An overview of Ethnomedicinal plants of Uzbekistan

Olim K. Khojimatov, Dilovar T. Khamraeva, Alisher N. Khujanov and Rainer W. Bussmann

Databases and Inventories

Abstract

Background: The Flora of Central Asia is extremely rich, with about 9800 species of vascular plants. Uzbekistan, with over 4500 species, has a central position in the region, and is regarded as one of the main centers of medicinal plants diversity, in particular because of its high percentage of local endemism. About 600 species of medicinal plants have been documented in Uzbekistan for the treatment of numerous diseases, many of them endemic. These plants are still used for the medicinal traits in industrial scale as well as by local tabibs (local practitioner).

Methods: During research, semi-structured interviews were conducted with tabibs, elders and herders with experience in healing by using medicinal plants. During expedition visits, herbarium material and samples of medicines from vegetative raw materials were collected. Collected materials were determined using local floristic monographs and herbarium vouchers.

Results: During fieldwork, we recorded 117 medicinal plants belonging to 45 families and 94 genera, used widely for the treatment of various diseases. Traditional practitioners prepared the plants mostly as extract, decoction, powder, bathing and sometimes used them fresh. Extract and decoction were generally preferred, and the preparations were normally made fresh just before use. Some of the encountered plants are now also used by private entrepreneurs for the production of herbal medicines for various purposes.

Conclusions: Our results show that despite the achievements of modern allopathic medicine, the population in Uzbekistan continues to actively use wild medicinal plants for health purposes. The wide availability of medicinal plants, low costs, and perceived efficacy contribute to popularization of traditional medicine.

Keywords: Ethnobotany; ethnopharmacology; medicinal plants; Uzbekistan; Central Asia.

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Xulosa

Ma'lumot: O'rta Osiyo florasi juda boy bo'lib, 9800 ga yaqin yursak o'simliklari mavjud (Xasanov 2015). 4500 dan ortiq turga ega bo'lgan O'zbekiston mintaqada markaziy mavqega ega va dorivor o'simliklar xilma-xilligining asosiy markazlaridan biri hisoblanadi, qisman uning mahalliy endemizm darajasi juda yuqori. O'zbekistonda ko'plab kasalliklarni davolash uchun dorivor o'simliklarning 600 ga yaqin turi hujjatlashtirilgan, ularning ko'plari endemikdir. Ushbu o'simliklar hanuzgacha sanoat miqyosida dorivor xususiyatlari uchun mahalliy amaliyotchilar tomonidan qo'llaniladi.

Usullari: Tadqiqot davomida dorivor o'simliklardan foydalangan holda davolash tajribasiga ega bo'igan tabiblar, oqsoqollar va cho'ponlar bilan intervyu o'tkazildi. Ekspeditsiya safarlari davomida gerbariy materiallari va o'simlik xom ashyosidan olingan dorilar namunalari to'plangan. To'plangan materiallar mahalliy floristik monografiyalar, o'simliklar

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aniqlagichlari va gerbariy namunalari yordamida aniqlandi.

Natijalar: Ushbu maqolada ko'p yillik etnobotanik tadqiqotlar natijalari tahlil qilingan bo'lib, unda O'zbekistonda an'anaviy tibbiyotda yovvoyi o'simliklarning 100 dan ortiq turlariqo'llanilishi hamda ulardan hozirda xususiy tadbirkorlar tomonidan turli maqsadlarda ishlatiladigan dorivor preparatlar ishlab chiqarishda foydalanilishi keltirilgan.

Xulosa: Bizning natijalarimiz zamonaviy ilmiy tibbiyotda erishilgan yutuqlarga qaramay, O'zbekiston aholisi yovvoyi dorivor o'simliklardan davolanish uchun faol foydalanishda davom etishini ko'rsatdi. Bunda dorivor o'simliklar ta'sir darajasini keng qamrovligi, tabiiyligi va arzonbopligi an'anaviy tibbiyotni ommalashtirishga yordam beradi.

Kalit so'zlar: Etnobotanika; etnofarmakologiya; dorivor o'simliklar; O'zbekiston; O'rta Osiyo.

Background

There are some regions in the world that have been very important for the development of human civilization. Central Asia - the region between the Caspian Sea and Siberian Altay Mountains, features prominently among them. According to Nicolai Vavilov (Vavilov 1992), Central Asia is one of the eight centers of origin and diversity of cultivated plants. Many domestic species originated from this region, including apples, dwarf wheat, lentils, and garlic. Many wild relatives of onion, apple, spinach, and almond, to name a few, still grow there along with other wild relative species of crops. The region was and is still botanically extremely rich and has a lot of promising economic and ornamental plants that have not yet been explored or introduced into international horticulture. Central Asia includes five countries of the former Soviet Union: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

The long isolation of these countries, both from one another and from the world, has prevented them from undertaking a coordinated, regional approach toward understanding and conserving their interrelated floras. Central Asia extends 1300 km from north to south and 2400 km from west to east. The large Turanian Lowland forms the northern part of the region. It gradually rises in the southeastern part to high mountain borders. Large areas are occupied by deserts and by high mountains, including the Tien Shan and Pamir-Alay which harbor numerous plateaus that range from 3700 to over 5000 m. Fittingly, Pamir means "roof of the World" in the Tajik language. The Flora of Central Asia is extremely rich, with about 9800 species of vascular plants (Khassanov 2015). Uzbekistan, with over 4500 species, has a central position in the region. The southern border of the region runs along Iran, Afghanistan and China. About 600 plant species are used in traditional medicine, but only around 200 species have been phytochemically investigated, and some 150 plants species were included in the original Pharmacopoeia of Uzbekistan (Khojimatov *et al.* 1993). Traditional medicine in Central Asia has a long history, which began many centuries ago, but its most notable period was in the 10th - 11th centuries. Many early scientists tried to explore the secrets of folk medicines, including, Abu Raihon Beruni (973 - 1048) (Figure 1) and Abu Ali ibn Sino (Avicenna) (980-1037) (Figure 2), both of which contributed greatly to the early codification of herbal medicines.

