Introduction of valuable medicinal plants of traditional medicine of Lamiaceae family in the conditions of the Tashkent Botanical Garden

D.T. Khamraeva, D.K. Fakhriddinova, O.K. Khojimatov, Rainer W. Bussmann, and S.Kh. Abdinazarov

Correspondence

D.T. Khamraeva[1], D.K. Fakhriddinova[1], O.K. Khojimatov[1], Rainer W. Bussmann[2,3], and S.Kh. Abdinazarov[1]

[1]Tashkent Botanical Garden named after F.N. Rusanov at the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan
[2] Department of Botany, State Museum of Natural History, Karlsruhe, Germany
[3]Department of Ethnobotany, Institute of Botany and Bakuriani Alpine Botanical Garden, Ilia State University, Tbilisi, Georgia

*Corresponding Author: hamraeva.dilovar@mail.ru

Ethnobotany Research and Applications 29:11 (2024) - http://dx.doi.org/10.32859/era.29.11.1-12
Manuscript received: 31/03/2024 – Revised manuscript received: 28/05/2024 - Published: 28/05/2024

Notes on Ethnobotany

Abstract

Background: The article shows the results of introduction of essential oils bearing medicinal plants of Lamiaceae in the conditions of the Tashkent Botanical Garden, with their phenological observations and information on use in folk medicine.

Methods: Ethnobotanical data were collected in surveys from 2018-2024 as a result of interviews. Interviews with the local population were conducted in the form of a questionnaire with the consent of informants. The interviews were conducted in accordance with the rules of the ISE Code of Ethics 2006 established by the International Society of Ethnobiology (www.ethnobiology.net). The study was conducted in markets, interviews with tabibas (traditional healers) and elders throughout Uzbekistan.

Results: Some essential plants such as, *Hyssopus officinalis* L., *Lavandula angustifolia* Mill., *Melissa officinalis* L., *Origanum vulgare* L., *Salvia rosmarinus* Spenn., *Salvia officinalis* L. and *Thymus vulgaris* L., were introduced in the Tashkent Botanical Garden in 1963-1965. Over the years of introduction, all plants have successfully adapted in the dry climatic environment of the city of Tashkent. For several generations, these species resume as self-defined. Due to the successful introduction of these valuable medicinal plants, the created collection site was a mother material nursery for breeding *Lavandula angustifolia*, *Origanum vulgare*, *Salvia rosmarinus* and *Salvia officinalis* in other regions of the Republic of Uzbekistan. Compared with previously mentioned species, *Agastache foeniculum* (Pursh) Kuntze was introduced only 10 years ago. However, despite the shorter adaptation time, *Agastache foeniculum* also has a positive introduction rating, reproduces well with self. In addition, the work provides ethnobotanical information on the use of introduced species in folk medicine in Uzbekistan.

Conclusion: Over a long period of time, widely known essential oil plant species from Lamiaceae had a positive acclimatization result under Tashkent conditions. The most promising medicinal species for use in folk and official medicine are *Lavandula angustifolia*, *Origanum vulgare*, *Salvia rosmarinus* and *Salvia officinalis*.

Keywords: phenology, ethnobotany, Lamiaceae, introduction, raw materials, essential oil plants.

Background

The attraction of wild species of local flora into the culture was often motivated by useful properties - medicinal, decorative, spicy aromatic, fodder, food, etc. (Mashanov 1972; Andreev 1975). Undoubtedly, the content of certain substances made it possible to introduce useful plant species in various soil and climatic conditions. It is one of the tasks of most botanical gardens of the world that is to expand the range of ornamental, medicinal or food species of plants from various geographical latitudes. The introduction in various economic sectors of the country, adapted to the local conditions of new introduced plants to the botanical garden will allow in the future to use these species of plants in landscape design, or grow in industrial plantations to obtain plant raw materials. In modern conditions, with the growth of social and environmental pressure, this issue becomes the subject of concern of organizations engaged in the cultivation of new plant species from foreign flora. The introduction of medicinal and essential oil plants has a long history. In Western Europe, botanical gardens or their predecessors were institutions that specially grew some medicinal, aromatic plants to supply court doctors, monastery or court pharmacies. When introducing medicinal and ether-oil plants, botanical gardens perform two functions - scientific-theoretical and industrial-practical (Cicilin 2021). For a long time, many species of representatives of the family Lamiaceae Martinov have been used in traditional medicine to treat colds, inflammatory processes, hypertension, diseases of the cardiovascular system, pain relief, etc. (Hamidpour *et al.* 2014; Zielińska *et al.* 2014; Bozin *et al.* 2017; Ivanov *et al.* 2019; Mahmood *et al.* 2020; Ghasempour *et al.* 2022; Najafi *et al.* 2022; Batiha *et al.* 2023). Most species of the family Lamiaceae have been studied on chemical, pharmacological, ethnobotanic, clinical, ecological properties, etc., since they contain many different biologically active substances (Tahir *et al.* 2018; Kompelly *et al.* 2019; Soltani *et al.* 2020; Tundis *et al.* 2020; Liaqata *et al.* 2023). The flora of Uzbekistan has 40 genera and 206 species of plants of the Lamiaceae family (Flora of Uzbekistan, 1961). Huge work has been carried out to study 40 species of medicinal plants belonging to the Lamiaceae family growing in Uzbekistan, in particular, a number of medicinal plants with cardiovascular, sedative, antihypertensive, hemostatic effects have been identified (Khodjaev & Kholmatov 1965; Khojimatov 1982; Abdurakhmonov & Valikhujaeva 1996). Currently, 2,455 species of trees, shrubs and herbaceous plants are preserved in the collections of the Tashkent Botanical Garden, from foreign and local flora the assortment of mother trees and shrubs is 1,404 species, which serve as a seed gene fund for forest and other farms of the Republic. In order to preserve the gene pool of wild plants of the flora of the Republic, about 50 species of plants included in the Red Book of the Republic of Uzbekistan were brought from nature and planted (Abdinazarov *et al.* 2022).

