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Herbal Practices for Urolithiasis Treatment: An Ethnobotanical Approach in Western Algeria (Relizane)

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Abstract

Based on ethnopharmacological knowledge, plants are used worldwide, across various countries and cultures, for the prevention and treatment of kidney stones, which remain a major health concern. To document the traditional uses of medicinal plants in western Algeria and preserve our cultural heritage, an ethnobotanical survey was conducted in Relizane Province from February to May 2024. A total of 200 informants were interviewed using a semi-structured questionnaire. The data were analyzed using the Frequency Citation (FC) and Relative Frequency Citation (RFC) indices. The results showed that *Herniaria hirsuta*, *Hordeum vulgare*, *Atriplex halimus*, and *Petroselinum crispum* were the most commonly used species by the inhabitants of the region to treat urolithiasis. The Caryophyllaceae family was the most represented, followed by Apiaceae, Poaceae, and Amaranthaceae. Leaves were the most commonly used part, while infusion was the dominant method of preparation. These results can serve as a basis for further pharmacological and phytochemical studies to evaluate the therapeutic effects of anti-lithiasic plants.

Key Words: Urolithiasis, medicinal plants, *Herniaria hirsute*, kidney stones, Relizane.

Introduction

Medicinal plants are an invaluable heritage for humanity. Used for centuries for their healing properties, their methods of use have been passed down from generation to generation, based on theories, beliefs, and experiences without knowing their chemical composition or effects. Although significant advances have been made in the pharmaceutical field, the therapeutic use of plants remains widespread, particularly in Algeria, a country with exceptional floristic diversity.

Urolithiasis, derived from the Greek *ouron* (urine) and *lithos* (stone), is a condition characterized by stones formation in in any part of the urinary tract such as kidneys, ureters, urinary bladder and urethra (**Salman *et al.*, 2018**). Promoted by metabolic or renal disorders, anatomical abnormalities, digestive diseases, urinary infections, as well as poor dietary habits, these dysfunctions lead, through various mechanisms, to the oversaturation of urine with substances capable of crystallizing and forming stones (**Courbebaisse *et al.*, 2020**). Worldwide, the affected population is estimated at 2 to 3% (**Mbouché *et al.*, 2023**).

Several therapeutic strategies have been developed for the treatment of urinary stones, most of which are surgical in nature, making them costly and not always widely accessible. As a result, many people turn to herbal medicine as an effective alternative technique that is economical, easily available, and has few or no side effects for the treatment of kidney stones or urolithiasis. According to the World Health Organization (WHO) data, nearly 80% of the world's population relies on traditional medicine to treat various diseases. Meanwhile, 40% of approved drugs today are derived from natural substances, highlighting the importance of preserving these resources for public health and the development of treatments. Various studies have been published on the medicinale plantes employed for urolithiasis in Algeria (**Mechri *et al.* 2023; Taïbi *et al.*,2020; Khitri *et al.*, 2016**). The aim of the present study is to inventory and gather as much information as possible on medicinal plants used in traditional medicine for the treatment of urolithiasis in the province of Relizane, Algeria.

Materials and Methods

Study area

Relizane province is located in north-western Algeria and is considered a link between the western, central, eastern, and southern regions of the country. It covers an area of 4,851.21 km², mainly consisting of rural zones, which represent 70% of the total area. It is composed of 38 communes distributed across 13 districts, with an estimated population of 743,500 people. This area is characterized by a semi-arid bioclimatic stage (**Fig.1**).

Data collection

A cross-sectional descriptive ethnobotanical study was conducted, aimed at identifying medicinal plants traditionally used for the treatment of urinary lithiasis in the city of Relizane. For this purpose, semi-structured questionnaires and face-to-face interviews were administered to 200 (N = 200) patients with urinary lithiasis coming for consultations with urologists in the city, through a series of field visits conducted over a period extending from February to May 2024. The questionnaire had two parts: the first part consisted of collecting demographic characteristics of people (gender, age, study level, family status, locality, etc.), and the second part dealt with gathering information about the uses of medicinal plants such as local name, parts used, mode of preparation and administration modes.