Avicenna was born in the territory of modern Uzbekistan, near Bukhara. He wrote 456 books, among them 62 books about medicines. The most famous part of his work is the "Canon" in 5 volumes (Ibn Sina 1982, Uzbek edition), the second volume of which was dedicated to medicinal plants, describing about 1500 drugs and almost 800 species of medicinal vascular plants. Historically Uzbek and Tajik botanists, especially in 20th century made significant contributions to develop pharmacognosy, pharmacology and phytotherapy (Khojimatov & Kobetc 1988; Khojimatov & Olloyorov 1988; Kholmatov *et al.* 1984).

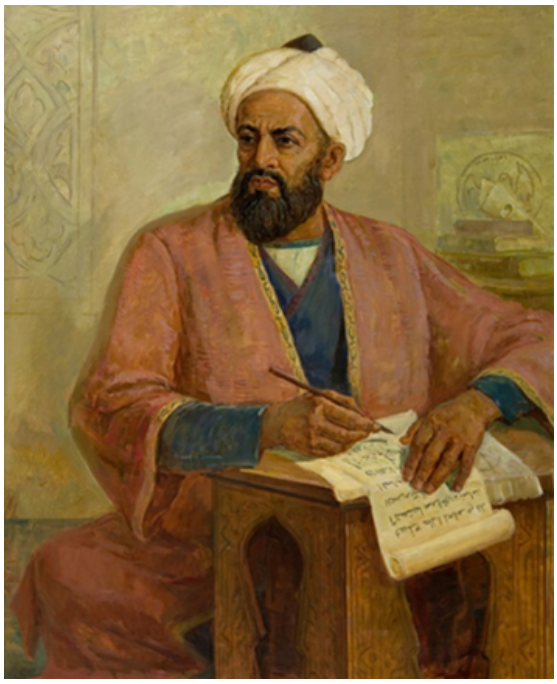

Figure 1. Abu Raykhon Beruny

Figure 2. Avicenna

Since Uzbekistan's independence, the use of medicinal herbs in the treatment of various diseases has been significantly developed. This was facilitated by measures taken by the State in terms of popularizing the centuries-old experience of folk medicine, through the creation of the Academy of Folk Medicine of Uzbekistan, the Ibn Sina International Foundation (Avicenna), as well as the way out of the shadow of folk healers (tabibs), which in previous times was not welcome treatment by folk means. All this led to the further popularization of the traditional medicine and the local population began to use herbs more confidently. Often, herbal preparations have a wider spectrum of action compared to synthetic preparations, and, in view of their naturalness, are often more tolerable to the human body, due to less toxicity. Nowadays pharmacy chains and markets are selling medicinal plants in natureal state, as well as, extracts and tinctures, especially of popular species like *Ziziphora pedicellata*, *Origanum tyttanthum*, *Matricaria chamomilla*, *Achillea millefolium*, among others.

The purpose of this work was to identify wild medicinal plants of the flora of Uzbekistan used by the local population for medicinal purposes, and to analyze and systematize the information received.

Materials and Methods

Classical ethnobotanical methods were used for gathering information obtained from the mountain villages of Uzbekistan and provided by the local tabibs, schoolteachers and shepherds. Participants were selected by snowball sampling and gave their prior informed consent before conducting semi-structured interviews using a standard questionnaire. Plant samples were collected on walks in the fields. Ethnobotanical studies were carried out in the spring - autumn periods of 2014-2019. The Kashkadarya, Samarkand and Tashkent regions of the territory of the Republic of Uzbekistan were examined. Information was collected in mountain settlements by interviewing tabibs, elders, shepherds and other storage media, of which 9 interviewees were tabibs, 9 were elders and 7 shepherds. As a rule, representatives of the male part of the population are engaged in traditional medicine in Central Asia, as a result of which, all the respondents were men. For ethnobotanical work, we used a specially developed questionnaire to elucidate more detailed information convenient for further analysis (Khojimatov, 2008). The age of the interviewees ranged from 38 to 84 years. Interviews were conducted in Uzbek, Tadjik and Russian after receiving prior informed consent. It must also be emphasized that many tabibs are however not willing to disclose their knowledge about treatment methods and the plants used, since traditionally the experience of the healer is transmitted only to family members from generation to generation and, therefore, the recipes for preparing treatment are kept secret.

All specimens have been taxonomically analyzed, and all herbarium samples are stored in the Herbarium (TASH) of the Institute of the Botany Academy of Sciences, Uzbekistan. The nomenclature of species was revised in using www.tropicos.org, and family classification follows APGIII (APG 2009).

Results

During fieldwork, we recorded 117 medicinal plants used widely for the treatment of various diseases (Table 1). Traditional practitioners prepared the plants mostly as extract, decoction, powder, bathing and sometimes used them fresh. Extract and decoction were generally preferred, and the preparations were normally made fresh just before use. For some plants like Issirik (*Peganum harmala*), the aerial part was burned, and the smoke was inhaled, for treatment and prophylactics of infectious diseases, such as influenza, as also reported by other studies (Astulla *et al.* 2008; Moloudizargari *et al.* 2013). Species had often multiple uses, and e.g. 24 medicinal species were commonly used as food (Table 1). These plants were also used for the preventive treatment of diseases such as vitamin deficiency and common cold.