In 1963-1965, K.Kh. Khodjaev and Kh.Kh. Kholmatov conducted scientific work on the cultural cultivation of medicinal plants in the collection and the agrotechnical measures applied to them. After the research work of these scientists, in 1970 the laboratory of the Introduction of Medicinal Plants was founded as part of the Botanical Garden.

However, despite the variety of medicinal species of the local flora of Uzbekistan, attracting new species from other regions or geographical landscapes is extremely necessary to supply the pharmaceutical industry with demanded environmentally friendly raw materials. In this regard, as part of the development and replenishment of the assortment of the Tashkent Botanical Garden, since its creation, work has been carried out on the ecological and introductory analysis of introduced plants of scientific and practical value.

The purpose of this study was to analyze the phenological observations of introduced 8 species of the Lamiaceae family, their use in folk medicine and the characteristics of plant raw materials.

Materials and Methods

The Botanical Garden on the modern territory, was founded in 1950. Currently, the area of the Botanical Garden is 66.5 hectares. The Botanical Garden is located in the northeastern part of Tashkent, 480 m above the sea level. Its territory has a roughly triangular shape, from the south and southeast the border runs along the shore of the Salar River. In the northern part of the garden, near the entrance, the Akkurgan River flows. The total area of the laboratory of introduction of medicinal plants collection is 0.78 hectares, with coordinates 41°20ˈ42.4ˈˈN 69°18ˈ44.2ˈˈE.

The climate of Tashkent is sharply continental and is characterized by high insolation (duration of sunshine 2871 h/year), dryness, significant daily temperature fluctuations, hot summers, dry, warm autumn, and moderately cold winters. The absolute minimum temperature is ...-25,80 °C (very rarely), the absolute maximum is... + 44.6°C. The main amount of precipitation, according to long-term data, is 380-440 mm, which falls during the autumn-winter-spring periods (Belolipov 1989). The climate of Tashkent according to the Köppen-Geiger system is classified as Csa (hot summer Mediterranean climate). The temperature here averages 14.1 ° C. The average annual rainfall is 623 mm (https://ru.climate-data.org).

Photography of plants was carried out by the digital camera Canon EOS 90D. Statistical processing of quantitative data was carried out according to G.N. Zaitsev (Zaitsev 1990) using the MS Excel program. Phenological observations and biometric measurements (Beideman, 1974) were carried out during the growing season of essential oil plants during 2014-2023. According to the traditional methodology of phenological observations (Methodology ..., 1975), the dates of the following phenophases were recorded: the beginning of spring regrowth (the beginning of vegetation), the beginning of budding, the flowering season, fruit ripening. The following is a list of ether-oil plants introduced in the Tashkent Botanical Garden (Table 1).

