

USES OF THE MEDICINAL PLANT *Asphodelus microcarpus* IN ALGERIAN TRADITIONAL MEDICINE AND STUDY OF SOME OF ITS ACTIVE COMPONENTS

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ABSTRACT: *Asphodel* is a spontaneously occurring and relatively less known medicinal plant that has been the subject of a study on ethnobotany and phytochemistry, illuminating the relationship between this plant and human cultures, as well as its active compounds. The ethnobotanical study was conducted in two phases, involving responses from 80 individuals. The initial phase consisted of general inquiries aimed at gaining a better understanding of the participants, followed by questions regarding their familiarity with the studied plant. The obtained results indicate that the respondents represented both genders, various age groups, education levels, and

occupations, with the majority residing in urban areas. Interestingly, a large portion of them were not familiar with *Asphodel*. Among those who were familiar with it, it was noted that they utilize the tubers combined with olive oil for earaches. The subsequent phase of the study focused on phytochemical analyses, employing the powdered form of the dried tubers of *Asphodelus microcarpus* with various reagents to identify the presence of secondary metabolites, including tannins, saponins, alkaloids, terpenes, and flavonoids. The results demonstrated the presence of saponins, flavonoids, and alkaloids within the studied plant. In conclusion, the studied plant *Asphodelus microcarpus* is relatively less known and contains some secondary metabolites, which give it many therapeutic properties.

KEYWORDS: Medicinal plant, Ethnobotanical, Phytochemical, Tubers, *Asphodelus microcarpus*.

USOS DA PLANTA MEDICINAL *Asphodelus microcarpus* NA MEDICINA TRADICIONAL ARGELA E ESTUDO DE ALGUNS DE SEUS COMPONENTES ATIVOS

RESUMO: O asfódelo é uma planta medicinal de ocorrência espontânea e relativamente menos conhecida, que tem sido objeto de estudo em etnobotânica e fitoquímica, elucidando a relação entre essa planta e as culturas humanas, bem como seus compostos ativos. O estudo etnobotânico foi realizado em duas fases, envolvendo a participação de 80 indivíduos. A primeira fase consistiu em questionamentos gerais para melhor compreensão dos participantes, seguidos por perguntas sobre seu conhecimento da planta estudada. Os resultados obtidos indicam que os entrevistados pertenciam a ambos os sexos, diferentes faixas etárias, níveis de escolaridade e ocupações, sendo a maioria residente em áreas urbanas. Curiosamente, grande parte dos participantes não conhecia o asfódelo. Entre aqueles que o conheciam, foi observado que utilizam os tubérculos combinados com azeite de oliva para tratar dores de ouvido. A fase subsequente do estudo concentrou-se em análises fitoquímicas, utilizando os tubérculos secos e pulverizados de *Asphodelus microcarpus* com diversos reagentes para identificar a presença de metabólitos secundários, incluindo taninos, saponinas, alcaloides, terpenos e flavonoides. Os resultados demonstraram a presença de saponinas, flavonoides e alcaloides na planta estudada. Em conclusão, a planta *Asphodelus microcarpus* é relativamente pouco conhecida e contém alguns metabólitos secundários, conferindo-lhe diversas propriedades terapêuticas.

PALAVRAS-CHAVE: Planta medicinal, Etnobotânica, Fitoquímica, Tubérculos, *Asphodelus microcarpus*.

INTRODUCTION

The genus *Asphodelus* has recently been classified within the subfamily *Asphodeloideae* of the family *Asphodelaceae*. This family encompasses 40 genera and 900 species, primarily located in temperate regions and in Africa. (El Shabrawy et al., 2018; Malmir et al., 2018). *Asphodel* is a perennial plant about 1 meter tall. Its long and narrow leaves, 1 to 4 cm wide and 50 to 60 cm long, are hollowed into a triangular groove and grouped in rosettes at the base of the stem. The fruits are small capsules slightly narrowed at the base with thin valves, elliptical with flat edges. The roots are strongly swollen, resembling turnips in shape (Rashed Majeed, 2014; Razik et al., 2016).