Table 1. The most using species in traditional medicine of Middle Asia

Scientific name	Local name	Part used	Forms of preparation	Traditional uses	Remarks	Herbarium samples voucher (TASH)
Amaryllidaceae						
Allium karataviense Regel	Piyoz	bulbs	fresh	common cold	E, F	specimen voucher K. Tojibaev, 07.06.2015. №7
Allium suworowii Regel	Piyoz	bulbs	fresh	skin diseases, vitamin deficiency	F	specimen voucher N. Beshko,12.05.2012.№258
Ungernia sewerzowii (Regel) B. Fedtsch.	Qoraqovuk	bulbs, leaves	extract	bronchitis, for treatment of wounds	E	specimen voucher G. Khamidov, 24.05.1987. №37
Ungernia nvictoris Vved. ex Artjush.	Omonqora	bulbs, leaves	extract	poliomyelitis	E	specimen voucher K. Khozhimatov, 09.07.1960. №232
Anacardiaceae						
Pistacia vera L.	Pista	galls	extract	cardiac and respiratory diseases	F	specimen voucher A. Kazakbaev, 09.06.1986. №136
Rhus coriaria L.	Tatum	leaves, fruits	decoction	hypertension, gastric ulcer		specimen voucher M. Nabiev, 03.06.1972. №405
Apiaceae						
*Elwendia persica (*Boiss.) Pimenov & Kljuykov	Zira	seeds	decoction	stomach, cardiac diseases	F	specimen voucher G. Gaffarov, 27.07.1986. №5335
Ferula foetida Regel	Sassiq kovrak	gum	fresh, extract	for wounds, diabetes, tuberculosis		specimen voucher N. Beshko, 05.05.2011. №005
Heracleum lehmannianum Bunge	Boldirgan	leaves, roots	extract	dental and skin diseases, convulsion		specimen voucher M. Nabiev, 31.05.1980. № 502
Mediasia macrophylla (Regel et Schmalh.) Pimenov	Alqoruti	a. p.	fresh, extract	liver and gall-bladder diseases, rheumatism, nephritis, eczema (Kurimoto et al., 2011; Khojimatov et al., 2015)	E, F	specimen voucher A. Pyatayeva, 14.07.1976.№2
Prangos pabularia Lindl.	Shashir	a. p.	extract	external for skin diseases		specimen voucher M. Nabiev, 31.05.1980. №515
Apocynaceae						
Vinca erecta Regel & Schmalh.	Barigul	whole, plants	decoction	headache, cardiac diseases	E,T	specimen voucher E. Korotkova, 26.06.1967. №1163.
			powder	external for wounds		
Araceae						

Acorus calamus L.	Igir	rhizome	powder	liver cancer		specimen voucher N. Naralieva, 30.05.2015.№56
			extract	diuretic, tonic for central nervous system		
Asteraceae						
Achillea filipendulina Lam.	Dastarbosh	a. p.	extract	stomach diseases		specimen voucher A. Yuldashev, 01.06.1987. №12
Achillea millefolium L.	Buymadaron	a.p.	extract	stomach diseases		specimen voucher A. Egamberidev, 14.06.2001.№64
Arctium tomentosum Mill.	Qarikiz	leaves, roots	decoction	rheumatism, external skin diseases		specimen voucher Yu. Grigoriev, 06.07.1959. № 32.
Artemisia absinthium L.	Erman	a.p.	extract	liver, kidney, sleeplessness		specimen voucher K. Djabbarov, 23.07.1983. №530
Artemisia dracunculus L.	Sherolgin	a.p.	extract	stomach diseases		specimen voucher K. Toyjanov, 14.07.1996. №101
Bidens tripartita L.	Ititkanak	leaves	bath	skin diseases		specimen voucher S. Sokhobiddinov, 09.06.1949. №1849
Centaurea cyanus L.	Butakuz	flowers	decoction	fever		specimen voucher O. Turginov, 10.07.2012. №87
Centaurea. depressa M. Bieb.	Bulakuz	flowers	decoction	common cold		specimen voucher T. Makhkamov, 25.04.2006.№26
Cichorium intybus L.	Sachratki	roots	decoction	cardiac diseases		specimen voucher T. Makhkamov, 01.05.2005. №8.
Helichrysum maracandicum Popov ex Kirp.	Ulmasut	flowers	decoction	liver and gall-bladder diseases	E	specimen voucher A. Khujanov, 03.07.2018. №38
Inula macrophylla Kar. & Kir.	Sariqandiz	roots	extract	intestinal diseases, laxative		specimen voucher M. Nabiev, 23.07.1988. №174
Inula helenium L.	Qoraandiz	roots	extract	blood coagulant, laxative		specimen voucher M. Nabiev, 18.06.1980. №108
Onopordum acanthium L.	Oqqarak	a.p.	decoction	astma, cought, high blood pressure		specimen voucher E. Kortokova, 25.06.1978. №229
Rhaponticum integrifolium C. Winkl.	Levzeya	roots	extract	as a tonic, diabetes		specimen voucher I. Raikova,01.09.1987.№1535
Tanacetum pseudachillea C. Winkl.	Dastarbosh	a.p.	decoction	laxative		specimen voucher I. Khamidhodjaev, 25.07.1973.№78
Taraxacum officinale (L.) Weber ex F.H. Wigg.	Koki	leaves, roots	extract	diuretic, laxative, liver diseases		specimen voucher S. Kovalevskaya, 14.04.1961. №45