Table 1. Information on essential oils species of collection of medicinal plants introduction laboratory

Plant name	**Who introduced the species**	**Life form**	**Distribution area**
Agastache foeniculum (Pursh) Kuntze	Atamuratova N.T.	Perennial herb	North America
Hyssopus officinalis L.	Khodjaev K.Kh., Kholmatov Kh.Kh.	Semi shrub	Eurasia, Africa
Lavandula angustifolia Mill.	Khodjaev K.Kh., Kholmatov Kh.Kh.	Semi shrub	French and Spanish Mediterranean coast
Melissa officinalis L.	Khodjaev K.Kh.	Semi shrub	Eastern Mediterranean region to Iran, Black Sea and Asia Minor
Origanum vulgare L.	Khodjaev K.Kh.	Perennial herb	Europe and the Mediterranean
Salvia rosmarinus Spenn.	Murdakhaev Yu.M.	Semi shrub	North Africa, Turkey, Cyprus; in Europe
Salvia officinalis L.	Khodjaev K.Kh., Kholmatov Kh.Kh.	Semi shrub	Italy and Southeastern Europe
Thymus vulgaris L.	Khodjaev K.Kh., Kholmatov Kh.Kh.	Semi shrub	Mediterranean coast, Spain and southern France

Ethnobotanical data were collected in surveys from 2018-2024 as a result of interviews. Interviews with the local population were conducted in the form of a questionnaire with the consent of informants. The interviews were conducted in accordance with the rules of the ISE Code of Ethics 2006 established by the International Society of Ethnobiology (www.ethnobiology.net). The study was conducted in markets, interviews with tabibas (traditional healers) and elders throughout Uzbekistan.

Results and Discussion

Agastache foeniculum (Pursh) Kuntze - was introduced in the conditions of the Tashkent Botanical Garden in 2014 (Fig. 1 a, b). In the conditions of the Tashkent Botanical Garden, the growing season of *A. foeniculum* falls on the end of February or the beginning of March, when the air temperature is above + 10... +15ºC. In mid-May, the plant enters the generative phase of development, that is, the stage of budding is observed. Flowering begins in the third decade of May. By the end of June, the fruiting phase begins (Table 2). The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants.

Agastache foeniculum for traditional medicine of Uzbekistan is a new species. However, there is work on the study of biological features in the conditions of introduction (Fakhriddinova & Dusmuratova, 2023). The local population in folk medicine uses the aerial part of the plant, which is used as an immunostimulant, for hypertension, tonsillitis, prostatitis, inflammatory processes of the gastrointestinal tract and urinary system. Tinctures made from leaves, stems and flowers have a bactericidal effect. An infusion or decoction made from the flowers and leaves of the plant is used to moisturize hair and stimulate its growth. *Agastache foeniculum* is not only a medicinal, but also a spicy aromatic plant, as it contains essential oils (Abdelaal, 2009; Atamuratova *et al.* 2012; Mohammadi *et al.* 2022).

Hyssopus officinalis L. - in the conditions of the Tashkent Botanical Garden was introduced in 1965 (Fig. 1 c, d). In the Tashkent region, in small areas in mountain valleys, a single species of this genus *Hyssopus seravschanicus* (Dubj.) Pazij is found. (Abdurakhmonov & Valikhujaeva, 1996). In the conditions of the botanical garden, in comparison with other essential oil-bearing species, the vegetation of *Hyssopus officinalis* begins at an elevated air temperature, when the air warms up above

+ 15... +20ºC. This falls in the middle or end of March. In mid-May, plants begin budding. At the end of this month, flowering begins. By the end of June, the plant enters the fruiting phase (Table 2). The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants.

a

b

c

d

Figure 1 a-d. General appearance of plants at different stages of development. a – vegetative stage *Agastache foeniculum*, b –blooming stage *Agastache foeniculum*, c – vegetative stage *Hyssopus officinalis*, d – blooming stage *Hyssopus officinalis*.

In folk medicine, above ground part of *Hyssopus officinalis* is used to increase appetite and as a tonic for the body. In scientific medicine, it can be used in the treatment of rheumatism, asthma (shortness of breath), bowel disorders, lethargy, hepatitis A, etc. (Borisova, 1954; Kalinichenko, 2013; Strilbytska *et al.* 2020).

Lavandula angustifolia Mill. - was introduced in 1963 in the Tashkent Botanical Garden in order to replenish the assortment of medicinal plants and study the biological properties of the plant in new environmental conditions (Fig. 1 e, f). The vegetation of *Lavandula angustifolia* in the conditions of the botanical garden begins in late February or early March. With an increase in air temperature + 10... +15ºC the plant begins to grow. The generative period falls on the beginning of May. Mass flowering occurs in the third decade of May and by the end of the month the fruiting phase begins (Table 2). The raw materials for medicinal purposes are color-bearing shoots, which are recommended to be harvested from medium-aged generative plants, since the volume of raw materials is the largest (Buyukli, 1969).

