

# Identification and Investigation of Mistakes in Medicinal Species *Adiantum capillus-veneris* L. in the Iranian Market (with Reviews and References to Global Ethnobotany)

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Received: 2023-06-08

Accepted: 2023-08-05

## Abstract

The plant *Adiantum capillus-veneris*, which is known by the native name “Parsiavashan” in Iran, is a species of Pteridaceae dark ferns that have pinnatifid-shaped compound fronds, fan-shaped pinnae, and brown stipe. Different parts of this plant such as fronds and rhizome have medicinal properties and are used as decoctions, infusions, etc. to treat diseases such as cough, asthma, bronchitis, and jaundice. In this study, 33 samples belonging to 21 provinces of Iran were collected in the summer and autumn of 2022 to identify and investigate suspected adulterated in the supply and sale of this herbal product in Iran’s herbal markets, then the samples were studied with the help of Floras and articles were identified macroscopically. In addition to the laboratory procedures, articles related to the ethnobotany of the mentioned species were studied and important materials were extracted by referring to databases such as Google Scholar. The results of the studies showed that out of 33 studied samples, 6 samples belonged to the *Asplenium*

*adiantum-nigrum* species and were wrongly offered in the herbal markets. Also, all the collected samples had sori on the surface of the fronds, which increases the possibility of allergies and side effects in consumers. For this reason, it is more important to investigate and study this species as an important medicinal plant in the stages of collection, packaging, and supply in local markets. In addition, the wrong sale of alternative plants of this species endangers the health of customers and requires morphological, anatomical, and molecular investigations.

**Keywords:** *Adiantum*, Parsiavashan, Suspected to be adulterated, Fern, Medicinal plants

## Introduction

The use of herbal medicines has been one of the oldest effective methods of maintaining health, which is an integral part of the development of modern civilization. Many of today’s medicines are of herbal origin. WHO (World Health Organization) estimates that today about 80% of the world’s

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Doi: 10.48308/jpr.2024.234968.1066



people use medicinal plants for the primary treatment of diseases (Al-Snafi et al. 2015). Medicinal plants are considered valuable genetic resources and national assets of any country (Mohebbali et al. 2021). Currently, the treatment of bacterial infections with antibiotics faces limitations, therefore the use of medicinal plants has attracted the attention of researchers due to having fewer side effects and sometimes greater effectiveness (Bahmani et al. 2014). Today, quality control of local herbal markets that deal with medicinal plant products is very necessary and important; because the health of customers may be endangered due to mistakes in local pharmaceutical markets (Sheidai et al. 2019; Motahhari et al., 2022). Work error in the supply of herbal medicines has been common throughout human history and is directly related to negative and sometimes even fatal medicinal effects on human health. It seems that the methods of cheating in the sale of medicinal plants include substitution with a fake plant, cheating by adding substandard substances or adding chemicals, and also adding foreign substances (Liu et al. 2022).

*Adiantum capillus-veneris* L. is a woody plant with a height of about 35 cm, which is distributed in southern Europe, the Alps, the Atlantic Ocean, and Iran (Ansari and Ekhlasi-Kazag 2012a). Among the other distribution areas of this species, we can mention the countries of Afghanistan, Brazil, India, France, Italy, Mexico, Nepal, etc. (POWO, 2023). This species is perennial and grows in shady and humid mountainous areas and aqueducts. In this species, the rhizome is straight and without scales and hairs, as well

as the fertile and sterile fronds of the same shape, the divided ovate-bayonet blade, the stipe is grooved and brown in color, the pinnae are fanned with free veins and forks and without middle veins. Sori have pseudo indosium and are discrete (Rahmani, 2017). *Adiantum capillus-veneris* is a species belonging to the Pteridaceae family that exists in the medical and pharmaceutical textbooks of traditional Iranian medicine under the name “Parsiavashan”. The medicinal parts of this plant are fronds and rhizomes. This species is used as a single medicine or in multiple herbal combinations to treat many diseases, especially respiratory diseases, and diseases related to the reproductive system. The use of this type of fern along with plants such as licorice, celery, fennel, Alcea, sweet violet, and hyssop has been the most used in traditional medicine (Ansari et al. 2012b). Phytochemical analysis of *A. capillus-veneris* shows that there is a set of chemical compounds such as flavonoids, triterpenoids, oleans, phenylpropanoids, carbohydrates, and carotenoids in this plant (Rajurkar et al., 2012). In a study, it was observed that *A. capillus-veneris* contains 8.3% moisture, 11.44% extractable ethanol, and 24% water-extractable substances. Also, this species contains 73.2% phenol and terpenoid, 20% fat and wax, 53% alkaloid, 33.26% quaternary and oxide, 23.67% fiber, and also contains 10 elements of magnesium, calcium, potassium, manganese, iron, cobalt, sodium, nickel, copper and zinc (Farràs et al. 2022).