Tussilago farfara L.	Oqqaldirmoq	a.p.	decoction	asthma, cough		specimen voucher O. Turginov, 23.04.2012.
Xanthium strumarium L.	Guzatkon	fruits, leaves	extract	dysentery, wounds		specimen voucher R. Yesemuradova, 16.05.2010. №0214.
Berberidaceae						
Berberis integerrima Bunge	Zirk	bark	decoction	liver and kidnes chseascs	F	specimen voucher M. Nabiev, 25.05.1978. №758
Berberis oblonga (Regel) C.K. Schneid.	Qorazirak	fruits	extract	rheumatism, bruise and wounds	F	specimen voucher H. Mirzakarimova, 16.06.2008. №201
Brassicaceae						
Capsella bursa-pastoris (L.) Medik.	Jagjag	a. p.	decoction	blood coagulant		specimen voucher E. Sulaymonov, 23.05.2006. №2
Campanulaceae						
Codonopsis clematidea (Schrenk ex Fisch. & C.A. Mey.) C.B. Clarke	Dugboy	a. p.	decoction	liver, nausea, skin rash	E	specimen voucher K. Tojibaev, 11.06.2004. №56
Capparaceae						
Capparis spinosa L.	Kovar	Roots	extract	rheumatism, liver diseases		specimen voucher L. Botirova, 01.10.2010. №32
		fruits	decoction	jaundice, diabetes		
Caryophyllaceae						
Allochrusa gypsophiloides (Regel) Schischk.	Yetmak	roots	extract	bronchitis, cough		specimen voucher K. Toyjanov, 24.07.1996. №118
Chenopodiaceae						
Anabasis aphylla L.	Itsigak	shoots	extract	lung tuberculosis, asthma	T	specimen voucher K. Buriev, 17.10.1974.№95
Salsola richteri (Moq.) Kar. ex Litw.	Cherkez	a.p.	extract	hypertension, headache (Pak et al., 2019)		specimen voucher U. Pratov, 18.05.1976. №584
Convolvulaceae						
Convolvulus arvensis L.	Quypechak	leaves, roots	extract	laxative, wounds		specimen voucher E. Abdullajanov, 2.7.1974. №214
Convolvulus subhirsutus Regel & Schmalh.	Ming bosh	a.p.	decoction	convulsion, asthma	T	specimen voucher N. Beshko, 16.07.2012. №264

Crassulaceae						
Rhodiola heterodonta (Hook. f. & Thoms.) Boriss.	Oltin ildiz	roots	ethanol	tonic, impotence	T	specimen voucher I. Levichev, 17.06.1980. №90
Cupressaceae						
Juniperus polycarpos var. *seravschanica* (Kom.) Kitam.	Archa	fruits	extract	kidney, liver, urinary bladder diseases		specimen voucher V. Titov, 10.08.1932.№132.
Junioperus pseudosabina Fisch. & C.A.Mey.= *J. turkestanica* Kom.	Urik archa	fruits	extract	rheumatism		specimen voucher V. Titov, 10.08.1932.№127.
Elaeagnaceae						
Elaeagnus angustifolia L.	Jiyda	leaves, fruits	extract	bruise and wounds,	F	specimen voucher H. Khaydarov, 12.06.2018. №56
Hippophae rhamnoides L.	Chakanda	fruits	oii	uterine cervical erosion, for burn	F	specimen voucher H. Khaydarov, 12.06.2018. №12
Ephedraceae						
Ephedra equisetina Bunge	Togqizilcha	shoots	extract	common cold, gastric ulcer, diabetes		specimen voucher K. Borlev, 28.05.1981. №377
Ephedra intermedia Schrenk & C.A. Mey.	Qizilcha	shoots	extract	bronchial asthma, rheumatism		specimen voucher U. Pratov, 14.05.1975. №54
Euphorbiaceae						
Euphorbia jaxartica Prokh.	Sutlama	latex	fresh	wart and corn	E, T	specimen voucher I. Maltsev, 18.07.1987. №sn
Fabaceae						
Alhagi pseudalhagi Desv.	Yantoq	a.p.	decoction	fever, diuretic, cough		specimen voucher T. Makhkamov, 15.07.2008. №241
Astragalus eximius Bunge	Aslragal	a.p.	extract	cough		specimen voucher M. Nabiev, 25.05.1980. № 145
Astragalus sieversianus Pall.	Pahtak	a.p.	extract	epilepsy, nervous system diseases		specimen voucher U. Pratov, 22.05.1976 №636
Cullen drupaceum (Bunge) C.H. Stirt.	Oqqurai	leaves, roots	powder	eczema, prolapsed		specimen voucher A.Kuziev, 15.06.2006. №52
Glycyrrhiza glabra L.	Shirinmiya	roots	decoction	cardiac and respiratory diseases		specimen voucher O. Turginov, 13.06.2011. №0062
Melilotus officinalis (L.) Lam.	Qashqar beda	a.p.	extract	laxative, cough		specimen voucher T. Makhkamov,06.07.2006.№312

Thermopsis alterniflora Regel & Schmalh	Afsonak	a.p.	extract	bronchitis, pneumonia	T	specimen voucher R. Halmukhamedova, 19.06.1975. №69
Thermopsis lanceolata R. Br.	Afsonak	a.p.	extract	bronchitis, pneumonia	T	specimen voucher K. Toyjanov, 17.09.1978. №5269.
Grossulariaceae						
Ribes nigrum L.	Qorakat	fruits	fresh, decoction	gastric ulcer, common cold	F	specimen voucher O. Turginov, 29.09.2006.№231
Hypericaceae						
Hypericum elongatum C.A. Mey.	Dalachoi	a.p.	decoction	blood coagulant, antiseptic		specimen voucher H. Esankulov, 26.06.2010. №265
Hypericum scabrum L.	Choiut	a.p.	decoction	cough, bruise and wounds		specimen voucher A. Egamberdiev,11.06.2001.№153
Hypericum perforatum L.	Qizil-poicha	a.p.	decoction	stomach and gall-bladder diseases		specimen voucher A. Egamberdiev,11.06.2001.№203
Juglandaceae						
Juglans regia L.	Yongoq	leaves	extract	diabetes, skin tuberculosis	F	specimen voucher M. Tulaganova, 10.08.1972.
Leontice ewersmannii Bunge	Ersovun	tubers	extract	laxative, diuretic		specimen voucher R. Yesemuratova,12.05.2009.№0169.
Thalictrum foetidum L.	Sanchikut	a.p.	extract	hypertension		specimen voucher A. Pyatayeva, 07.1966. №2091
Thalictrum isopyroides C.A. Mey.	Sanchikut	roots	extract	malaria, jaundice, tuberculosis		specimen voucher E. Korovin, 07.1939. №544.
Lamiaceae						
Dracocephalum komarovii Lipsky	Buzbosh	a. p.	extract	high blood pressure (Uchiyama et al., 2006)	E	specimen voucher T. Khudaiberdiev, 30.07.1967.№234
Hyssopus seravschanicus (Dub.) Pazij	Kukut	a. p.	extract	cough, bronchitis, asthma	E	specimen voucher K. Djumaev, 25.07.1972. №23
Lagochilus inebrians Bunge	Bozulbang	flowers, leaves	decoction	blood coagulant, hypertension	E	specimen voucher N. Beshko, 22.07.2007. № 7068
Leonurus turkestanicus V.I. Krecz. & Kupr.	Buyrakchoi	whole plants	ethanol	neuro - cardiac diseases, diabetes		specimen voucher N. Beshko, 20.07.2009. № 9032
Melissa officinalis L.	Limon-ut	a.p.	extract	anemia, asthma		specimen voucher G. Khamidov, 25.06.1973. №37
Mentha asiatica Boriss.	Yalpiz	a. p.	decoction	against nausea, cough		specimen voucher U. Pratov, 24.06.1996. №512