In traditional medicine of Uzbekistan, *Lavandula angustifolia* is a young but promising plant. In recent years, a number of government documents on increasing the assortment of medicinal plants grown have been adopted aimed at introducing new promising species into the list of agricultural plants and at creating large-scale plantations in various regions of Uzbekistan. In this regard, *L. angustifolia* is currently grown in the Ferghana Valley, Samarkand, Navoi and Tashkent regions in farming and private farms (Dusmuratova & Begmatova, 2017). According to literary data, the aerial part of *L. angustifolia* is used to the treatment of cardiovascular diseases, improving the digestion process, as a means of increasing appetite, sputum discharge, sweating, and reducing blood pressure. In folk medicine, infusion is used for the above purposes. Essential oils from plants are part of drugs that help to activate the thought process, improve memory, concentration of attention. In modern medicine, it is used in diseases of the heart, gastrointestinal tract, urological, worm preparations. In the food industry, scent-imparting aromatic essence is also used in beverages (Prusinowska *et al.* 2014; Ibragimov 2016).

Melissa officinalis L. - in the conditions of the Tashkent Botanical Garden was introduced in 1963 (Fig. 1 g, h). Currently, *Melissa officinalis* is grown in all regions of the Republic of Uzbekistan, mainly in adir zones. The vegetation of the plant begins in late February or early March, in warm winters it sometimes grows throughout the winter. The beginning of its growing season occurs at an air temperature of + 5... +10ºC. In the first decade of May, plants have a budding phase, flowering begins in early June. Fruiting occurs at the beginning of July (Table 2). The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants. In traditional medicine of Uzbekistan, decoction of this plant used as a pain reliever, soothing, stimulating appetite and having an antiemetic effect. In addition, often local Tabib's use the plant in the treatment of diseases of the cardiovascular system, with increased blood pressure for blood liquefaction.

Origanum vulgare L. - was introduced in 1965 in the Tashkent Botanical Garden (Fig. 1 i, j). *Origanum vulgare* subsp. *gracile* (K. Koch) Ietsw. is found in the local flora. gracile (K. Koch) Ietsw., which differs in the white color of the petals from *Origanum vulgare*. The vegetation of *O. vulgare* in a botanical garden begins in late February or early March. The beginning of its growing season is associated with the above objects with an increase in air temperature, that is, at an air temperature of + 12... +15ºC vegetative growth begins. In spring, the plant grows actively, and in early June a generative phase begins. In the middle of the month, the flowering phase begins, and at the end of the month there is a massive flowering of plants. In July, the plant enters the fruiting phase (Table 2). The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants (Kitova 2007; Boyko 2011). *Origanum vulgare* are also grown in woodland areas in specialized collectible nurseries. In folk medicine, mostly preparations prepared from the local species *Origanum vulgare* subsp. *gracile* are used. Local tabib's use decoction of above ground part of plant for intestinal atonia (weakening of the intestines), as well as to improve the digestive process. In addition to this, it is also used as a means of excreting sputum and sweating, to relieve toothache (Khojimatov *et al.* 2020).

In addition, drugs from *Origanum vulgare* subsp. *gracile* have a calming effect on the nervous system. Infusion of flowers is used as tea for normal course of menstrual cycle in women of climacteric period and as disinfectant.

e

f

g

h

Figure 1 e.-h. General appearance of plants at different stages of development. e – the beginning of budding *Lavandula angustifolia*, f – blooming stage *Lavandula angustifolia*, g –vegetative stage *Melissa officinalis*, h – blooming stage *Melissa officinalis.*

Salvia rosmarinus Spenn. - in the conditions of the Tashkent Botanical Garden was introduced in 1980 (Fig. 1 k, l). The beginning of the growing season of *Salvia rosmarinus* occurs in early and mid-March, at an air temperature of + 15... +18ºC. In plants, at the beginning of May of the month, a generative phase is observed, i.e., a budding stage, then at the end of this month, plants enter the flowering phase (Table 2). Every year in plants at the end of the month of June or in early July, the fruiting stage is observed, seeds are almost not formed. If even formed, then they are inferior. Therefore, in the conditions of Uzbekistan, *Salvia rosmarinus* breeds only with woody cuttings, which can be harvested in autumn or winter. The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants (Dusmuratova & Fakhriddinova 2019). Rosemary has a strong and pleasant aroma. In folk medicine, it has been proven that the infusion of plant grass improves digestion, enhances heart contractions, increases blood pressure in a short time, relieves stress and nervous tension. Rosemary-made decoction in traditional medicine treats stomatitis, respiratory diseases, wounds, baths for eczema and other skin diseases. Infusion made with rosemary leaves and flowers also fights hair loss well (Nasriddinova 2015; Tokhsyrova *et al*. 2016; Nikitina *et al*. 2017).