The data was processed by Excel software; results were interpreted using standard descriptive statistical methods, GraphPad Prism 8 was used for creating graphs. The frequency of citation (FC) and Relative frequency of citation (RFC) was calculated; The (FC) is described as the number of informants citing the use of plant species obtained by; $FC = \frac{n}{N} \times 100$ **n**: number of people who cited the species, **N**: total number of respondents

RFC is calculated to appreciate the local importance of each species. The RFC is the result of the citation frequency (Fc), which is the number of informants who mentioned the use of the species, divided by the total number (N) of respondents. $RFC = \frac{FC}{N}$

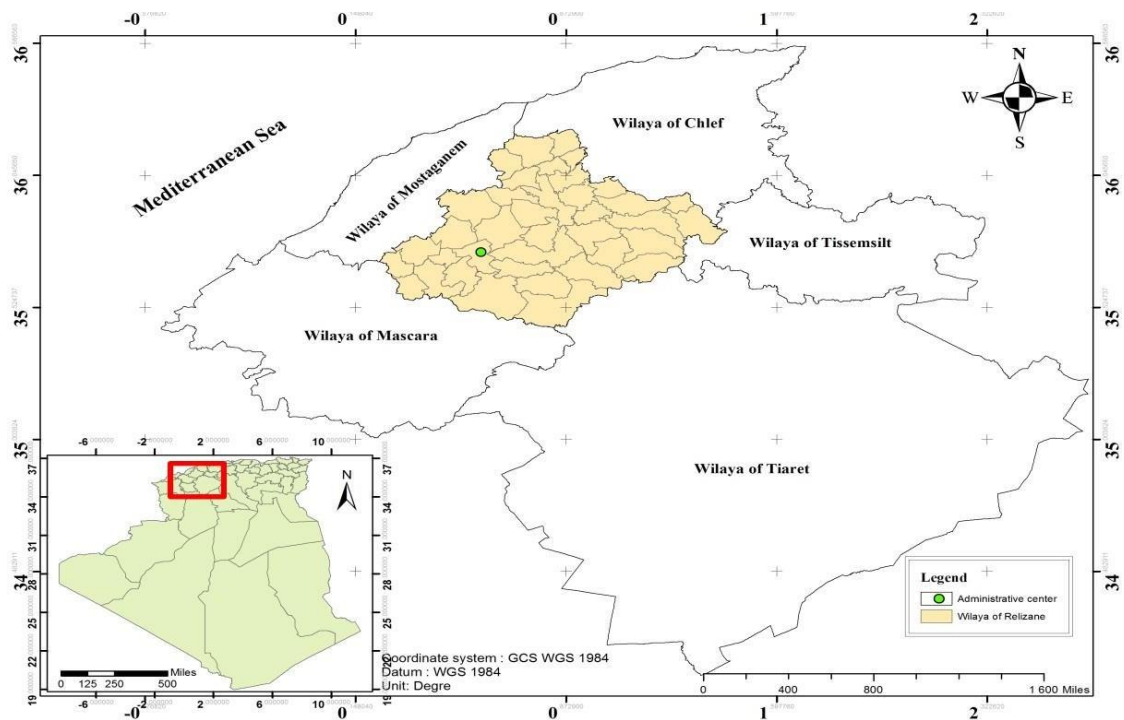


Fig.1 geographical location of the study area

Results and discussion

The ethnobotanical survey involved interviewing 200 patients with urinary lithiasis. The results presented in **table.1** indicate a female predominance, with 57% of participants being female compared to 43% male. The predominance of women in the population studied reflects their greater knowledge of medicinal species than men, as well as their leading role in the use of traditional therapies. Women are looking for natural herbal remedies to maintain their health and that of their families. In a retrospective epidemiological study on urolithiasis in western of Algeria, conducted by **Sbahi *et al.* (2021)**, a male predominance was observed. This later has experienced significant variations over 50 years from 1965 to 2014. Our results are similar with those of **Mechri *et al.* (2023)**, who observed a female predominance (57%) in a sample of 450 patients from five university hospitals located in the northeastern region of Algeria. a female predominance was recorded In an ethnobotanical study on the antolithiasis plants used by the population of the Izarène forest, located in the northwestern part of Morocco, with 75% of women compared to 25% of men (**Orch *et al.*, 2020**).

The use of medicinal plants for the treatment of urinary lithiasis spans all age groups. The highest frequencies were noted among patients aged 30 to 40 years (40%) and 40 to 50 years (26%), followed by 14% for those aged 20 to 30 years, and then 10% for the 50 to 60 and over 60 age groups. A very low proportion of 1% was observed among those under 20 years old. It is well established that older people provide more reliable information on the traditional use of medicinal plants, as they hold much of the ancestral knowledge passed down orally. This study's dominant age category (30–40 years) was similar to that observed in Algeria by **Ouelbani *et al.*, (2016)** in Constantine and Mila in northeast and **Boudjelal *et al.*,(2013)** in Msila region .