Origanum tyttanthum Gontsch.	Tograihon	a.p.	decoction	laxative, diuretic	E	specimen voucher G. Goipova, 04.07.1961. № 340.
Salvia sclarea L.	Mavrak	flowers	extract	oro-dental diseases		specimen voucher I. Makhmedov, 26.06.1978.№41
Stachys betoniciflora Rupr.	Togqudusi	a. p.	extract	menstrual disorders, neurosis	E	specimen voucher R. Kholmukhamedova, 20.06.1975. №32.
Ziziphora pedicellata Pazij & Vved.	Qiyiq-ut	a.p.	extract	for gall-bladder stones, hypertension	E	specimen voucher L. Botirova, 01.05.2006. №164
Liliaceae						
Asparagus officinalis L.	Dorivor sarsabil	roots	extract	hydropsy, inflammation of urinary, bladder	F	specimen voucher N. Beshko, 18.07.2015. .№118
Asparagus persicus Baker	Sarsabil	roots	extract	hypertension		specimen voucher M. Sovetkina, 1.08.1945. №500
Malvaceae						
Althaea armeniaca Ten.	Gulhairi	roots	decoction	respiratory diseases		specimen voucher K. Toyjanov, 22.08.1960.№148
Althea officinalis L.	Dorivor gulhairi	roots	decoction	respiratory and stomach diseases		specimen voucher M. Abdullaev, 28.07.1968.№2
Moraceae						
Ficus carica L.	Anjir	leaves, fruits	fresh, extract	skin diseases, common cold	F	specimen voucher O. Khassanov, 30.07.1959. №56
Morus alba L.	Tut	leaves, bark	decoction	diuretic, hypertension	F	specimen voucher A. Butkov, 15.05.1955. №69
		fruits	fresh	stomach disorders		
Morus nigra L.	Qoratut	leaves, bark	decoction	hypertension	F	specimen voucher O. Khassanov, 30.07.1959. №45
		Fruits	fresh	stomach disorders		
Onagraceae						
Epilobium angustifolium L.	Bargchoi	a.p.	decoction	gastric ulcer, inflammation of throat		specimen voucher U. Pratov, 05.2001. №146
Orchidaceae						
Dactylorhiza umbrosa Kar. & Kir.) Nevski	Salib	tubers	decoction	cough, impotence		specimen voucher F. Karimov, 07.06.2011. №5

Papaveraceae						
Fumaria vaillantii Loisel.	Shotara	a.p.	decoction, bath	menstrual disorders as bath for skin diseases		specimen voucher D. Jamalova, 05.06.2006.
Papaver pavoninum C.A. Mey.	Qizgaldak	flowers	extract	cough, common cold		specimen voucher R. Khalkuziev, 24.05.1966. №108
Roemeria refracta DC.	Qizgaldok	flowers	extract	skin rash, fever		specimen voucher A. Ibragimov, 05.06.2006.
Plantaginaceae						
Gratiola officinalis L.	Safrouti	a.p.	decoction	diuretic, jaundice	T	specimen voucher V. Pasius, 18.05.1932. №73.
Plantago major L.	Bakayaprok	leaves	extract	cough, external for wounds		specimen voucher N. Beshko, 18.07.1994. №62
Plantago lanceolata L.	Bargizub	leaves	extract	asthma, cough, external for wounds		specimen voucher U. Pratov, 24.06.1996.№134
Polygonaceae						
Polygonum aviculare L.	Qushtili	a.p.	decoction	blood coagulant		specimen voucher T. Sarybaev, 08.06.1970. №43
P. coriarium Grig.	Toron	roots	extract	dysentery, diarrhea	E	specimen voucher A. Ibragimov, 25.05.2006. №192
Persicaria hydropiper (L.) Delarbre	Suv qalampir	a.p.	extract	malaria, blood coagulant		specimen voucher M. Nabiev, 31.07.1954.№472
Rheum maximowiczii Losinsk.	Ravoch	roots	extract	diarrhea, malaria	E,F	specimen voucher A. Li, 16.06.1960.№27
Punicaceae						
Punica granatum L.	Anor	bark, fruits	extract	stomach diseases, laxative	F	specimen voucher S. Chevrenidi, 18.08.1955. №503
Ranunculaceae						
Adonis turkestanica (Korsh.) Adolf	Sank gul	a.p.	decoction	cardiac diseases	E, T	specimen voucher O. Turginov., 11.05.2012.№314
Delphinium semibarbatum Bien. ex Boiss.	Isparak	a.p.	decoction	tonsillitis	T	specimen voucher A. Batashov, 05.05.2012.№211
Rhamnaceae						
Rhamnus cathartica L.	Togjumrut	fruits	extract	cancer, skin and stomach diseases	F	specimen voucher T. Adylov, 09.07.1972. №19
Ziziphus jujuba Mill.	Unabi	fruits	fresh, extract	anemia, asthma, kidney, liver diseases	F	specimen voucher K. Toyjanov, 19.09.1998. №265