According to the World Checklist of Selected Plant Families (WCSP), the genus *Asphodelus* L. comprises 32 accepted names along with over 150 synonyms, including both homo- and heterotypic synonyms, for all its species, subspecies, and varieties (WCSP, 2017), however, the Missouri Botanical Garden database (Tropicos) lists two additional accepted names, namely *Asphodelus cerasifer* and *Asphodelus microcarpus* (Missouri, 2017).

In traditional use *Asphodelus microcarpus* is used in many ways to treat earache, abscesses, vitiligo and any kind of white spots on the skin, ulcers. Also its extract, rich in anthraquinones, is a laxative and a purgative (Razik et al., 2016) Economically, the roots of some *Asphodelus* species provide gums, glue, and dye and are used in the fermentation of alcohol (El Shabrawy et al., 2018)

However, the few biological studies for *microcarpus* species indicate antioxidant, anti-inflammatory, antibacterial and anticancer activities of different parts of the plant in different regions all over the world. These properties are due to it containing several components known as secondary metabolites or active compounds. That's why, the objective of this work is to detect certain active substances (Saponins, Tannins, Flavonoids, Terpenes and Alkaloids) in the tubers of the Algerian species *Asphodelus microcarpus*, named Berouag in Arabic, to understand its medical importance after an ethnobotanical study to ascertain the extent of people's knowledge of this plant and its various uses.

MATERIALS AND METHODS

Ethnobotanical study

A questionnaire was filled out by 80 individuals anonymously, they live in the wilaya of Skikda, Located in the northeast of Algeria, in two stages; the first stage involved general questions to understand them (gender, age, level of education, occupation and their place of residence), followed by questions to assess their knowledge about the plant under study (Do they know the plant, why they use it, which part, whether it is used alone or not, and how it is used?)

Data Analysis: After collecting all the filled forms from 80 persons, the information pertaining to each question was processed and converted into percentages, then represented in graphs using Excel software version 2013.

Informant Consensus Factor (ICF): The degree of consensus on the plant, or Informant Consensus Factor (ICF), was calculated to assess the agreement among informants regarding the use of the plant, using this formula: $ICF = IP / IT$ (IP represents the number of informants who have cited a species, while IT represents the total number of informants. The ICF varies between [0 - 1]. A low value, close to 0, indicates that informants disagree. When this value is close to 1, it indicates a high level of agreement) (Effeo et al., 2020).

PHYTOCHEMICAL STUDY

Sampling Area: The plant was harvested in October, 2023, from the city of Filfila, in the same Wilaya of Skikda (Figure 1).

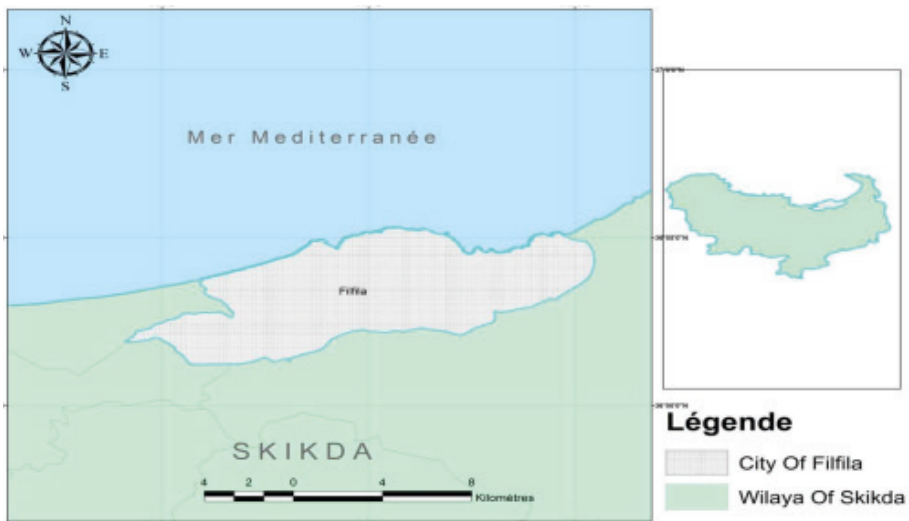


Figure 1: Location of the study area: City of Filfila, Wilaya of Skikda. (<https://www.researchgate.net/publication/269633991>).