*Adiantum capillus-veneris* has a long history in medical science and is the main ingredient of a popular cough syrup called

Capillaire, which was used until the 19th century (Ibraheim et al. 2011). According to Ethnobotany, this plant is used as a tonic, diuretic, treatment for colds, fever, cough, lung disorders, stimulant, emollient, cleanser, sedative, hair tonic, treatment of skin diseases, tumors of the spleen, liver, treatment of jaundice and hepatitis (Umakanthan et al., 2020).

In the last two decades, the coronavirus has emerged as a global health threat due to its rapid geographical spread and has historically caused two pandemics: severe acute respiratory syndrome and Middle East respiratory syndrome, followed by covid-19, which emerged from China (Hendawy et al. 2022); This disease causes mild to severe respiratory symptoms and there is no specific treatment for it, however, in modern medicine, it has been proven that *A. capillus-veneris* has medicinal efficacy to treat many symptoms similar to those caused by covid-19 (Hendawy et al. 2022). Currently, there is no certain standard method for identifying and separating medicinal plant species that are offered in the world market, and it is only in recent years that the attention of researchers on the negative effects of mistakes in medicinal plants on the health of consumers has been revealed (Srirama et al. 2017; Motahhari et al., 2022); On the other hand, accurate identification of medicinal plants is very challenging, because these products are sold in most countries of the world in the form of leaves, flowers, seeds, and stems in powdered or fragmented form and do not have the diagnostic features required for plant morphology. Of course, in order to

identify these products, there are methods such as microscopy, chemotaxonomy, and chromatography, and these methods also have limitations such as the presence of complex chemical compounds, the absence of unique metabolites, the effects of environmental and geographical factors, and also the age of the plant (Nithaniyal et al. 2017).

Therefore, in the present study, an attempt has been made to accurately identify the *A. capillus-veneris* species, which is sold as an important medicinal plant throughout Iran, by using different methods such as morphological studies, to verify the accuracy. Also, the botanical research of this species of ferns in the world and Iran will be discussed concerning past studies.

## **Materials and methods**

### *Morphological studies*

Initially, 33 specimens of fronds and stems from the *A. capillus-veneris* species, known locally as Paresiavashan, were gathered from herbal markets across 21 provinces in Iran during the summer and autumn of 2023 (refer to Table 1). The sampling locations are illustrated in Figure

The collected samples were identified based on the study of Flora of Iran (Rahmani, 2017) based on morphological characteristics such as the shape of fronds, stems, type of veining, the position of sori on fronds, the color of the fronds, the shape of the edge of the blade, etc. Some of the samples were powdered and fragmented, which could not be distinguished based on morphological characteristics.

### *Ethnobotanical studies*

**Table 1.** Collecting location of Paresiavashan species from herbal markets in Iran

Number	Location	Number	Location
1	Alborz Province, Karaj	16	Sistan va Baluchistan Province, Zabul
2	Alborz Province, Karaj	17	East Azerbaijan Province, Tabriz
3	Alborz Province, Karaj	18	East Azerbaijan Province, Tabriz
4	Alborz Province, Fardis	19	Isfahan Province, Kashan
5	Alborz Province, Fardis	20	Khorasan-e Razavi Province, Mashhad
6	Alborz Province, Karaj	21	Ilam Province, Sirvan
7	Bushehr Province, Brazjan	22	Fars Province, Shiraz
8	Khuzestan Province, Ahvaz	23	Fars Province, Shiraz
9	Hamedan Province, Hamedan	24	Fars Province, Shiraz
10	Khuzestan Province, Shush Daniyal	25	Qom Province, Qom
11	Isfahan Province, Foladshahr	26	Golestan Province, Gorgan
12	Kermanshah Province, Kermanshah	27	Kerman Province, Kerman
13	Zanjan Province, Zanjan	28	Lorestan Province, Khorramabad
14	Ardabil Province, Bileh Sawar	29	Semnan Province, Shahrood
15	Khuzestan Province, Ahvaz	30	Tehran Province, Tehran



**Fig. 1.** The location of the collection of Paresiavashan samples from groceries in Iran

Studies and reviews were conducted on articles about the ethnobotany of *A. capillus-veneris* species by utilizing databases like Google Scholar, PubMed, ScienceDirect, and the indigenous name of the species *A. capillus-veneris*, as well as the specific plant parts utilized in treating various diseases in different regions. Additionally, information on its medicinal uses was gathered.