Rosaceae						
Amygdalus communis L.	Bodom	oil, seeds	fresh	asthma, cough, anemia	F	specimen voucher U. Pratov, 02.09.2005.№281
A. spinosissima Bunge	Bodomcha	seeds	fresh	anemia		specimen voucher K. Toyjanov, 07.07.2006.№451
Crataegus pontica Koch	Dulana	flowers	ethanol	cardiac diseases,	F	specimen voucher N. Beshko, 15.09.2012.№213
		fruits	decoction	hypertension, sleeplessness		
Crataegus turkestanica Pojark.	Dulana	flowers	ethanol	cardiac diseases,	E,F	specimen voucher A. Gazybaev, 12.07.1991.№344
		fruits	decoction	hypertension		
Potentilla anserina L.	Ak-dana	a.p.	extract	hemorrhage		specimen voucher U. Pratov, 01.05.2002. №189
Rubus idaeus L.	Parmanchak	fruits	decoction	common cold, cough, fever	F	specimen voucher A. Egamberdyev, 11.06.2001. №211
Rosa canina L.	Itburun	fruits	decoction	fever, stomach disorders		specimen voucher K. Tojibaev, 19.07.2009. №245
Rosa fedtschenkoana Regel	Namatak	fruits	extract	vitamin deficiency		specimen voucher A. Egamberdyev, 13.06.2001.№95
Sorbus tianschanica Rupr.	Chetani	fruits	fresh, extract	vitamin deficiency	F	specimen voucher U. Pratov, 02.09.2005.№281
Spiraea hypericifolia L.	Tobulgi	whole plant	decoction	stomach disorders, vermifuge		specimen voucher K. Toyjanov, 07.07.2006.№451
Rubiaceae						
Rubia tinctorum Lapeyr.	Ruyan	rhizome	extract	diuretic, dissolve kidney stones		specimen voucher T. Adylov, 05.07.1957. №582.
Rutaceae						
Dictamnus albus L.	Togturbid	whole plant	extract	epilepsy, jaundice, snake bite		specimen voucher I. Maltsev, 10.09.1998. №127
Saxifragaceae						
Bergenia ugamica V.N. Pavlov	Badan	roots	decoction	menstrual disorders, immuno-stimulant	E	specimen voucher I. Maltsev, 10.09.1998. №127
Scrophulariaceae						
Verbascum songaricum Schrenk	Sigir kuyruk	flowers	decoction	cough, external for wounds		specimen voucher L. Nazarenko, 27.06.1970. №185

Solanaceae						
Datura stramonium L.	Bangidevona	leaves	extract	external use only for rheumatism	T	specimen voucher H. Esanov, 12.05.2006. №82.
Hyoscyamus niger L.	Mingdevona	leaves	extract	external use only for rheumatism	T	specimen voucher R. Khalkuziev, 02.06.1984. №99
Urticaceae						
Urtica dioica L.	Gazanda ut	leaves	extract	blood coagulant, vitamin deficiency		specimen voucher H. Esanov, 17.07.2009. №405
Zygophyllaceae						
Peganum harmala L.	Issiriq	a.p.	smoke, bath,	influenza, malaria,	T	specimen voucher L. Botirova, 06.2010. №512
			decoction	as bath for itching		

Legend: E — Endemic plants, F — Food, T — Toxic

Taxonomically the 117 species belonged to 45 families and 94 genera. The families which were more frequently used are shown in Table 2. Medicinal plants from Amaryllidaceae, Asteraceae, Lamiaceae and Rosaceae are prevailing in usage in Central Asia (Keusgen *et al.* 2006.; Ryabushkina *et al.* 2008; Sakhobiddinov 1948; Sharopov *et al.* 2015). Local people interviewed in Uzbekistan (Table 3) were using traditional remedies mainly for the treatment of respiratory, gastrointestinal and liver diseases. Medicinal plants used to treat cancer still are a very recent emergence.

Table 2. The most using plant families of medicinal plants

Family	Genera	Species	%
Amaryllidaceae	2	4	3,42%
Apiaceae	5	5	4,27%
Asteraceae	14	18	15,38%
Fabaceae	6	8	6,84%
Juglandaceae	6	4	3,42%
Lamiaceae	10	10	8,55%
Polygonaceae	2	4	3,42%
Rosaceae	7	10	8,55%
Total	52	63	53,85%

Table 3. Rank-ordered list of folk remedies according to group of ailments employed for the treatment

Diseases	Genera	Species	%
Cardiovascular	11	12	7,36%
Oro-dental	3	3	1,84%
Skin	12	12	7,36%
Endocrine system	6	6	3,68%
Gastrointestinal	21	23	14,11%
Genital-urinary	12	12	7,36%
Infectious	6	6	3,68%
Liver	17	19	11,66%
Nervous system	9	9	5,52%
Tumours	2	2	1,23%
Respiratory	22	25	15,34%
Other	30	34	20,86%
Total	151	163	100,00%

For the most used plants in folk medicine and export-oriented species (*Ungernia victoris, Ferula foetida, Helichrysum maracandicum, Capparis spinosa, Ephedra equisetina, Glycyrrhiza glabra*), we assessed the current state of natural populations in the regions of the Republic of Uzbekistan. As a result of the study, we identified opportunities for the annual exploitation of wild resources, compiled GIS maps and proposed measures for sustainable use, which in the future will optimize the production of raw materials and preserve existing plant populations.

The obtained data serve as the basis for further ethnobotanical research to identify original data on the use of medicinal plants in folk medicine in treatment. Established reliable data through analysis will be proposed for further in-depth study by phytochemists, pharmacologists and toxicologists, which in the future will replenish the arsenal of medicines of scientific medicine.

Discussion

Around 100 different nationalities live in Uzbekistan, and ethnic differences explain to some extent the wide spectrum of medicinal plant uses found. Traditional medicine has been an invaluable segment of healthcare in the past and needs to be documented to prevent the disappearance of knowledge. However, our study indicates that medicinal plant knowledge is still widespread in Uzbekistan. After mostly focusing on chemically synthesized medicines in the 20th century, the pharmaceutical industry is slowly shifting towards herbal preparations, in particular in the form of herbal supplements, and the interest in natural remedies and alternative healing methods is increasing throughout the western world. In addition, despite great advances in the chemical industry, some plant substances, e.g. the compounds found in Valerian root (*Valeriana officinalis* L.), or their natural combinations are unique, and yet non-replicable by synthetic chemistry.