Plant material

The plant harvest was carried out very carefully so as not to damage the organic elements present, than the roots are washed before being cut into small cubes and placed in the oven for drying at 60°C for 3 days, and then ground into fine powder using an electric mill. Using the obtained fine or its infusion, phytochemical tests were conducted to highlight the presence of certain bioactive compounds.

Preparation of the aqueous extract: It was prepared by adding 10g of plant powder to 100ml of boiling water, which is allowed to infuse for 15 minutes. Then, it is filtered.

Phytochemical Tests: After the preparation of the aqueous extract, each test was prepared as follows (EL-Haoud et al., 2018; Edeoga et al., 2005 and Shaikh and Patil, 2020)

Saponins: Take 10 sterile test tubes with a capacity of 20 ml and number them from 1 to 10, Place from 1 to 10 ml of aqueous extract in each tube respectively than fill up the volume of all tubes to 10 ml with distilled water. Shake the tubes well for 15 minutes and observe the foam formed.

The foam index (I) is determined using the following formula: $I = 1000 / N$ Here, N represents the tube number in which the foam height corresponds to 1 centimeter.

Tannins: Place 1 ml of extract in a test tube, then add 1 ml of distilled water and 2 drops of $FeCl_3$ solution (Iron chloride). The appearance of a dark green or blue-green color indicates the presence of Catechic or Gallic Tannins respectively.

Flavonoids: Place 1 ml of extract in a test tube, then add 5 ml of NH_4OH (Ammonium Hydroxide) and a few drops of H_2SO_4 (Sulfuric Acid). The appearance of a yellow color indicates the presence of Flavonoids.

Terpenes: Place 1 ml of extract in a test tube, then add 2 ml of Chloroform and 3 ml of H₂SO₄ (Sulfuric Acid). The appearance of a red/brown color indicates the presence of Terpenes.

Alkaloids: Mix 50g of powder with a few ml of HCl (Hydrochloric Acid), then filter. Add 1 to 2 drops of Wagner's reagent to the obtained filtrate. The appearance of a red/brown color indicates the presence of Alkaloids.

RESULTS

Ethnobotanical study

Both genders participated in filling out the forms with a disparity in percentages between them, where women accounted for 70% while men represented only 30%. Due to the variance in ages of the respondents, ranging from 17 to 82 years old, they were divided into 4 age groups, and the results were processed and classified as follows: Individuals aged over 60 represented the highest percentage, reaching 43.75%, followed by those in the age groups of 41-60, 20-40 and under 20, which corresponded to the following percentages: 32.5%, 18.75%, and 4.8%, respectively. It became apparent that most of the respondents belonged to the educated category, with the percentage of university graduates at 37.5%, followed by other educational levels: without diploma, secondary, primary, and middle, with percentages of 32.5; 15; 10 and 5%, respectively, in order.

As for the occupation, the information obtained is derived from different groups where the category of workers obtained the highest percentage (32.5%), followed by the percentage for the category of retirees then students (30, 25%). As for the unemployed, they obtained the lowest percentage, which amounted to 12.5% ; with the majority residing in town (75%) instead (25%) out of town as shown in Table 1.

Gender	Women	Men				Total
	56	24				80
		70%	100 %			30%
Age	<20	20-40	41-60	>60	Total	
	4	15	26	35	80	
	4.8%	18.75%	32.5%	43.75%	100 %	
Education Level	No diploma	Primary	Middle	Secondary	University	Total
	26	8	4	12	30	80
	32.5%	10%	5%	15%	37.5%	100%
Occupation	Unemployed	Student	Worker	Retired	Total	
	10	20	26	24	80	
	12.5%	25%	32.5%	30%	100%	
Place of Residence	Town	Out of Town			Total	
	60	20			80	
	75%	25%			100%	

Table 1: Results of the ethnobotanical study; First part: General questions.