According to the education level, 55% of patients have a secondary education, 18.5% have a primary education, and 16% have a university education, while illiterate individuals account for only 10.5%. Additionally, the highest percentage of medicinal plant use for urinary stones was observed among married individuals, with 56.5% (113), compared to 43.5% (87) among single individuals. This result can be explained by the constraints of family life and the responsibilities of parents towards their household, especially given the high costs of medications, this encourages them to use medicinal plants, which are less expensive and sometimes even more effective (**Ourgha *et al.* , 2024**).

In terms of monthly income, 31% of respondents earn less than or up to 20,000 DA, while only 2% earn an income of 50,000 DA or more. Approximately 29.5% have an income between 25,000 and 35,000 DA, and 15.5% fall within the range of 35,000 to 45,000 DA. The most represented category is those with an income of 20,000 DA or less. This result can be explained by the fact that traditional medicine serves as an alternative for individuals with a modest monthly income. As a result, interest in the use of medicinal plants is increasing. This result aligns with **Khouchlaa et al.,(2016)**, which stated that resorting to traditional medicine would serve as an alternative for individuals with a modest monthly income. Several studies have reported that there is a profound relationship between income and the use of medicinal plants (**Ourgha et al. 2024; Chaachouay et al., 2020, Ammor et al., 2020**). The use of medicinal plants for various health issues is not only a choice but is also linked to poverty and the high costs of modern medicines (**Ngbolua et al., 2011**).

We observed that 89% of patients had their stones located in the kidneys, while 8% were found in the ureter and 3% in the bladder (**Fig. 2**). This localization was predominantly in the right kidney, accounting for 65.73%, whereas the left kidney hosted 34.26% of the stones (**Fig.2**). This result does not agree with those reported by **Djelloul et al.,(2006)**. In a study of 1,354 calculi collected in Western Algeria, a predominance of left-sided stones was observed (56.4% vs. 42.5%).

Table.1: Socio-demographic characteristics of the of the informants

	Distribution	Number of informants	Percentages (%)
Gender	Male	86	43
	Female	114	57
Age	≤ 20	1	0,5
	] 20-30]	27	13,5
	] 30-40]	80	40
	] 40-50]	52	26
	] 50-60]	20	10
	≥ 60	20	10
Education level	Illiterate	21	10,5
	Primary	37	18,5
	Secondary	110	55
	University	32	16
Family situation	Married	87	43,5
	Single	113	56,5
Monthly income	≤ 20000	62	31
	25000-35000	59	29,5
	35000-45000	31	15,5
	≥ 50000	4	2
	ND	44	22

Ethnobotanical data

The analysis of the data collected allowed for the identification of 16 species of medicinal plants belonging to 12 botanical families, used by the local population in the Relizane province for the treatment of urinary lithiasis. The frequency of the species mentioned by the surveyed patients with lithiasis varies, this variation could be attributed to factors such as tradition, efficacy, availability, or cost in the market (**Mechri et al., 2023**). Results are presented in **Table.2**.

To highlight the importance of ancestral knowledge, a high relative citation frequency (RCF) was determined and assigned to the most recommended plant species by the local population. Thus, these plants have a high level of use. On the basis of relative citation frequency the most cited plant species by the informants were (**Fig.3**); *Herniaria hirsuta* (RFC= 0,280), *Hordeum vulgare* (RFC= 0,185), *Atriplex halimus* (RFC= 0,150), *Petroselinum crispum* (RFC= 0,130), *Apium graveolens* (RFC= 0,075), *Citrus limon* (RFC= 0,055).

In this survey (**Fig.4**), the *Caryophyllaceae* (27%) family was the most represented, followed by *Apiaceae* (20%), *Poaceae* (19%) , and *Amaranthaceae* (15%). In a field survey conducted over three years, from June 2017 to July 2020, a total of 385 herbalists and traditional healers from different regions of Algeria were interviewed **Taïbi et al.,(2021)** declared that *Lamiaceae*, *Apiaceae*, *Asteraceae*, and *Poaceae* were the most represented families used for the traditional therapy of urinary diseases. **Mechri et al.,(2023)** reported that *Lamiaceae* , *Apiaceae* followed by *Poaceae* are the most recommended by lithiasis patients in in the North East of Algeria.

