the most used, and the most common method is infusion, followed by decoction. Furthermore, the one-way ANOVA analysis shows a significant difference between sex and the use of medicinal plants ($p = 0.000 < 0.05$; $F = 577.510$) on one hand, and between the type of diabetes and the use of medicinal plants ($p = 0.022 < 0.05$; $F = 5.243$) on the other hand. Based on the results of this study, we can assert that the use of medicinal plants by diabetics is a relevant approach to regulate their diabetes. However, precautions must be taken into consideration, particularly regarding the dosage and frequency of use of these plants.

1. INTRODUCTION

Diabetes is the greatest public health problem and is considered the silent epidemic of the 21 century (Nur et al., 2024; Vora & Kaur, 2024). It is a chronic condition characterized by hyperglycemia caused by defective insulin

action, insufficient insulin secretion, or a combination of both (Dmello & Bhagwat, 2024; Rathor et al., 2024). Prolonged persistence of high blood glucose levels leads to a series of harmful complications, including psychological, physical, socio-economic, and even spiritual issues for the patient (Khumalo et al., 2021; Shahidi & Danielski, 2024; Yadav et al.,

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2024). Indeed, various approaches have been established for the management of diabetes, and these complications include insulin, sulfonylureas, biguanides, alpha-glucosidase inhibitors, and thiazolidinediones (Tiwari, 2015). Although these synthetic medications or artificial strategies are widely accessible for treating diabetes and its complications, these medications may have undesirable side effects (Shahzad et al., 2024; Yan et al., 2024). Furthermore, some of these conventional diabetes management approaches are often too costly, especially in poorer and developing countries (Rawal et al., 2012). Therefore, natural remedies based on conventional herbs with rich antioxidant capacity are preferably used extensively in the treatment of diabetes complications (El Kamari et al., 2025; Sachan et al., 2024). Thus, some of these patients have often consulted traditional practitioners who heavily rely on the use of herbs to manage this challenge and the associated health conditions. As a result, medicinal plants as natural resources are potential sources of new phytoactive ingredients that exhibit antidiabetic properties with fewer side effects compared to synthetic remedies for diabetes complications (Patle et al., 2021; Ponnusamy et al., 2011). Indeed, numerous research works, including those by (Jugran et al., 2021; Sudhakar et al., 2021), indicate that these herbal decoctions have shown robust antioxidant potential and could reduce diabetes complications when consumed. In Morocco, this chronic pathology remains a major public health issue, with a significant number of people affected (Dankoly et al., 2023; Mharchi & Maamri, 2023). The wealth of traditional pharmacopoeia based on the use of medicinal plants plays a considerable role in health care in the country (Chaachouay et al., 2019; EL Boullani et al., 2022). Several research works have been conducted in this context, among them, those by (Chebaibi et al., 2016; Douira & Zidane, 2015; Doukkali et al., 2015; El Hafian et al., 2014). However, with the exception of a comprehensive study conducted by (Salhi et al., 2010), no study has specified the use of medicinal plants to manage and reduce complications of diabetes in the city of Kénitra. Thus, the objective of the present study was to evaluate the medicinal plants used by the inhabitants of Kénitra in order to contribute to the knowledge of indigenous plants used for the treatment of diabetes. Moreover, it is very important to transform this traditional knowledge into scientific knowledge in order to enhance, preserve, and use it rationally.

• Problem of Study

The basis of the problem of the study can be summarized in the following question:

- What are the main plant species traditionally used to treat diabetes in Kénitra?

• Importance of study

- Medicinal plants can be used in conjunction with drug treatments to improve blood sugar control and reduce side effects.
- The study of traditionally used plants may lead to the discovery of new molecules with antidiabetic properties, thus opening new perspectives for drug development.

2. MATERIALS AND METHODS

2.1. Study Area

Kénitra (figure 1) is a territory defined by the latest urban development master plan, whose perimeter includes the cities of Kénitra, Mehdyia, Sidi Yahia du Gharb, as well as nine surrounding rural communes. This territory extends over a total area of 1,752 km² and has a coastline of 60 km. It is part of the geographical area commonly referred to as the Gharb plain, which includes the lower plain, the northern pre-Rif hills, and the northern edge of the Maâmora forest. This area covers approximately 7,000 km² (Karibi & Messous, 2019).