The second part of the ethnobotanical study aims to identify informations from the respondents about the mentioned plant, and the results were as follows: Regarding their knowledge of the plant, it was weak, with Informant Consensus Factor (ICF) of 0.375 compared to 0.625 who did not know it. The reasons for its use varied among them, as most of them use it as a treatment for earaches, accounting for ICF of 0.5, followed by acne and skin problems at 0.33 and finally arthritis at 0.16. As for the part of the plant used, most of them use the roots or tubers, accounting for 0.66, followed by the leaves at 0.33 and none use the stems or flowers. Regarding the method of use, the most mentioned method is digging the roots or tubers, filling them with olive oil, leaving them for few hours, then taking the resulting oil and warming it for use as drops. So most of them use it with olive oil at 0.83 and alone at 0.16 (Table 2).

Parameters	Response	Number of Respondents	Total	ICF
Knowledge of the plant	Yes	30	80	0.375
	No		50	0.625
Causes of Use	Earaches	15	0.5	
	Arthritis	10	30	0.16
	Acne and Skin problems	5	0.33	
Used part	Leaves	10	30	0.33
	Tubers	20	0.66	
Alone or Combined	Alone	5	30	0.16
	Combined	20	0.83	

Table 2: Results of the ethnobotanical study; Second part: Plant questions.

Also, the majority of the thirty respondents who know and use it reported no secondary effects of the plant when used correctly and in appropriate doses (83.33%), whereas 16.66% reported gastrointestinal issues and skin irritation when consumed in high doses.

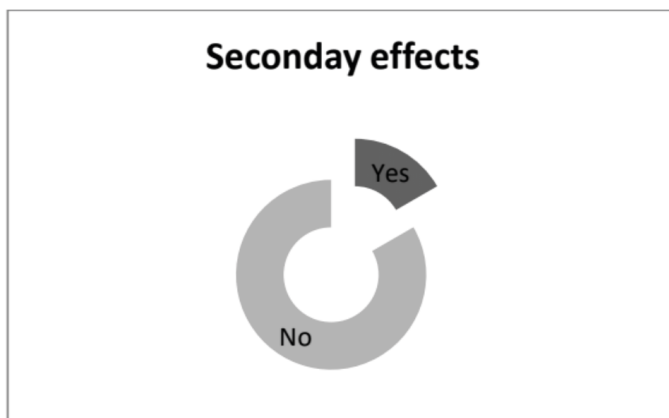


Figure 2: Presence of secondary effects or not according to respondents.

Phytochemical study

When detecting the presence of saponins in the aqueous extract according to the previous steps, after shaking the tubes, a stable foam formed on top of the solution, indicating their presence in the roots of the plant. The thickness of the foam was about 1 cm in tube number 5. Based on this result, the foam index was calculated according to the previous relationship, and the result was as follows: $I = 1000/5 = 200$.

As for detecting the presence of tannins in the aqueous extract according to the aforementioned steps, after adding 2 drops of FeCl_3 solution, the result was no change in color, indicating their absence.

To detect the presence of flavonoids in the plant roots, the previous steps were followed, and a yellow color appeared after adding drops of H_2SO_4 solution, indicating the presence of flavonoids in those roots.

Regarding the detection of terpenes in the aqueous extract according to the previously mentioned stages, after adding 3 ml of H_2SO_4 solution, the color of the solution did not change, confirming the absence of terpenes in the plant.

As for alkaloids, after adding 1-2 drops of Wagner's solution according to the mentioned steps, a brown color was obtained, indicating the presence of alkaloids in the plant roots.

These results indicate the presence of saponins, flavonoids, and alkaloids in *A. microcarpus* roots, and their absence of tannins and terpenes (Table 3).

Compounds	Saponins	Tannins	Flavonoids	Terpenes	Alkaloids
Appearance	+ Foam	-	Yellow color	-	Brown color
Results	+ $I = 1000/5 = 200$	-	+	-	+

Table 3 : Results of phytochemical study.