Like in many regions worldwide, the population of Uzbekistan is facing the spread of cardiovascular and gastrointestinal diseases. For treatment of these diseases, people are frequently using the aerial parts of the *Hypericum scabrum* (Matsuhisa *et al.* 2002; Tanaka *et al.* 2004), *Leonurus turkestanicus* and *Adonis turkestanica* (Figure 3). Using samples collected during our investigation, it was found that *Bergenia ugamica* (Figure 4) contains substances with immuno-stimulating activity, confirming the oral information of participants, who indicated that the root of Badan (*B. ugamica*) make the human body stronger to defend against diseases.

Figure 3. Flowers of *Adonis turkestanica* (Korsh.) Adolf.

Figure 4. Flowers of *Bergenia ugamica* V.N. Pavlov

Several endemic species are still widely used as astringents and coagulants (e.g. Bozulbang - *Lagochilus inebrians)*. All parts of *L. inebrians* contain the diterpene-alcohol lagochilin, alkaloids, essential oils, tannins, resins, Ca, Mg and 20 different microelements (Co, Ti, Au), vitamins C and K, and organic acids (Kholmatov *et al.* 1984). Drugs prepared from Bozulbang are widely used in official public healthcare as blood coagulant, sedative for nervous diseases and for treatment various skin diseases as eczema, itching, etc.

Another endemic species, naturally growing in Pamir-Alay (Hissar ridge), is Omonkora - *Ungernia victoris* (Figure 5). Ethnobotanical information about this plant indicates that traditionally the population is still using baked bulbs and fresh leaves for the disinfection of wounds. Local people are also still making glue from bulbs. All parts of *U. victoris* contain alkaloids (leaves-0,33%-1%; bulbs 0,8%-0,9%, especially galantamin 0,7%-1%, licorin 0,073%, gordenin 0.039%, tatecin 0,1%, pankratin 0,15%, narvedin 0,0054%). The maximum concentration of alkaloids in *U. victoris* can be found in early spring. This plant also contains cumarin (0,09%), essential oils 0,12%, resins 6%, pectin 4,9%, mucus 7%, sugars 6,1% and organic acids 8,91% (Khojimatov *et al.* 2009). The leaves and bulbs of the plant are now used as an industrial source of the alkaloid galantamin, which is widely used in allopathic medicine for treatment of poliomyelitis and polyneuritis.

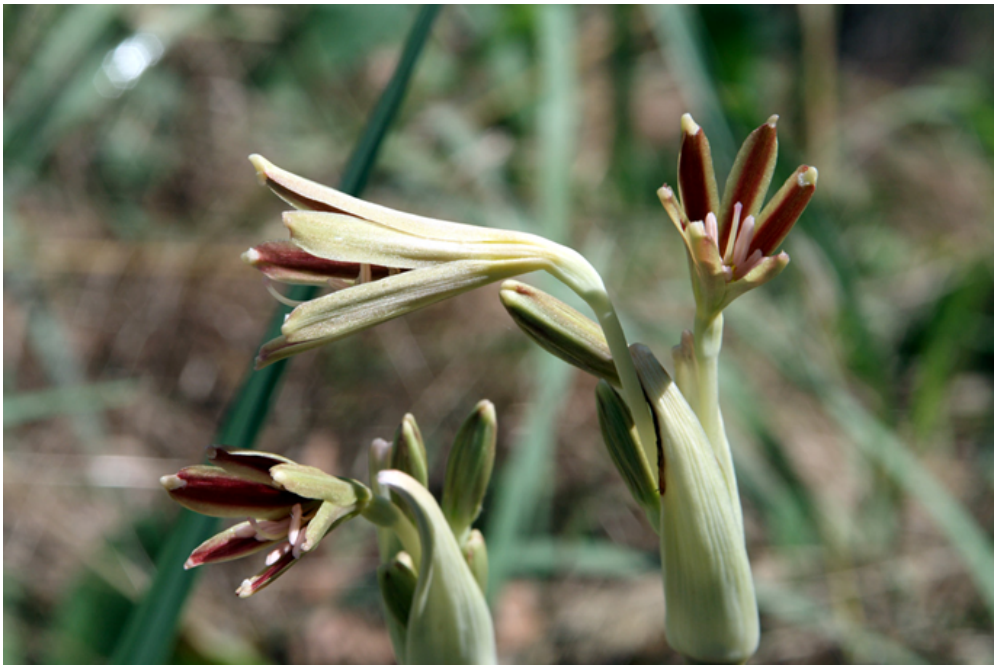

Figure 5. Flowers of *Ungernia victoris* Vved.

Another endemic species Alkoruti - *Mediasia macrophilla* (Figure 6) is usually added to milk or dairy products to keep them fresh. It is also used as medicine by local people in Uzbekistan. The aerial parts have been used traditionally as a perfume, an appetite enhancer, as a natural preservative, and for treatment of rheumatism, nephritis, and eczema (Kurimoto *et al.* 2010).

Only recently *Codonopsis bactriana* (Figure 7) was described. This species is closely related to Tien Shan - Dzhungarian *C. clematidea* (Schrenk.) C.B. Clarke, which is found commonly in the Western Pamir-Alay (Uzbekistan and Tajikistan) and used by tabibs for the treatment of different kinds of liver diseases, such as hepatitis, jaundice and the first stage of liver cirrhosis. Such traditional knowledge has already found its way into the market economy. Ethnobotanical studies provided the base for the development of an original and effective “Species cholagogae Chodjimatovii,” which has been in use since 2002. This drug has shown high efficacy in the treatment of various forms of hepatitis, the initial stages of cirrhosis and diseases of the biliary tract. It was patented on 26.03.2006, No. IAP 02046, registration certificate dated September 30, 2017 No. 02/548/17 (Figure 8).