Figure 1. Geographical situation of the study area

2.2. Sampling

The study took place over 4 months (January/April) of the year 2024 at the Moulay el Hassan diabetes center in Kenitra. Direct interviews were conducted with 450 diabetic individuals to identify the medicinal plants used to manage diabetes complications. The questionnaires included personal information about the individuals affected by diabetes, the type of diabetes, the parts of the plant used, and the preparation methods. The time spent on each interview was approximately 40 minutes, and all respondents were informed about the purpose of the study. It should be noted that the participants were randomly selected to ensure the representativeness of the sample.

2.3. Calculation of the questionnaire's validity

The validity of the questionnaire was confirmed by submitting it to a group of members of the physicians at the Moulay El-Hassan primary health center in the Kénitra region in 2024, in order to gather their opinions and comments regarding the comprehensiveness of the questionnaire's dimensions, the representativeness of the statements in relation to the axes and dimensions addressed, their relevance as well as the clarity of each statement. Subsequently, the choice of responses for each

of the statements was calculated. As a result, some statements were eliminated while others were modified and rephrased.

2.4. Calculation of the reliability of the questionnaire

The reliability coefficient was determined using Cronbach's alpha coefficient to evaluate the reliability of each dimension of the questionnaire as well as that of the questionnaire as a whole, as shown in tables 1 and 2. The search for the reliability of this questionnaire shows a Cronbach index of 0.7, which indicates a reasonable reliability of the questionnaire.

Table 1

Cronbach's alpha reliability statistics

Reliability Statistics	
Cronbach's Alpha	Number of Items
,700	18

2.5. Statistical analysis of the data

The collected data was entered and filtered in Excel and then transposed onto a SPSS (version 25.0 free) platform. Qualitative variables are expressed as percentages and quantitative variables are expressed as mean \pm standard deviation. The chosen hypothesis tests are the chi-square test of independence and one-way Anova. The significance level was set at 0.05.

3. RESULTS

3.1. Sociodemographic Characteristics of the Respondents

The study we conducted involved 450 respondents, of whom 76.1% ($n = 343$) are over 60 years old, 13.3% ($n = 60$) are between 50 and 60 years old, 6.4% ($n = 29$) are between 40 and 50 years old, 2.9% ($n = 13$) are between 30 and 40 years old, and 1.1% ($n = 5$) are under 30 years old Table 3. Additionally, 74.7% ($n = 337$) are female compared to 25.1% ($n = 113$) who are male. Similarly, regarding educational level, 84.8% ($n = 202$) have primary education, 36.9% ($n = 166$) have secondary education, and 14% ($n = 63$) have higher secondary education, while participants with a university level represent only a small proportion at 14.2% ($n = 19$). Regarding family status, 77.4% ($n = 349$) of respondents stated that they are married, compared to 13.7% ($n = 62$) who are single. The others reported being divorced or widowed, with percentages of 4.2% ($n = 19$) and 4.4% ($n = 20$) respectively. Furthermore, among the 450 respondents, 34.6% ($n = 156$) reported being unemployed. The others indicated that they hold different positions, including 4.7% ($n = 21$) who are students. Regarding socio-economic level, more than half of the respondents reported having a low socio-economic level, compared to 34.1% ($n = 154$) who reported having an average level, while only 8.2% ($n = 37$) reported being affluent.

3.2. Disease-related criteria

Table 4 summarizes the various disease-related criteria. Thus, according to the responses of the respondents, we distinguish two groups of types of diabetes: group 1 is characterized by type 1 diabetes (T1D), which affects 23.5% ($n = 106$) of those with this type of diabetes, and group 2 (T2D), which affects 76.3% ($n = 344$) of those with this type. Regarding the duration of diabetes, nearly half of the respondent's report that the duration of diabetes exceeds ten years (45.2%; $n = 204$), while others state that it ranges from 5 to 10 years (35.9%; $n = 162$), and the remainder report that the duration of diabetes does not exceed 5 years (18.6%; $n = 84$). As for the type of recommended treatment, the study showed that 66.7% of respondents take oral medication, and 28.4% stabilize their diabetes through insulin injections, while 4.7% of diabetic patients follow a strict diet without treatment.