## Results

### Morphology

Among the 33 individuals studied, 6 individuals belonged to the *Asplenium adiantum-nigrum* species, 23 individuals belonged to the *A. capillus-veneris*, and 4 individuals were unidentifiable (Table 2 and Figures 2-5). In 6 individuals belonging to the species *A. adiantum-nigrum*, the fronds are 2-3 times pinnated, almost regular, and broad in triangular or bayonet shape, while in 23 individuals belonging to the species *A. capillus-veneris*, the stipes are brown, the pinnae are fan-shaped with veins, free and forked and without middle vein, the stem is hairless and shiny, and in the reproductive pinnae, the sori are oval or linear on the upper margin of the pinnae, all these characteristics belong to the species *A. capillus-veneris* (Rahmani et al., 2017) (Table 3).

### Ethnobotanical studies

The study of articles related to the ethnobotanical of *A. capillus-veneris* species in 22 countries showed that the most part use of this species is related to the aerial parts of the plant as among the 22 countries studied, people of all countries use the fronds of the plant. and the most medicinal use of

this plant is in the treatment of respiratory diseases such as colds, coughs, etc. (Tables 4 and 5).

In the following, some of the healing properties of *A. capillus-veneris* will be mentioned:

### Inhibition of microbes

*A. capillus-veneris* extract has a noticeable inhibitory effect on the growth of *Staphylococcus aureus*, *Escherichia coli* and *Helicobacter pylori*, while Salmonella, *Shigella sonhai*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Streptococcus pyogenes* did not show significant sensitivity to *A. capillus-veneris* extract (Shirazi et al., 2011).

### Treatment of diseases

The presence of mucilaginous compounds in *A. capillus-veneris* helps to eliminate the secretions of the respiratory system and improve breathing, in addition, research has shown that this plant helps to improve the disease with the programmed death of cells that cause inflammation in the process of diseases such as colds (Haghighi et al., 2023).

### Source of vitamin D

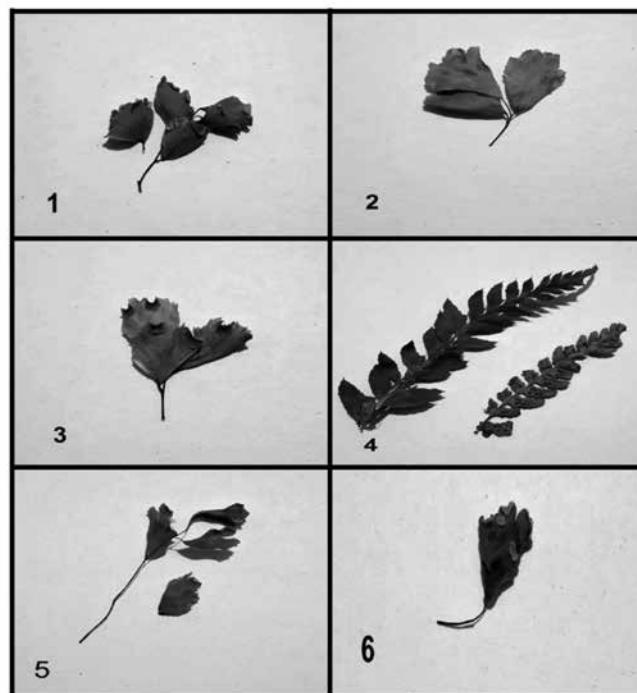
Research has shown that the plant is high in vitamin D. This vitamin has a strong antioxidant by trapping free radicals and preventing diseases (Samydurai et al., 2013).