Table 2. Phenological phase duration and raw material yield from some essential oil-bearing species collection

Species	**Vegetation, number of days**			**Raw material yield, 1 plant * (g)**	
	budding	**blossoming**	**fructification**	**raw mass**	**dry weight**
Agastache foeniculum (Pursh) Kuntze	110-120	115-125	135-140	1252±0,42	569±0,21
Hyssopus officinalis L.	110-120	115-125	135-140	678±0,31	336±0,12
Lavandula angustifolia Mill.	35-45	45-55	40-45	978±0,26	468±0,21
Melissa officinalis L.	30-35	130-140	140-150	497±0,23	201±0,11
Origanum vulgare L.	60-70	70-75	80-85	666±0,15	230±0,2
Salvia rosmarinus Spenn.	30-35	55-60	80-85	1132±0,46	324±0,21
Salvia officinalis L.	35-45	45-55	40-45	1071±0,42	278±0,16
Thymus vulgaris L.	30-35	130-140	90-95	467±0,24	160±0,12

* From one individual of a medium-aged generative plant

Salvia officinalis L. - in the conditions of the botanical garden has been grown since 1963 (Fig. 1 m, n). In the natural flora of Uzbekistan, 25 species of the genus *Salvia* L. (Turdibaev 2023) are distributed. Of these, the most significant species that give valuable medicinal raw materials are *Salvia sclarea* L., *Salvia bucharica* Popov. The beginning of the growing season of *S. officinalis* depends on environmental factors. At an air temperature of + 12... +15ºC plants begin to grow, it can be either in early or mid-March of the month. In early April, *Salvia officinalis* enters the generative period and mass flowering begins in the middle of the month. In early May, the fruiting phase begins and by the end of June the seeds of the plant are fully ripened (Table 2). The raw materials for medicinal purposes are leaves and shoots, which are harvested mostly from medium-aged generative plants. In the territories of forest farms under the Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan, *Salvia officinalis* is grown in specialized collection nurseries.

Preparations from the leaves of *S. officinalis* in folk and official medicine are used as a disinfectant and anti-inflammatory for mouthwash and throat for diseases of the upper respiratory tract, diseases of the oral cavity (gingivitis, stomatitis, periodontal disease) and food poisoning. Prepared infusion is added for baths and legs are evaporated for fungal diseases and increased sweating. Sage leaves produce herbal tea, which are used internally for diseases of the throat, stomach and to relieve abdominal pain. Essential oil is used to improve the taste of liquid dosage forms in pharmaceutical production (Belolipov 1972; Bodrug 1993; Ghorbani *et al.* 2017).

Thymus vulgaris L. - in the conditions of the Tashkent Botanical Garden was introduced in 1965 (Fig. 1 o, p). One species is found in the local flora - *Thymus seravschanicus* Klokov, which is common in the mountain zones of the Ferghana, Tashkent and Samarkand regions.

In the conditions of the Tashkent Botanical Garden, the vegetation of *Thymus vulgaris* begins at an air temperature of + 15... +18ºC, which can occur in early or mid-March. Plant budding occurs in the first decade of May. In early June, plants begin to bloom, in early July, plants enter the fruiting phase (Table 2). The raw material for medicinal purposes is the above-ground flowering part, which is harvested from medium-aged generative plants.

Figure 1 i-l. General appearance of plants at different stages of development. i – vegetative stage *Origanum vulgare*, j – blooming stage *Origanum vulgare*, k – vegetative stage *Salvia rosmarinus*.

m

n

o

p

Figure 1 m-p. General appearance of plants at different stages of development. m – the beginning of budding *Salvia officinalis*, n – blooming stage *Salvia officinalis*, o – vegetative stage *Thymus vulgaris*, p – blooming stage *Thymus vulgaris*.

Indigenous peoples have used *Thymus vulgaris* as a spice since ancient times (Ivashchenko 1955). The plant can be used in the preparation of vegetable, meat, fish and mushroom canned food, as well as to give a spicy taste to tea, and as a sedative. Currently, in folk medicine, decoction is prepared from *T. vulgaris* for sputum discharge, wound healing, urination and improving appetite, etc. (Reddy *et al*. 2014; Satyal *et al*. 2016; Sardari *et al*. 2021).

The local population of the mountainous villages of Uzbekistan often use the leaves and flowers of *Thymus seravschanicus* when preparing meat dishes for a faster process of fermenting meat and improving digestion (Gafarova, 2022; Khojimatov *et al*. 2023).