3.3. Use of medicinal plants

Table 5 shows the results of yes or no responses regarding the use of medicinal plants by the respondents. Indeed, 78.9% ($n = 356$) reported that they use medicinal plants to manage complications related to diabetes, compared to 20.8% ($n = 94$) who do not.

Furthermore, among this category that confirmed they use medicinal plants to alleviate complications of diabetes, we were able to identify the main plants used for this purpose (Table 6). Indeed, 33 species of medicinal plants were reported by the respondents, belonging to 21 families. The most represented family is the Lamiaceae (8 species), followed by the Myrtaceae family (3 species). The Asteraceae and Cucurbitaceae families are each represented by 2 species. The other families are each represented by only one species.

Similarly, among the 356 individuals, or 78.9%, who report using medicinal plants, 57% ($n = 257$) confirm that leaves are the most commonly used part, while roots, fruits, and other parts of the plant represent only low proportions ranging from 5.8% to 9.3% (Table 7). It is noteworthy that infusion and decoction are the most commonly employed preparation methods, accounting for 39.9% and 33.5%, respectively, based on respondents' answers. Regarding the mode of administration, 60.8% of the 356 respondents confirm that they use these plants orally, while 14.4% use them for massage; only a small proportion of 3.8% indicates that this use is for rinsing. Furthermore, among the 356 individuals who report using medicinal plants, 32.8% state that they use them to reduce or prevent complications of diabetes related to vascular diseases, 19.7% declare they use them to reduce osteo-articular complications related to diabetes, 5.1% to reduce genito-urinary conditions, and 21.3% use them for other diabetes-related complications.

Similarly, the analysis of the results obtained from the chi-square test (Table 8) indicates that women (at 94.1%) tend to use medicinal plants significantly more frequently than men (at 19.5%).

Table 2

Statistics of total items

Item's	Average of scale in case of removal of an item	Variance of the scale in the case of removing an element	Complete correlation of corrected elements	Cronbach's alpha in case of item deletion
Item 1. Have you ever used medicinal plants to manage your diabetes?	28,1000	29,610	-,134	,714
Item 2. How long have you been using these plants?	27,5667	29,289	-,085	,726
Item 3. What is the frequency of use?	27,2333	25,426	,225	,701
Item 4. Duration of use (processing time)?	27,5667	25,564	,449	,672
Item 5. Mode of administration ?	27,6667	26,506	,266	,690
Item 6. Use to manage complications?	27,4667	24,671	,431	,670
Item 7. How do you prepare and consume these plants?	26,8000	21,545	,624	,635
Item 8. Why did you choose to use these plants?	27,2333	24,806	,448	,668
Item 9. Have you consulted a healthcare professional before starting to use these plants?	27,6667	27,402	,300	,689
Item 10. Have you informed your treating physician about your use of medicinal plants?	28,0000	28,345	,125	,700
Item 11. In your opinion, do these plants have an effect on your blood sugar?	27,9667	26,585	,357	,682
Item 12. What motivated you to use medicinal plants?	27,8667	27,706	,094	,709
Item 13. Which part of the plant do you use?	27,1000	21,955	,587	,642
Item 14. Where do you get these plants?	27,8333	26,006	,390	,678
Item 15. What benefits do you expect from these plants?	27,7000	26,838	,243	,692
Item 16. Do you think that these plants improve your blood sugar control?	28,1000	28,852	,038	,705
Item 17. Would you recommend the use of these plants to other diabetic individuals?	28,2333	28,116	,373	,691
Item 18. Do you think you have enough information about medicinal plants and diabetes?	28,0000	27,586	,282	,690

Furthermore, the use of one-way ANOVA shows that there are no significant differences between the use of medicinal plants and the dependent variables such as age, academic level, and duration of diabetes. On the other hand, there is a highly significant difference between gender and the use of medicinal plants ($0.000 < 0.05$; $F = 577.510$) on one hand, and a significant difference between the type of diabetes and the use of medicinal plants ($0.022 < 0.05$; $F = 5.243$) on the other hand (Table 9). Regarding the duration of use of these plants and their frequency of use, this same analysis shows that there are no significant differences (0.819 and $0.701 > 0.05$).