In Algeria, several studies have reported the use of *Herniaria hirsuta* in traditional medicine, for treatment of urolithiasis. **Yabrir et al.,(2018)** stated that, in Djelfa region *Herniaria hirsuta* was the most species cited by the local population with RFC= 0.91 for the treatment of kidney stones. Our results are consistent with those of **Khitri et al., (2016)**, who found that *Herniaria hirsuta* is the most frequently cited plant by the population of the city of Oran, located in northwestern of Algeria. Several ethnobotanical studies carried out in Morocco have reported the use of *H. hirsuta* against kidney stones (**Orch et al., 2020; Salhi et al., 2010; Lahsissene et al.,2009**). Phytochemical analysis and pharmacological studies revealed that *H. hirsuta* contained phenolics, flavonoids, flavonols and saponins (**Taïbi et al., 2021; Al-Snafi.,2019**). It was reported that *H. hirsuta* have antiurolithiatic effect and act as

preventive agent for calcium oxalate crystals in the formation of urinary stones (**Atmani et al., 2004; Senthil Kumari and Logeshwari, 2021**).

Miara et al., (2019) reported that *Hordeum vulgare* is used by the population of Bordj Bou Arreridj located in the eastern of Algeria to treat kidney disorders. **Shah et al.,(2012)** highlighted in their study on Wistar albino rats with ethylene glycol-induced urolithiasis that the ethanolic extract of *Hordeum vulgare* seeds significantly reduced the levels of key kidney stone-forming constituents, primarily calcium, phosphate, uric acid, magnesium, urea, and oxalate. In contrast, it increased citrate excretion and urine output. *H. vulgare* include a range of minerals, phenolic acids, alkaloids, dietary fibers, unsaturated fatty acids, and sphingolipids, along with antioxidants and vitamins (**Darias et al., 2001; Taïbi et al., 2021**).

In a study conducted by **Taïbi et al.,(2021)**, *Parietaria officinalis*, *Allium cepa*, *Citrus limon*, *Olea europaea*, *Petroselinum crispum*, *Acacia senegal* and *Apium graveolens* were the most frequently reported species in 13 locations in Algeria, with therapeutic potential for the treatment and management of urinary infections.

In addition, patients reported the use and effectiveness of other natural products, such as honey, in combination with medicinal plants like olive oil and lemon. Furthermore, the thermal waters of Chigueur, consumed as a drink, have been mentioned as a potential therapeutic agent for treating urinary diseases, particularly lithiasis, due to their phosphate and sulfate content, which aid in the healing of kidney stones. **Touhami et al., (2007)** reported that *Citrus limon* have an important effect in preventing calcium oxalate crystal deposition in the kidney of experimental animals. Herbal treatments can provide specific bioactive compounds that inhibit stone formation, reduce oxidative stress and improve renal function (**Allam and Sabra, 2024**), Phytochemicals such as Phenoxyllic acids, flavonoids, and triterpenoids have been shown to reduce kidney stones in both *in vitro* and *in vivo* studies (**Zakaria et al., 2023**).

Plant parts used, dosage used and methods of preparation

The results obtained show that leaves are the most commonly used part in the treatment of urinary lithiasis (**Fig.5**), with 58%, followed by stems and seeds at 17% and 15%, respectively. Other parts are used to a lesser extent. Due to its ease of collection, the leaf is the preferred organ. Moreover, it is recognized as the main site of various phytochemical reactions, thus housing essential active ingredients (**El Oihabi et al., 2024**). Several studies

have reported the dominance of leaves use in anti-lithiasis therapeutic recipes (**Allam and Sabra, 2024 ; Mechri *et al.*, 2023; Taïbi *et al.*, 2021; Khouchalaa *et al.*, 2016; Ghouri *et al.*, 2013**).

Infusion is the most commonly used preparation method (66%), followed by decoction (17%) (**Fig.6**). these two methods are primarily the most frequently used in therapeutic preparations. Infusion is intended for the more delicate parts of the plant; it involves immersing the plant in hot, but not boiling, water to extract the active compounds. On the other hand, decoction is suited for tougher parts, such as roots, bark, stems, or seeds, and involves boiling these parts in water for an extended period, which allows for the extraction of more difficult-to-release active compounds. **Salhi *et al.*, (2010)** reported that decoction can reduce toxicity when mixing certain plants. While, preserving a large proportion of the secondary metabolites responsible for the biological properties of the plant.