## Discussion

The present study was conducted in order to identify and investigate the mistakes or in other words to identify the errors in the supply of the medicinal species *A. capillus-veneris* with the local name Paresiavashan in the Iranian market. The first finding that

**Table 2.** Identified and prepared samples of Iranian groceries based on morphological traits

Number	Species Name	Location
1	<i>Adiantum capillus-veneris</i>	Alborz province, Karaj
2	<i>Adiantum capillus-veneris</i>	Alborz province, Karaj
3	<i>Adiantum capillus-veneris</i>	Alborz province, Karaj
4	<i>Asplenium adiantum-nigrum</i>	Alborz province, Fardis
5	<i>Adiantum capillus-veneris</i>	Alborz province, Fardis
6	<i>Adiantum capillus-veneris</i>	Alborz province, Karaj
7	<i>Adiantum capillus-veneris</i>	Bushehr province, Brazjan
8	Unrecognizable	Khuzestan province, Ahvaz
9	<i>Adiantum capillus-veneris</i>	Hamedan province, Hamedan
10	<i>Adiantum capillus-veneris</i>	Khuzestan province, Shush Daniyal
11	<i>Adiantum capillus-veneris</i>	Isfahan province, Foadshahr
12	<i>Adiantum capillus-veneris</i>	Kermanshah Province, Kermanshah
13	<i>Asplenium adiantum-nigrum</i>	Zanjan Province, Zanjan
14	<i>Asplenium adiantum-nigrum</i>	Ardabil province, Bileh Sawar
15	<i>Adiantum capillus-veneris</i>	Khuzestan province, Ahvaz
16	Unrecognizable	Sistan and Baluchistan Province, Zabul
17	<i>Asplenium adiantum-nigrum</i>	East Azarbaijan Province, Tabriz
18	<i>Asplenium adiantum-nigrum</i>	East Azarbaijan Province, Tabriz
19	<i>Adiantum capillus-veneris</i>	Isfahan Province, Kashan
20	<i>Adiantum capillus-veneris</i>	Khorasan Razavi Province, Mashhad
21	<i>Adiantum capillus-veneris</i>	Ilam province, Sirvan
22	<i>Adiantum capillus-veneris</i>	Fars province, Shiraz
23	<i>Adiantum capillus-veneris</i>	Fars province, Shiraz
24	<i>Adiantum capillus-veneris</i>	Fars province, Shiraz
25	<i>Adiantum capillus-veneris</i>	Qom province, Qom
26	<i>Adiantum capillus-veneris</i>	Golestan province, Gorgan
27	<i>Adiantum capillus-veneris</i>	Kerman Province, Kerman
28	<i>Adiantum capillus-veneris</i>	Lorestan province, Khorramabad
29	<i>Asplenium adiantum-nigrum</i>	Semnan Province, Shahrood
30	<i>Adiantum capillus-veneris</i>	Tehran Province, Tehran
31	<i>Adiantum capillus-veneris</i>	Central Province, Mahalat
32	<i>Adiantum capillus-veneris</i>	Talesh, Gilan province



**Fig. 2.** Identified samples of Paresiavashan in Alborz Province

**Table 3.** Morphological differences between the two species *A. capillus-veneris* and *A. adiantum-nigrum*

Morphological traits	<i>Adiantum capillus-veneris</i>	<i>Asplenium adiantum-nigrum</i>
No. of pinnae	1	2-3
Pinnae margin shape	lobed	divided
Fronnd color	light green	dark green
Blade shape	fan shape	Triangular to bayonet
Sori type	discrete	discrete
Sori position	Blade upper edge	The back surface of the frond