4. DISCUSSION

In this research work, the targeted population is randomly selected and concerns individuals affected by diabetes. The studied sample is characterized by a gender ratio in favor of women (74.7%; $n = 337$), indicating that women tend to resort to medicinal plants significantly more often than men. This supports the conclusions of other ethnobotanical studies conducted on a national level, including that of (Douira & Zidane, 2015). Moreover, the age of the majority of respondents

is over 60. Indeed, as reported by several research studies including those by (Douira & Zidane, 2015), these elderly individuals are considered more reliable sources of information due to their possession of a significant portion of ancestral knowledge that is passed down orally. As for the academic level, nearly half of the respondents have a primary education level. This can be explained by the fact that these individuals were farmers before settling in Kénitra. The results obtained show that the majority of respondents are affected by type 2 diabetes. Indeed, although antidiabetic medications are available on the Moroccan pharmaceutical market, the use of medicinal plants to treat, manage, and reduce complications from diabetes often proves fruitful (Kooti et al., 2016). In this regard, the surveyed population reports using a significant number of medicinal plants to treat and manage diabetes complications; for example, some plants from the Lamiaceae, Cucurbitaceae, Asteraceae, Myrtaceae, Fabaceae, Amaryllidaceae, Anacardiaceae, Apiaceae, and Apocynaceae families. This is explained by the fact that these plants have more potent hypoglycemic effects because they contain compounds such as flavonoids, tannins, phenolics, and alkaloids due to their insulinomimetic activity (Matalqah & Al-

Table 3

Variation of age, sex, education level, type of diabetes, and duration of diabetes according to participants' responses

	Parameter	Frequency	Percentage %	Mean \pm Standard deviation
Age	Under 30 years old	5	1,1	4.6067 \pm 0,82200
	Between 30 and 40 years old	13	2,9	
	Between 40 and 50 years old	29	6,4	
	Between 50 and 60 years old	60	13,3	
	Over 60 years old	343	76,1	
Sex	Masculine	113	25.1	1.7489 \pm 0.43413
	Feminine	337	74.7	
Academic Level	Primary	202	84.8	1.7756 \pm 0.84201
	College	166	36.9	
	Secondary	63	14	
	University	19	4.2	
Profession/Activity	Employee	44	9,8	2.9333 \pm 1.37590
	Unemployed	156	34,6	
	Merchant	40	8,9	
	Farmers	44	9,8	
	Student	21	4,7	
	Retired	145	32,2	
Family Situation	Single	62	13,7	1.9911 \pm 0.59314
	Married	349	77,4	
	Divorced	19	4,2	
	Widower	20	4,4	
Socio-economic Level	Low	259	57.4	1.5067 \pm 0.64446
	Average	154	34.1	
	Well-off	37	8.2	

Table 4

Distribution of diabetes type, duration of diabetes, and medical treatment used according to participants' responses

	Parameter	Frequency	Percentage %	Mean \pm Standard deviation
Type of diabetes	Type 1 (DT1)	106	23.5	1.7644 \pm 0.42482
	Type 2 (DT2)	344	76.3	
Duration of diabetes	Less than 5 years	84	18.6	2.2667 \pm 0.75509
	Between 5 and 10 years	162	35.9	
	More than 10 years	204	45.2	
Medical treatment used	Oral treatments	301	66,7	1.3778 \pm 0.57370
	Insulin treatments	128	28,4	
	Diet without treatment	21	4,7	

Table 5

Distribution according to the yes or no response to the use of medicinal plants

Item	Yes	No	Average \pm Standard deviation
Use of medicinal plants	356 (78,9%)	94 (20,8%)	1.2089 \pm 0.40697

Table 6

Species used for the management of complications related to diabetes according to the participants' responses