Duration of treatment with medicinal plants

The duration of use of medicinal plants varies according to individuals, the disorder to be treated and the result obtained, our results (**Fig.7**), showed that 76% used plants for dissolution of stones for less than 1 month against 24% used plants for more than 1 month.

Patients with urolithiasis take medicinal plants at different times of the day, primarily in the morning before breakfast and in the evening before going to bed (58%), with the aim of stimulating kidney function and thus facilitating the elimination of stones. The dose used is a crucial parameter for human health. Among the studied population, 56% use medicinal plants to treat urinary stones with precise doses, while 44% do so with approximate doses (**Fig.8**).

The effectiveness of the plants used

In our study, 64% of the patients surveyed believe that medicinal plants allow for a complete recovery from urinary lithiasis after expelling the stones through their use. On the other hand, 36% of the patients stated that the plants were not effective and that they resorted to surgery. It was suggested that herbal remedies possess diuretic and antispasmodic properties, which can help in stone expulsion and offer symptomatic relief (**Allam and Sabra, 2024; Yadav *et al.*, 2011**).

Table.2: Medicinal plants used for the treatment of urinary lithiasis in Relizane city

Scientific name	Local name	Family	Parts used	Method of preparation	Fc	RFC
<i>Herniaria hirsuta</i>	ftatet lhdjer	<i>Caryophyllaceae</i>	Aerial part	Decoction/ infusion of the plant prepared in water, to be taken at a rate of one cup 2 to 3 times per day.	56	0,280
<i>Hordeum vulgare</i>	chair	<i>Poaceae</i>	seeds	A drink is prepared in water by decoction or maceration of a handful of seeds in 1 liter of water overnight. It is taken 2 to 3 times per day.	37	0,185
<i>Atriplex halimus</i>	Gtaff	<i>Amaranthaceae</i>	Aerial part	The leaves are prepared in water by infusion or decoction, and the drink is taken 2 to 3 times per day.	30	0,150
<i>Petroselinum crispum</i>	maadnous	<i>Apiaceae</i>	Leaves, stems	An herbal tea made from the leaves is prepared by infusion. The leaves and stems are prepared by decoction and taken up to 4 times per day.	26	0,130
<i>Apium graveolens</i>	krafess	<i>Apiaceae</i>	Leaves, stems	A drink made from the leaves is prepared by infusion, while the leaves and stems can also be prepared by decoction. It can be consumed up to four times per day.	15	0,075

<i>Citrus limon</i>	Lim, limoune	<i>Rutaceae</i>	Fruit	The lemon juice mixed with honey is used at a rate of two tablespoons per day (morning and evening).	11	0,055
<i>Zea mays</i>	Dra	<i>Poaceae</i>	The stigmas, (Silk)	The stigmas (the styles) of corn prepared as an infusion or by maceration in water, at a rate of two cups per day.	6	0,030
<i>Urtica dioica L</i>	Herig	<i>Urticaceae</i>	Leaves	The leaves are prepared as a decoction or infusion at a rate of two cups per day (morning and evening).	5	0,025
<i>Mentha spicata</i>	Naanaa	<i>Lamiaceae</i>	Leaves	An herbal tea, prepared with the leaves, with or without the stems, can be made by infusion or decoction; it is consumed twice per day.	5	0,025
<i>Acacia senegal L</i>	Samgh alarabi	<i>Fabaceae</i>	Exudate	A teaspoon of powder is used for maceration in a cup of water for overnight. The macerate is consumed in the morning and/or in the evening before sleeping.	4	0,020

<i>Zingiber officinale</i>	Skinjbir	<i>Zingiberaceae</i>	Rhizome	A portion of fresh ginger rhizome is macerated in 1 liter of water overnight. The macerate is consumed at a rate of one cup in the morning on an empty stomach or in the evening before sleeping.	3	0,015
<i>Olea europaea L</i>	Zitoune	<i>Oleaceae</i>	Fruit	Olive oil is mixed with lemon juice and honey and used against lithiasis.	3	0,015
<i>Origanum vulgare L</i>	Zaatar	<i>Lamiaceae</i>	Leaves, stems	An herbal tea, prepared with the leaves alone or with the stems, is obtained by infusion or decoction and is to be consumed once a day, either in the morning or in the evening.	2	0,010
<i>Eriobotrya japonica</i>	bouadima	<i>Rosaceae</i>	Leaves	An infusion of the leaves is prepared in water to be consumed once in the morning.	1	0,005
<i>Trigonella foenumgraecum L</i>	Helba	<i>Fabaceae</i>	seeds	An herbal tea of the seeds is taken twice a day, in the morning and in the evening.	1	0,005