Conclusions

The studied 8 species of essential oil plants are representatives of the northern hemisphere, and over the past years of introduction they have successfully adapted in the conditions of the Tashkent Botanical Garden. After analyzing the conducted study on the introduction of some essential oil-bearing medicinal plants in the conditions of the Tashkent Botanical Garden, it was revealed that of those studied, in addition to *Agastache foeniculum*, the rest have been grown for more than 40-60 years. In the past years of introduction, the collection of essential oil plants has been updated for several generations due to new seed crops, which were obtained from collector plants, then were adapted to local climatic and soil-edaphic conditions of existence. The advantage and main task of this collection site was to serve as a uterine nursery for *breeding Lavandula angustifolia*, *Origanum vulgare*, *Salvia rosmarinus* and *Salvia officinalis* in other regions of the Republic of Uzbekistan.

The species *Agastache foeniculum* is one of the promising plants for agriculture, pharmaceutical production and traditional medicine. For 10 years, *A. foeniculum* has successfully adapted to the conditions of the Tashkent and Dzhizak areas, which reproduces with the help of seeds.

Despite differences in biomorph, the studied objects in terms of vegetation duration can be attributed to plants, except for *Agastache foeniculum*, which have a short winter rest period associated with winter frosts and snowfall. The rhythm of development in all plant species flows moderately, almost all species actively bloom and bear fruit (only sterile seeds are formed in *Salvia rosmarinus*).

Thus, the success of the introduction of valuable ether-oil and medicinal plants from the Lamiaceae family in the Tashkent Botanical Garden made it possible to use the scientific and practical base on these plants for introduction into domestic industrial production.

Declarations

Ethics approval and consent to participate: All participants involved in the interview process gave their prior informed oral consent.

Consent for publication: Not applicable.

Competing interests: The authors declare that they have no competing interests.

Funding: Introduction of medicinal plants: replenishment and preservation of the collection and creation of a genetic bank of economically valuable plant species of the flora of Uzbekistan.

Availability of data and materials: The data was not deposited in public repositories but is available from the corresponding author upon request.

Authors' contributions: D.T. Khamraeva, D.K. Fakhriddinova, O.K. Khojimatov, S.Kh. Abdinazarov collected and analyzed the data, drafted, and developed the manuscript. Searched literature D.T. Khamraeva and adjusted the manuscript to the journal submission guidelines. R.W. Bussmann critically revised the manuscript. All authors contributed in the research, data collection, and approved the final manuscript.

Literature Cited

Abdinazarov S, Rakhimova N, Samadov I. 2022. The importance of the Tashkent Botanical Garden in the preservation, enrichment and replenishment of the gene pool of plants: Acta NUUz 3(2)1: 6-9

Andreev GN. 1975 Introduction of herbaceous plants to the Subarctic: L. 166

Abdurakhmonov AA, Valikhujaeva C. 1996. Introduction of plants. Tashkent.40

Abdelaal HAA. 2009. The use of essential oils of traditional plants of the aniseed lofant plant new to Russia (*Lophanthus anisatus* L. (Benth.)): Natural Sciences 3(28): 78-85

Atamuratova NT, Berdibayeva DB, Belolipov IV, Mukhamedzhanova R. 2012. (*Lophanthus anisatus* Benth.) Introduction and bioecological features of this plant in Tashkent problems of increasing the efficiency of innovative activity in the branches of the agro-industrial complex: Materials of the interuniversity scientific and practical conference of young scientists.

Borisova AG. 1954. *Hyssop* genus - *Hissopus* L. Flora of the USSR. -M.-L.: Nauka. 448-462

Batiha GES, Teibo JO, Wasef L. et al. 2023 A review of the bioactive components and pharmacological properties of *Lavandula* species: Pharmacol. 396: 877-900. https.doi.org/10.1007/s00210-023-02392-x

Beideman IN. 1974.Methodology for studying the phenology of plants and plant communities. Novosibirsk: Nauka.

Belolipov IV, 1972. Introduction of plants with a narrow ecological area in Tashkent: Introduction and acclimatization of plants. 9: 59-79

Belolipov IV, 1989. Introduction of herbaceous plants of the natural flora of Central Asia. Tashkent: Fan. 152 p.

Bozin B, Mimica-Dukic N, Samojlik I, Jovin E. 2007. Antimicrobial and Antioxidant Properties of Rosemary and Sage (*Rosmarinus officinalis* L. and *Salvia officinalis* L., Lamiaceae): Essential Oils J. Agric. Food Chem. 55. 19: 7879-7885

Bodrug M. 1993. Introduction of new essential oil plants in Moldova. Chisinau: Stiinza. 142 p.