**Table 4.** Ethnobotany of *Adiantum capillus-veneris* in the world

Country Name	Native Name	Plant organs used	Indications	Reference
1- Nigeria	-	Roots, Rhizomes and fronds	Treatment of convulsions, diabetes, headache, gonorrhoea, scorpion sting, dysentery and measles	(Souilah et al., 2018)
2- Greece	-	Fronnds	Treatment of respiratory diseases, parasitic and sweating diseases	(Vokou et al., 1993)
3- Himalayas	-	Fronnds	Anti-dandruff, astringent, antipyretic, stimulant, laxative, detoxification in alcoholism, antiparasitic, treatment of cough, bronchitis and throat infection, food seasoning	(Chander et al., 2017)
4- Brazil	Avenca, avenca-cabello-de-Vênus, avencacomum, cabelo-de-Vênus, capilária-do-comércio, capillaria-deMontpellier,	Fronnds	Treatment of cough	(Taylor, 2012)
5- India	Hansraj Maidenhair fern, Avenca, Herba capillorum, Veneri, Ladies' hair, Venus hair fern, Southern maiden hair fern	Roots, Rhizomes and fronds	Treatment of respiratory problems, menstrual disorders, oral blisters, diabetes and cough, removal of dandruff, treatment of cough, as an astringent, sedative, anti-bloating, emollient, expectorant, antipyretic, chest laxative, stimulant, treatment of cough, bronchitis, detoxification of alcoholism and elimination Parasites, snake and bee bites, headache or chest pain, fever treatment, removing the coldness of the uterus and facilitating the birthing process.	(Taylor, 2012) ; (Singh & Singh, 2012)
6- England	Maidenhair fern	Fronnds	Treatment of cough, bronchitis, and throat infection	(Taylor, 2012)
7- Iraq	Gya qeteran, Kharasha, Qetrana	Aerial organs	Treatment of asthma, cold, spleen pain, cough, flatulence, diarrhea, snakebite, rabies, insect bites, pain kidney stones, warts, and bladder diseases.	(Taylor, 2012); (Awara et al., 2020)
8- Pakistan	Panceer, Lailazulfi	Aerial organs	Treatment of cough, bronchitis, cataracts, sore throat, hair diseases and skin allergies, gastrointestinal diseases, colds, flu, asthma, jaundice, scorpion stings, chest pain, measles, spleen diseases, fever, pneumonia, snake bite, sore throat, infertility and as a diuretic, hair tonic, laxative, softening and relaxing	(Ullah et al., 2013)
9- Italy	Fraola salvatica, Capelvenere, capilvent, capiventi ,	Aerial organs	Reducing labor pain, stimulating menstruation, emollient, antiparasitic, expectorant, removing body bruises, treating cough, sore throat, loss of speech, hair loss and dandruff, abortion, regularizing and treating cough and treating skin wounds, treating pain Menstruation and abdominal pain	(Bruni and Ballero, 1997)
10-Türkiye	-	Fronnds	Treatment of chest tightness, dandruff, diseases of the digestive system, bronchitis, urinary disorders, kidney stones, diarrhea, cough, stomach pain, swelling of the testicles and prostate, appetite suppressant, expectorant, and regular, Increasing the amount of milk in livestock, treating sprains and swelling of body parts in livestock	(Hayta et al., 2014)
11- France	-	Fronnds and rhizomes	Cataract treatment is soothing and slightly stimulating	(Taylor, 2012)
12- amazon	-	Fronnds	Treatment of cough, menstrual disorders, urinary disorders, colds, rheumatism, heartburn, gallstones and alopecia	(Taylor, 2012)
13- Peru	-	Rhizomes	Alopecia, gallstones and jaundice	(Taylor, 2012)
14- Jordan	Venus's hair	Fronnds	Cough treatment	(Al-Qur'an, 2009)
15- Bosnia and Herzegovina	Vilina Vlas	Fronnds	Treatment of kidney problems and menstrual disorders	(Muratović & Parić, 2023)
16- Azerbaijan	-	Fronnds	Treatment of liver, kidney, bile, urinary tract diseases and bleeding	(Ibadullayeva et al., 2022)
17- Libya	-	Fronnds	Treatment of diseases such as bronchitis, kidney stones, urinary tract diseases, and infection and also as a diuretic, expectorant and stimulant	(El-Mokasabi et al., 2018)
18- Portugal	Avianca	Fronnds	Treatment of inflammation	(Camejo et al. 2003)
19- Africa	Lehörömetso Mmalewaneng	All plant organs	Treatment of tuberculosis, treatment of respiratory diseases, and fertility problems	(Wyk, 2008)
20- Arabia	lepata-maoa	All plant organs	Treatment of fever, cough, cold and cataract, diuretic and expectorant, food seasoning	(Dehdari & Hajimehdipoor, 2018)
21- Ethiopia	Joroasfit	Fronnds	Treatment of inflammation	(Chekole et al., 2015)
22- Algeria	Maidenhair	Fronnds	Treatment of respiratory diseases	(Ouelbani et al., 2016)