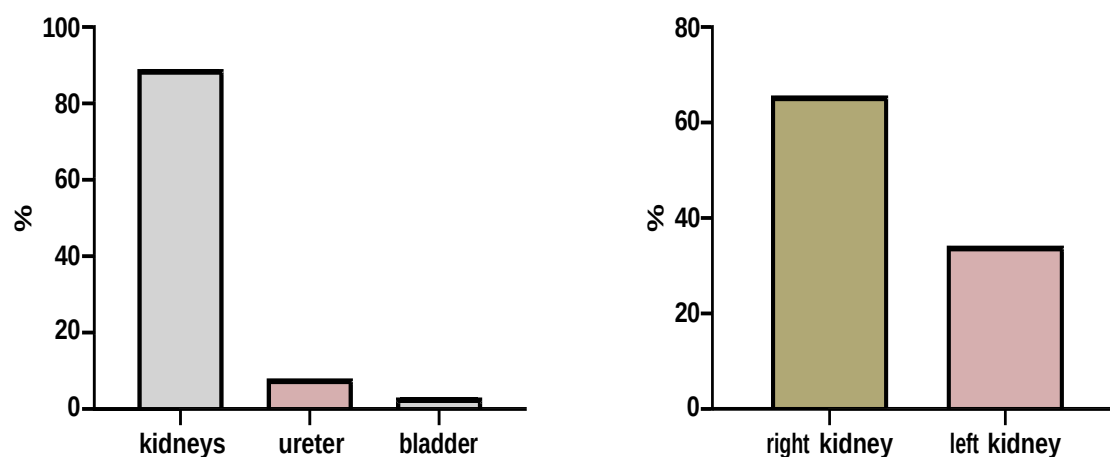


Fig 2. Location of stones in the patients interviewed .

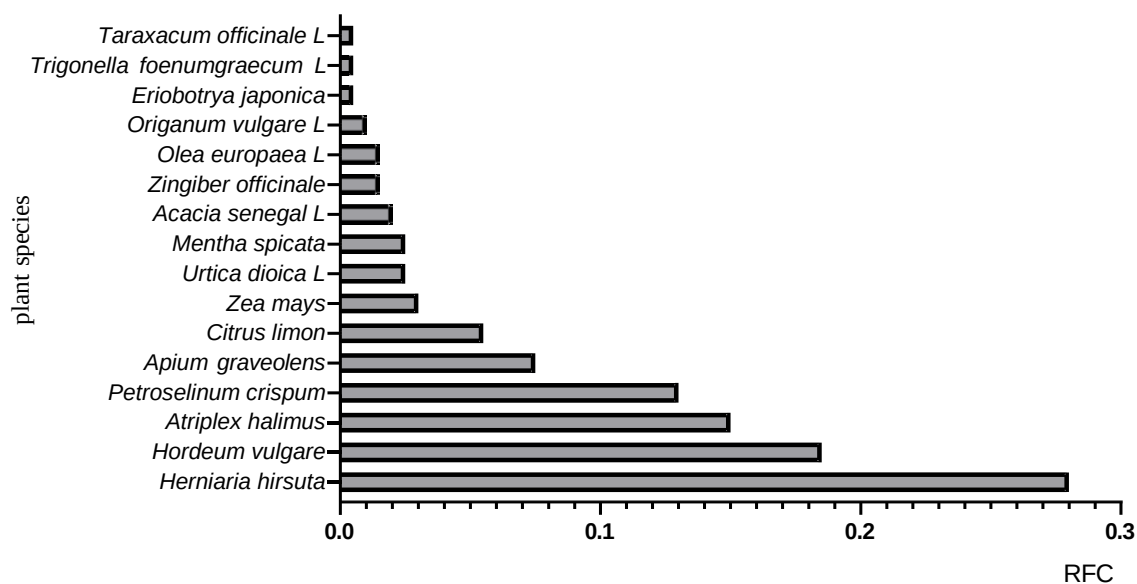


Fig.3 Relative frequency of citation (RFC) of antilithiasis medicinal plants.