+ Presence, - Absence

DISCUSSION

The survey results varied regarding general information about the respondents. Women outnumbered men significantly because they were more knowledgeable and interested in various medicinal plants. They confirmed having many of these plants in their homes and using them as needed. Regarding age, the group over 60 years old obtained the highest percentage, attributed to the seniors experience in alternative medicine or herbal therapy. Regarding educational level, university graduates obtained the highest percentage, but this did not provide more comprehensive information on the subject due to the scarcity of research and publications on the studied plant and the limited use of it. As for the professional category, the percentages varied among different groups, with retirees and workers dominating compared to students and the unemployed, due to the latter's lack of experience regarding medicinal plants, especially due to their limited usage. The majority of respondents were urban dwellers, contributing to their greater cooperation. Other results indicated that women aged 30 to 39 and 38 to 55 respectively, with no formal education, show a greater interest in medicinal plants (Bouayyadi et al. 2015; Beldi et al. 2021).

The second part of the survey was dedicated to the studied plant which was, not fully known by the participants compared to who were aware of it. These individuals cited reasons for its use, primarily for earaches, followed by acne and skin problems, and finally arthritis. These reasons have been mentioned in several other studies (Amar et al. 2013; Azzouzi and Zidane 2015; Malmir et al. 2018), and in addition, different parts of this plant including leaf, fruit, seed, flower, and root are used as traditional herbal medicines in the treatment of jaundice, Haemorrhoids, ulcers, eczema, paralysis, colds and rheumatism (Amar et al. 2013; Malmir et al. 2018). As for its utilized parts, the roots or tubers were the most commonly used, followed by the leaves. It was noted that it was used more frequently with olive oil than alone.

All the mentioned treatments are attributed to the presence of active components in the plant, which is why phytochemical study have been conducted to highlight the presence some of them, named also secondary metabolites.

Secondary metabolites are produced in small quantities, and their production depends on the family, genus, and species. They do not have a direct role in vital plant processes such as growth or reproduction, but they play a crucial role in maintaining their adaptation to their environment. They act very effectively to protect plants against various stresses such as drought, UV light, herbivores, and attacks from pathogenic organisms such as bacteria, fungi, and predatory insects. Currently, many of these compounds are used in traditional medicine, and these molecules are considered the basis of the active principles present in medicinal plants (Falodun 2010; Dias et al. 2012)

The detection of these chemical compounds is based on color changes and foam appearance for saponins. The tubers of *Asphodelus microcarpus* contain Saponins, Flavonoids and Alkaloids and do not contain Tanins and Terpenes. These results did not align with (Razik et al. 2016) where the aqueous extract of the same plant tubers collected from Morocco was used. Flavonoids, Tannins and alkaloids were absent while Terpenes and Saponins were present. As for the alcoholic extract, it was confirmed to contain all the cited compounds.

The variation in results among different studies can be attributed to several natural factors: the harvesting season, the quantity of plant material used, environmental and climatic conditions in the plant growth area (soil salinity, soil acidity, temperature), the geographical origin of the plant, and the extraction method.

These findings attribute numerous essential activities to *Asphodelus* different species, such as antihypertensive, antimicrobial, anti-inflammatory, antioxidant, insecticidal, antitumor and anticancer (Peksel et al. 2013; Khalfaoui et al. 2018; Razik et al. 2016; Dioguardi et al. 2019; Mahdi et al. 2019; Arslan et al. 2019; Lazarova et al. 2020), thereby paving the path for its potential application in synthesizing a variety of compounds targeted at treating different diseases.

CONCLUSION

Asphodelus microcarpus, Berouag in Arabic, is a less known medicinal plant, Despite this, the obtained results show that it is used in various traditional treatments due to its rich composition of active ingredients. Among these components, saponins, flavonoids and alkaloids are particularly remarkable. These constituents confer upon it numerous beneficial properties, thereby paving the way for its potential utilization in the synthesis of diverse compounds aimed at treating a wide array of diseases.

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