Plant family	Scientific name of the plant	Common name	Used part of the plant	Preparation method
Amaryllidaceae	<i>Allium cepa</i> L.	Al'Bassla	Bulb	Cru
Anacardiaceae	<i>Pistacia lentiscus</i> L	Aldru	Leaves	Deco, infu
Apiaceae	<i>Ammi visnaga</i> (Lam)	Bachnikha	Fruits	Decoction
Apocynaceae	<i>Nerium oleander</i> L.	Defla	Leaves	Deco, infu
Asteraceae	<i>Artemisia absinthium</i> L. <i>Artemisia herba alba</i> Assac.	Chiba Chih	Aerial part Leaves, Aerial part	Deco, infu Powder, deco, Infu.
Capparaceae	<i>Capparis spinosa</i> L	Al'Kabbar	Aerial part Fruits	Decoction
Chenopodiaceae	<i>Chenopodium ambrosioides</i> L	Mkhinza	Leaves, Flowers	Deco, infu.
Cucurbitaceae	<i>Cucurbita pepo</i> L <i>Citrullus colocynthis</i> L Schrad	L'krâa Lhdej	Seeds	Deco, Powder Déco, Powder
Cupressaceae	<i>Tetraclinis articulata</i> Benth.	Al'Araâr	Leaves	Powder, maceration
Fabaceae	<i>Trigonella foenum-graecum</i> L.	Al'Houlba	Seeds	Déco, Powder ,maceration
Lamiaceae	<i>Ajuga iva</i> (L.) Schreb. <i>Calamintha officinalis</i> Moench <i>Marrubium vulgare</i> L. <i>Origanum compactum</i> Benth. <i>Lavandula dentata</i> L. <i>Rosmarinus officinalis</i> L. <i>Salvia officinalis</i> L <i>Thymus vulgaris</i> L.	Chendgora Manta Merriwta Zaâtar Lakhzama Azir Assalmiya Zâaytra	Aerial part Aerial part Aerial part Leaves Aerial part Leaves Leaves	Decoction Deco., infu. Decoction Infusion Deco Powder Decoction Infusion Infusion
Myrtaceae	<i>Eucalyptus globulus</i> Labill (sp.) <i>Eugenia caryophyllata</i> <i>Myrtus communis</i> L.	Al' Kalitouss Qronfel Arraihan	Leaves Leaves Leaves	Decoction Decoction Decoction
Oleaceae	<i>Olea europaea</i> var. <i>sativa</i>	Zitoun	Leaves Fruits	Deco, Infu, oil
Pedaliaceae	<i>Sesamum indicum</i> Dc	Ajenlane	Seeds	Infusion, Powder
Ranunculaceae	<i>Nigella sativa</i> L.	Assanouj	Seeds	Decoction, Powder
Rutaceae	<i>Ruta montana</i> L.	Al'Fijel	Aerial part	Deco, Infu, Powder
Urticaceae	<i>Urtica dioica</i> L	Hourrika	Aerial part	Infusion
Verbenaceae	<i>Lippia citriodora</i>	Alwiza	Leaves	Deco, Infu.
Zingiberaceae	<i>Zingiber officinal</i> Rosc.	Sekinjbir	Rhizome	Deco, Powder, maceration
Aristolochiaceae	<i>Aristolochia longa</i> L.	Berez'tem	Rhizome	Powder
Polygonaceae	<i>Rumex acetosa</i> L.	Hommidia	Seeds	Infusion

Tawalbeh, 2025). Furthermore, the majority of participants in this survey state that the leaves are the most used parts when managing diabetes complications, which confirms the results obtained from numerous research works, including those by (Arraji et al., 2024). It should be noted that (Hajipour et al., 2024) explain the use of medicinal plant leaves by the fact that they are the main site of photosynthetic reactions and consequently the location for the synthesis of various primary and secondary metabolic compounds of the plant. On the other hand, one-way Anova analysis shows a significant difference between gender and the use of medicinal plants ($p = 0.000 < 0.05$; $F = 577.510$) on one hand, and between the type of diabetes and the use of medicinal plants ($p = 0.022 < 0.05$; $F = 5.243$) on the other hand. However, no difference is found between the use of medicinal plants and the duration of