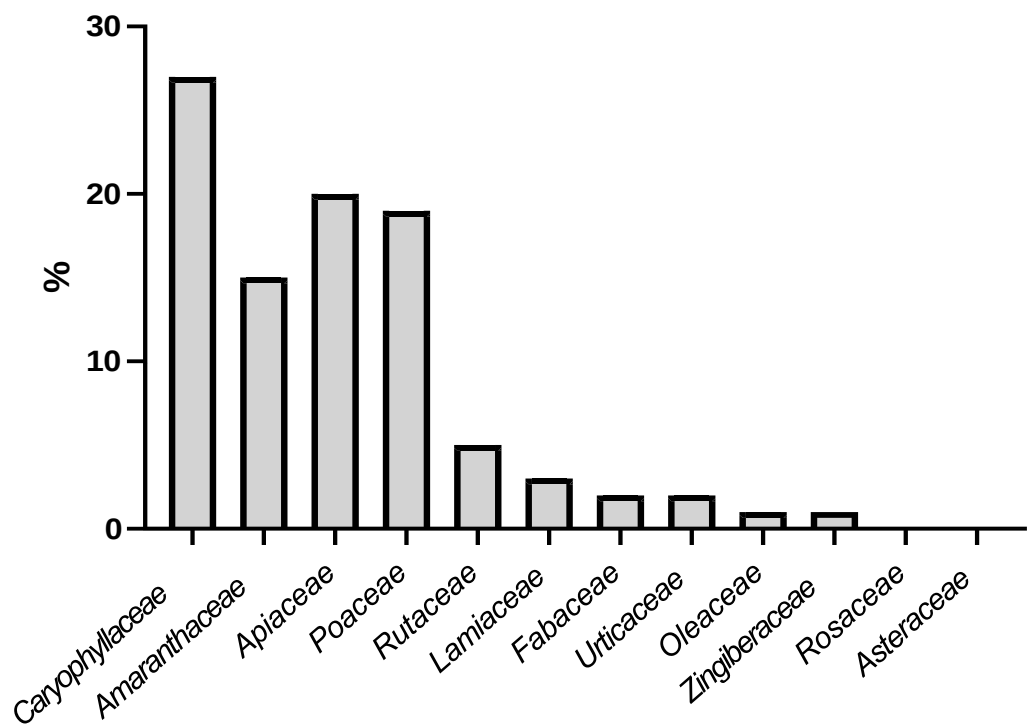


Fig.4 Frequency of use of antilithiasis plant families.