Boyko EF. 2011. Evaluation of the quality of vegetable raw materials *Origanum vulgare* L.: Proceedings of the Nikitsky Botanical Garden. 133: 28-41

Buyukli M. 1969. Lavender and its culture in the USSR. Chisinau. 152-170

Cicilin AN. 2021. Introduction of medicinal and essential oil plants in botanical gardens (current state, prospects and problems): Plant biology and Horticulture: theory and innovation. 4(161): 86-92

Dusmuratova FM, Begmatova DK. 2017. Medicinal lavender grown in the Tashkent Botanical Garden. Plant introduction: achievements and prospects: Materials of the scientific and practical conference. Pp. 77-80

Dusmuratova FM, Fakhriddinova DK. 2019. The influence of soil moisture on the growth and development of medicinal rosemary in conditions of introduction: Modern problems of morphology and reproductive biology of seed plants: Materials of the All-Russian conference with international participation dedicated to the memory of R.E. Levina, Ulyanovsk. Pp. 211-214

Flora of Uzbekistan. 1961. Tashkent: Academy of Sciences of the Uzbek SSR. Vol. 5.

Fakhriddinova DK, Dusmuratova FM. 2023. Biomorphology of generative branches of *Agastache foeniculum* (Pursh) Kuntze. Honored scientist of Uzbekistan: International scientific conference. Tashkent.

Ghorbani A., Esmaeilizadeh M. 2017. Pharmacological properties of *Salvia officinalis* and its components: Journal of Tradititional and Complementary Medicine 7(4): 433-440. doi:10.1016.2016.12.014

Ghasempour M, Hosseini M, Soltani-Zangbar MS, Motavalli R, Aghebati-Maleki L, Dolati S, Mehdizadeh A, Yousefi M, Ahmadian Heris J. 2022. The impact of *Hyssop* (*Hyssopus officinalis*) extract on activation of endosomal toll like receptors and their downstream signaling pathways. BMC Research Notes. 12. 15(1): 366. doi: 10.1186/s13104-022-06253-3

Gafarova SM. 2022. Biological features and importance of essential oil plants in the national economy: Eurasian Journal of Medical and Natural Sciences. 131.doi:org/10.5281/zenodo.6340157

Hamidpour M, Hamidpour R, Hamidpour S, Shahlari M. 2014. Chemistry, Pharmacology, and Medicinal Property of Sage (Salvia) to Prevent and Cure Illnesses such as Obesity, Diabetes, Depression, Dementia, Lupus, Autism, Heart Disease, and Cancer: Journal of Tradititional and Complementary Medicine 4(2): 82-88. doi: 10.4103/2225-4110.130373

Ivashchenko AA, 1955. *Thymus vulgaris*. Beekeeping: 8:61

Ibragimov AYa. 2016. Healing blessings. *Lavandula officinalis* L. Tashkent.

Kalinichenko LV. 2013. Agrobiological features of *Hyssopus officinalis* L. and ways to increase crop productivity in the non-chernozem zone: PhD dissertation. Moscow.

Khojimatov K. 1982. Spice plants of Uzbekistan. Tashkent: Fan.

Khodjaev Kh, Kholmatov KhKh. 1965. Culture of medicinal plants in Uzbekistan. Tashkent: Fan.

Khojimatov OK, Khamraeva DT, Khujanov AN, Bussmann RW 2020. An overview of Ethnomedicinal plants of Uzbekistan // Ethnobotany Research & Applications, 20:08 http://dx.doi.org/10.32859/era.20.08.1-19.

Khojimatov OK, Gafforov Y, Bussmann RW 2023. Ethnobiology of Uzbekistan: Ethnomedicinal Knowledge of Mountain Communities// ISSN 2365-7553 ISSN 2365-7561 (electronic) Ethnobiology, ISBN 978-3-031-23030-1 ISBN 978-3-031-23031-8 (eBook) https://doi.org/10.1007/978-3-031-23031-8, 1513 Pages.

Kitova EA, 2007. Some features of the growth and development of *Origanum vulgare* L. in culture and natural habitats: Bulletin of the Udmurt University. 10:31-38

Kompelly A, Kompelly S, Vasudha B, Narender B. 2019. *Rosmarinus officinalis* L.: an update review of its phytochemistry and biological activity: JDDT. 9(1):323-30. https://jddtonline.info/index.php/jddt/article/view/2218

Liaqata I, Mahreen A, Arshadc M, Arshad N. 2023. Antimicrobial and toxicological evaluation of *Origanum vulgare*: an in vivo study: Brazilian Journal of Biology, 83:e244551 https://doi.org/10.1590/1519-6984.244551

Mahmood ZF, Sami S, Ahmed DM, Reviews A. 2020. Review about Lavender Importance: Russian Journal of Biological Research 7(1):14-20. doi:10.13187/ejbr.2020.1.14

Mashanov V.I. 1972. Introduction and selection of essential oil plants in the Nikitsky Botanical Garden: 4th International Congress on essential oils. Tbilisi. 2:110-113.