diabetes, academic level, and age of respondents. Compared to other recently published works, the authors state that, based on their studies, the duration of diabetes, academic level, and age of respondents have significant differences (Selih et al., 2015), which is not the case in our study. As for the frequency of use of these plants and their duration of use, the Anova test indicates no significant differences respectively ($,819 > 0.05$; $F = ,053$ and $,544 > ; F = ,369$). This can be explained by the fact that the respondents take these plants in an arbitrary manner, which can be considered a risk to their health. Indeed, as reported in several studies including those by (Nchinech et al., 2024), the uncontrolled therapeutic use of medicinal plants leads to various diseases, nephrotoxicity being one of them, which is due to the regular intake of these plants, hence the need for active measures to regulate this sector (Naouaoui et al., 2020).

Table 7

Distributions of the part of the plant used, the method of preparation, the mode of administration, and the reasons for use according to the participants' responses

Parameter		Frequency	Percentage %	Average \pm Standard deviation
Used part of the plant	Leaf	257	57,0	1.5112 \pm 0.92987
	Root	42	9,3	
	Fruit	31	6,9	
	Other	26	5,8	
Preparation method	Infusion	180	39.9	1.6152 \pm 0.78052
	Decoction	151	33.5	
	Poultice	12	2.7	
	Raw	8	1.8	
Administration method	Other	5	1.1	1.2781 \pm 0.54507
	Oral	274	60.8	
	Massage	65	14.4	
	Rinse	17	3.8	
Use to manage complications	Cardiovascular conditions	148	32.8	2.1882 \pm 1.23607
	Osteoarticular conditions	89	19.7	
	Genitourinary conditions	23	5.1	
	Other	96	21.3	

Table 8

Cross-tabulation of Sex * Have you ever used medicinal plants to manage your diabetes?

Parameter		Have you ever used medicinal plants to manage your diabetes?		Total	
		Yes	No		
Sex	Masculine	Effective	22 _a	91 _b	113
		% in Gender	19,5%	80,5%	100,0%
		% in Have you ever used medicinal plants to manage your diabetes?	6,5%	82,0%	25,1%
	Feminine	Effective	317 _a	20 _b	337
		% in Gender	94,1%	5,9%	100,0%
		% in Have you ever used medicinal plants to manage your diabetes?	93,5%	18,0%	74,9%
Total		339	111	450	

Table 9

Degree of significance of the different parameters according to the one-way Anova test

Parameter		Sum of squares	ddl	Mean square	Sig.
Age	Inter-groups	,644	1	,644	,329; $F = ,953$
	Intra-groups	302,736	448	,676	
Sex	Inter-groups	47,656	1	47,656	,000; *** $F = 557,10$
	Intra-groups	36,969	448	,083	
Academic level	Inter-groups	,200	1	,200	,596; $F = ,281$
	Intra-groups	318,131	448	,710	
Type of diabetes	Inter-groups	,937	1	,937	,022; ** $F = 5,243$
	Intra-groups	80,094	448	,179	
Duration of diabetes	Inter-groups	,884	1	,884	,213; $F = 1,553$
	Intra-groups	255,116	448	,569	
Frequency of use of medicinal plants	Inter-groups	,060	1	,060	,819 ; $F = ,053$
	Intra-groups	402,996	354	1,138	
How long have you been using these plants?	Inter-groups	,135	1	,135	,544 ; $F = ,369$
	Intra-groups	129,416	354	,366	

5. CONCLUSION

The consumption of herbs as a treatment for managing complications of diabetes remains widespread among a significant portion of the Moroccan population, due to their accessibility and low cost, while also presenting relatively low toxicity. Furthermore, it is worth noting that the use of medicinal plants is a relevant alternative to synthetic drugs. Additionally, traditional medicine continues to be widely practiced by the Moroccan population for the treatment of various ailments, including diabetes. Consequently, with the increasing interest in medicinal plants, it is essential to conduct thorough scientific research on these plants, especially regarding their frequency of use and the necessary dosage.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

ETHICAL CONSIDERATIONS

Not applicable (the authors are committed to assuming full responsibility in this regard).

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