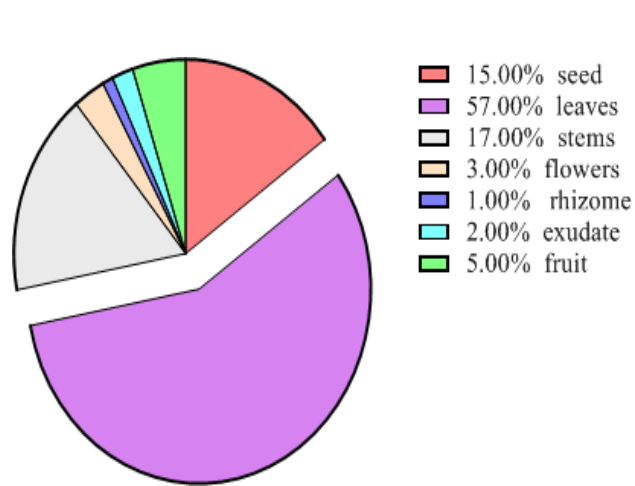


Fig. 5 plant parts used for kidney stone treatment

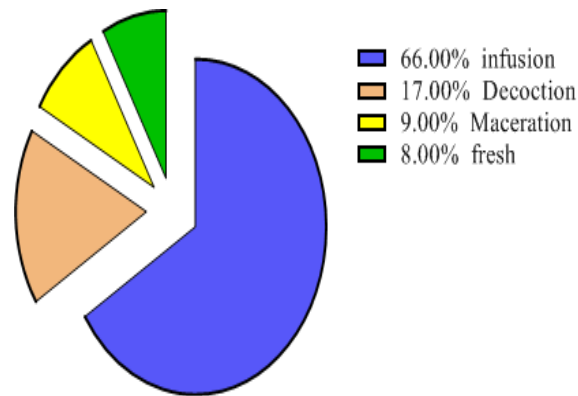


Fig.6 Mode of preparation of medicinal plants parts

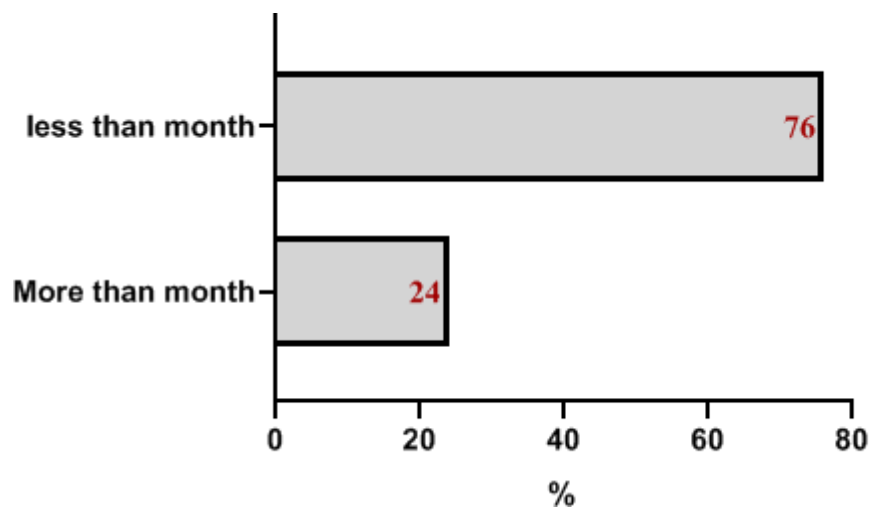


Fig. 7: duration of use of medicinal plants

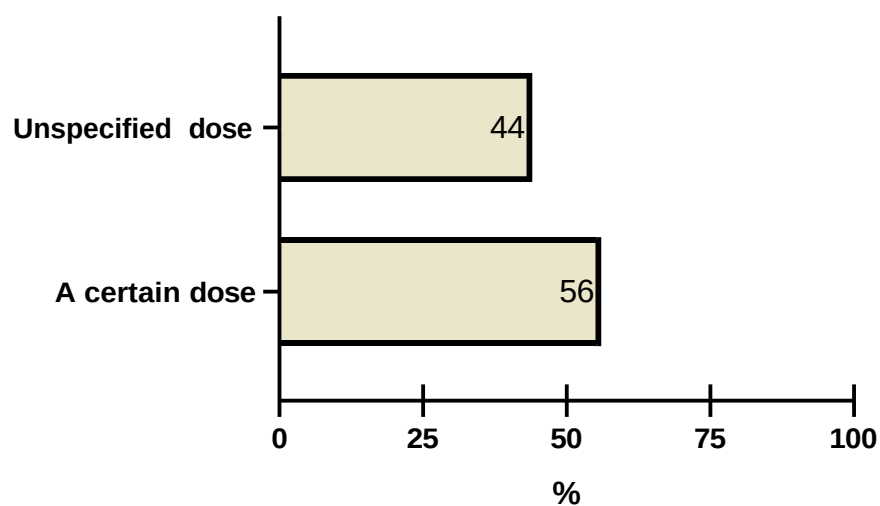


Fig.8 dosage used of anti urolithiasis medicinal plants

Conclusion

The present study reports an ethnobotanical survey in the province of Relizane about medicinal plants used for the treatment of urolithiasis. Among 16 species species belonging to 12 families, *Herniaria hirsuta*, *Hordeum vulgare*, *Atriplex halimus*, *Petroselinum crispum* were the most popular used by the inhabitants of the region to treat urolithiasis.

The study was conducted only in the city of Relizane, which limits the scope of results obtained. It is possible that other medicinal plants were used by the populations of different municipalities, characterized by a population of farmers and peasants. Traditional practices often vary from one locality to another, and some plants not listed in this study could be used in other areas depending on local specificities and the knowledge of the inhabitants.

This work is a source of information that contributes to the knowledge of medicinal plants and the preservation of local traditional knowledge. It provides baseline data for pharmacological and phytochemical studies aimed at evaluating the therapeutic effectiveness and enhancing the value of medicinal plants.

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