The methodology of phenological observations in the botanical gardens of the USSR. 1975. Moscow. 27 p.

Mohammadi H, Moradi S, Hazrati S, Aghaee, A. 2022. Melatonin application on phytochemical compositions of *Agastache foeniculum* under water-deficit stress: Botanical Sciences. 100(3): 645-656. https://doi.org/10.17129/botsci.2920

Nasriddinova MR. 2015. On the introduction of *Rosmarinus officinalis* L. into the Karshinsky oasis: Natural and Technical Sciences. 6

Nikitina AS, Tokhsyrova ZM, Popova OI. 2017. Elemental composition of *Rosmarinus officinalis* L. shoots introduced in the Botanical Garden of the Pyatigorsk Medical and Pharmaceutical Institute: Pharmacy and Pharmacology. 5(6):581-588. doi:10.19163/2307-9266-2017-5-6-581-588

Najafi F, Kavoosi G, Siahbalaei R, Kariminia A. 2022. Anti-oxidative and anti-hyperglycemic properties of *Agastache foeniculum* essential oil and oily fraction in hyperglycemia-stimulated and lipopolysaccharide-stimulated macrophage cells: In vitro and in silico studies: Journal of Ethnopharmacology 284. https://doi.org/10.1016/j.jep.2021.114814.

Prusinowska R, Śmigielski K. 2014. Composition, biological properties and therapeutic effects of lavender (*Lavandula angustifolia* L.). A review: Herba Polonica. 60(2). doi:10.2478/hepo-2014-0010

Reddy P, Kandisa RV, Varsha PV, Satyam S. 2014. Review on *Thymus vulgaris* traditional uses and pharmacological properties: Medicinal and Aromatic Plants. 3:3. http://dx.doi.org/10.4172/2167-0412.1000164

Soltani S, Shakeri A, Iranshahi M., Boozarib M. 2021. A review of the phytochemistry and antimicrobial properties of *Origanum vulgare* L. and subspecies: Iran Journal of Pharmacy Research 20(2):268-285. doi: 10.22037/ijpr. 113874.14539

Strilbytska OM, Zayachkivska A, Koliada A, Galeotti F, Volpi N, Storey KB, Vaiserman A, Lushchak O. 2020. Anise hyssop *Agastache foeniculum* increases lifespan, stress resistance, and metabolism by affecting free radical processes in drosophila: Frontiers of Physiology 16(11):596729. doi: 10.3389/fphys.2020.596729

Satyal P, Murray BL, McFeeters RL, Setzer WN. 2016. Essential oil characterization of *Thymus vulgaris* from various geographical locations: Foods 5(4):70. doi: 10.3390/foods5040070

Sardari S, Mobaien A, Ghassemifard L, Kamali K, Khavasi N. 2021. Therapeutic effect of thyme (*Thymus vulgaris*) essential oil on patients with covid19: A randomized clinical trial: Journal of Advances in Medical and Biomedical Research. 29(133):83-91. doi:10.30699/jambs.29.133.83

Tundis R, Leporini M, Bonesi M, Rovito S, Passalacqua GN. 2020. *Salvia officinalis* L. from Italy: a comparative chemical and biological study of its essential oil in the Mediterranean context: Molecules 25(24):5826. doi: 10.3390/molecules25245826

Tahir M, Khushtar M, Fahad M, Rahman Md A. 2018. Phytochemistry and pharmacological profile of traditionally used medicinal plant Hyssop (*Hyssopus officinalis* L.): Journal of Applied Pharmaceutical Science. 8(07):132-140

Tokhsyrova ZM, Nikitina AS, Popova OI. 2016. The study of the antimicrobial effect of essential oil from medicinal rosemary shoots (*Rosmarinus officinalis* L., Lamiaceae): Pharmacy and Pharmacology. 4(1-14). doi: 10.19163/2307-9266-2016-4-1(14)-66-71

Turdibaev OA. 2023. Flora of Uzbekistan *Salvia* L. types of categories. PhD thesis abstract.

Zielińska S, Matkowski A. 2014. Phytochemistry and bioactivity of aromatic and medicinal plants from the genus *Agastache* (Lamiaceae): Phytochemistry Review 13(2): 391-416. doi: 10.1007/s11101-014-9349

Zaitsev GN. 1990. Mathematics in experimental botany. Moscow: Nauka.