**Table 5.** Ethnobotany of *Adiantum capillus-veneris* species in Iran

Province name	Native Name	Plant organs used	Indications	Reference
Razavi Khorasan, Mashhad	Parsiavashan	Aerial organs	Treatment of jaundice, fever, cough, and hemorrhoids, treatment of sore throat, fever, jaundice, orchitis, and as a laxative and anti-thirst	(Amiri & Joharchi, 2013)
Sistan and Baluchistan, Taftan	Siyalangok	Fronde	Treatment of colds, coughs, chest infections, and hand and leg pain	(Maleki & Akhiani, 2018)
Kahkilouye and Boyer Ahmad	Siavashi flower	Aerial organs	Treatment of asthma and shortness of breath	(Mosaddegh et al. 2012)
Kerman, Sirjan	Land black tea tablet	Fronde	Treatment of respiratory ailments, colds, and earaches and also as an expectorant	(Vakili Shahrabaki, 2016)
Khorasan Razavi, Zanglanlu	Parsiavashan	Aerial organs	Treatment of fever, sore throat, cough, and mouth sores	(Amiri & Joharchi, 2013)
Fars	Mountain parsiavashan	Rhizomes and fronds	Treatment of kidney diseases, urinary system and cold, antipyretic and expectorant, treatment of throat infection, cold and lung diseases	(Safaian and Simkani, 2022)
Kermanshah	Parsiavashan	Aerial organs	Treatment of respiratory ailments	(Nemati and Jalilian, 2012)
Chahar Mahal and Bakhtiari	Parsiavashan	Rhizomes and fronds	Treatment of jaundice in babies	(Younessi-Hamzekhanlu et al., 2021)

was obtained from the present research showed that among the 21 investigated provinces, the supply of this medicinal plant has faced errors in 6 provinces of the country, which are: Alborz, East Azerbaijan, Semnan, Zanjan, and Ardabil. Since each of the mentioned provinces is among the valuable regions in terms of the richness of medicinal plants; monitoring the sale and supply of medicinal plants in these areas is of great importance, for example, Ardabil province, especially the Sablan pastures, is considered one of the leading pastures in Iran, which is the place of distribution of many plant species due to its special climatic and ecological conditions. This issue has caused the widespread approach of people in the use of medicinal plants of the region (Ghorbani et al. 2017).

Another result of this research is the identification of samples that are wrongly sold in the Iranian market under the name of Parsiavashan. A detailed examination of these specimens using Floras and articles as

well as macroscopic examinations showed that all the wrong specimens that are sold instead of *A. adiantum-nigrum* with the Persian name of black sedum, which has triangular to bayonet fronds, while the correct specimens of Parsiavashan have fan-shaped pinnae, which are in agreement with the reports in the Flora of China (Raven, 2023). On the other hand, in the wrong samples, the sori are linear and are located along one side of the frond vein and have long sori, while in the true Parsiavashan samples, the sori are located at the edge of the pinnae, and the pseudo-indosium are caused by the folding of the frond edge, which these cases are consistent with the findings of studies by Prada et al. (2004) and Lee et al. (2018).

Unfortunately, the lack of recognition of plant genera and species in some herbal markets has caused them to mistakenly prescribe a plant for a specific disease and cause problems such as side effects or negative effects on the disease (Tarsali et



al., 2021; Motahhari et al., 2022). In the present study, referring to the properties of the Paresiavashan species, it was found that this plant has good effects on the treatment of respiratory diseases such as asthma and bronchitis, as well as the elimination of menstrual disorders and the treatment of jaundice in infants (Ansari et al., 2012a); Meanwhile, the species *A. adiantum-nigrum* has other medicinal properties such as the treatment of eye diseases, jaundice, laxative and diuretic, which has more limited properties than the species Paresiavashan (Farràs et al., 2022).

In both samples of *A. capillus-veneris* and *A. adiantum nigrum*, many fronds had sori, which was more evident in the second species. The results of the present research showed that unfortunately the two mentioned samples are not washed before being put on the market, and because of this, sori-containing spores remain on the pinnae, if the consumer is not aware of this issue, the plant organs with medicinal properties along with the spores and this can cause side effects such as allergies in the user (Motahhari et al., 2022). These findings are in line with studies related to investigating the relationship between pollen grains and spores of ferns with diseases such as asthma and allergies that have been conducted in tropical regions (Chkhatrashvili et al., 2021).

Finally, it can be concluded that the species *A. capillus-veneris* is considered one of the most important medicinal plants due to its wide distribution in most provinces of Iran (Rahmani, 2017) and also has many medicinal properties. The widespread use

of this plant species during the coronavirus epidemic increases the necessity of studies related to this species (Hendawy et al., 2022). The results of the present study, which was conducted for the first time in Iran, show that there are many problems such as the correct identification of the species in the stages of collection and supply to the perfumers of the country. Also, due to non-observance of the principles of packaging and sterilization of samples during the sale, the possibility of side effects will increase due to the consumption of the product; for this reason, it is suggested that the identification of medicinal plant samples offered in apothecaries should be done with higher accuracy by taxonomists or even with new methods such as DNA barcoding.

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