Another endemic species Buzbosh – *Dracocephalum komarovii* (Figure 9) is a perennial spiny semi-shrub growing in the alpine zone at 3000-3600 m in the West Tien Shan mountain system. Local people are using aerial parts in a tea to cure various disorders such as inflammatory diseases and hypertony (Khojimatov *et al.* 1995; Uchiyama *et al.* 2003).

Figure 6. *Mediasia macrophylla* (Regel & Schmalh.) Pimenov

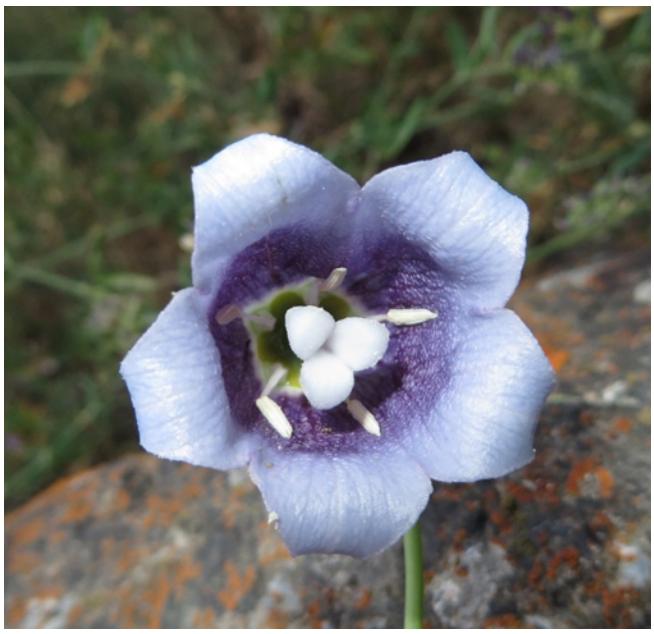

Figure 7. Flower of *Codonopsis clematidea* (Schrenk) C.B. Clarke

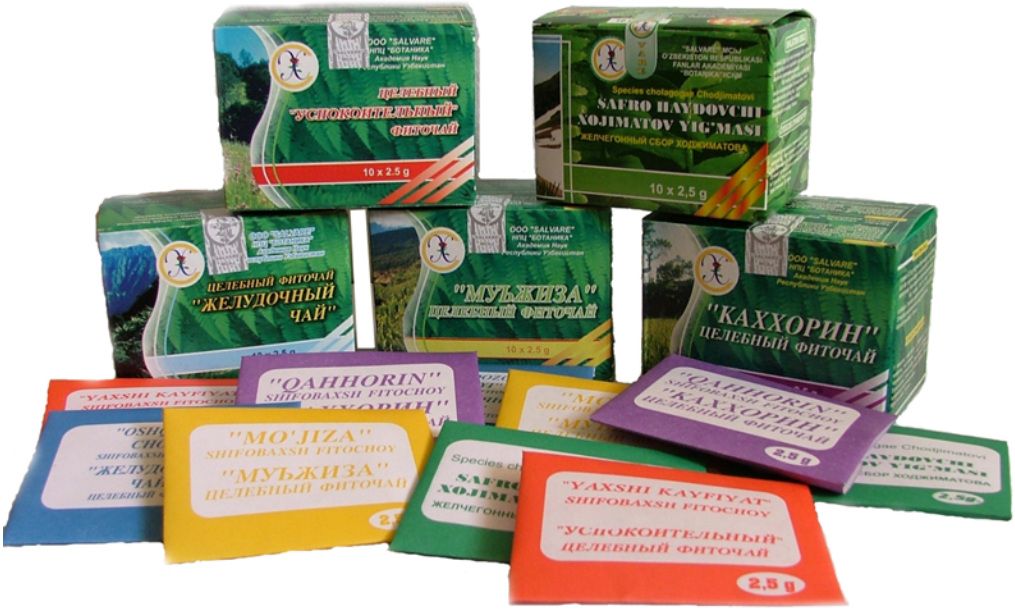

Figure 8. Species cholagogae Chodjimatovii

Figure 9. *Dracocephalum komarovii* Lipsky

In order to standardize the available ethnobotanical information, the Institute of Botany (Tashkent) has developed a database containing detailed information for each plant, e.g. scientific names (accepted name and, when necessary, main synonyms), common name used in literature, and any other names commonly in use, geographical distribution, morphological description, healing properties, traditional medicinal usage and known adverse effects, information on scientifically proven and medicinally approved data, and information received from sources related to traditional medicine, including associated remedies and recipes.

Conclusions

Our results show that despite the achievements of modern allopathic medicine, the population of Central Asia continues to actively use wild medicinal plants for health improvement. This refutes our hypothesis that knowledge is very widely lost. The

decisive factors for the choice and acceptance of herbal drugs are primarily the centuries-old experiences that forms the basis of traditional medicine. This is followed by a wide range of plant effects, that, in most cases, low toxicity of plant preparations, their low cost, and easy availability. All these factors contribute to the increasing popularization of treatments with medicinal plants, both in pure form and as part of multicomponent preparations. We consider it very important to continue ethnobotanical research, covering more and more territories and involving more participants who possess unique knowledge in the field, which may in the future help to develop new effective drugs based on centuries-old experience of folk medicine.

Declarations

List of abbreviations: TASH – Herbarium of the Institute of Botany Academy of Sciences, Uzbekistan.

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

Funding: Not applicable.

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

Authors' contributions: OK Khojimatov collected and analyzed the data, drafted and developed the manuscript. DT Khamraeva searched literature, cooperated in data collection and adjusted the manuscript to the journal submission guidelines. AN Khujanov analyzed the data and structured the tables. RW Bussmann critically revised the manuscript. All authors contributed in the research proposing the problem, data collection, and approved the final manuscript.

Consent for publication: Not applicable.

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

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