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Indigenous veterinary practices using medicinal plants in the Kara-Koy Gorge, Kyrgyzstan

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Within the western Tian Shan of southern Kyrgyzstan, the Kara-Koy Gorge is distinguished by a highly diverse flora, with numerous plant species possessing notable relevance to traditional veterinary practice. However, ethnoveterinary studies of medicinal plants and lichens in this area have not yet been conducted. This study documents the ethnoveterinary use of plants and lichens, along with associated traditional knowledge, in the Kara-Koy Gorge. Ethnoveterinary information was collected through semi-structured interviews (n=58) conducted between 2021 and 2022. Ethnobotanical data were analyzed using the Informant Consensus Factor and Use Value. The study documented 843 homemade single-species herbal/lichen remedies derived from 97 plant species across 31 families, 8 lichen species across 6 families. The most represented families were Asteraceae and Rosaceae, with commonly used species including *Artemisia absinthium*, *Elaeagnus rhamnoides*, *Trifolium pratense*, and *Aconitum soongaricum*. Lichens were used exclusively for treating skin wounds in horses. The majority of remedies utilized aerial parts and whole plants, typically prepared as decoctions and applied fresh. A total of 1,274 use reports for treating 39 animal diseases were recorded, with horses and cattle being the primary focus. Oral and topical applications were the most common methods of administration. Key medicinal species included *Artemisia absinthium*, *Elaeagnus rhamnoides* and *Allium sativum*. The medicinal plants of the Kara-Koy Gorge are essential to traditional veterinary practices and hold significant scientific potential. Documenting this knowledge supports the preservation and rational management of therapeutic plant species and lichens, while also facilitating their validation for veterinary applications and highlighting their ecological, cultural, and practical value.

Keywords: Animal diseases, Ethnoveterinary knowledge, Kara-Koy Gorge, Kyrgyz Republic, Medicinal plants/lichens

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Medicinal plants and lichens are used to treat and prevent various animal ailments[1,2]. These properties of plants have been utilized by humans for centuries, evolving through the adaptation process and being passed down from generation to generation across different ethnic groups worldwide. Modern knowledge of medicinal plants is based on both scientific research and traditional sources[3,4].

Rural populations in developing countries, where veterinary services are unavailable or of poor quality, rely on traditional herbal remedies for treating livestock diseases[5,6]. Traditional veterinary herbal remedies are an easily accessible, affordable, and effective way to treat animals. In developed countries, organic farming and efforts to reduce the use of synthetic drugs also promote the use of such remedies[7]. However, ethnoveterinary medicine is still underexplored[8].

The Kyrgyz people's knowledge of plant-based healing practices for both humans[2,9,10] and animals[2,9,11] are deeply rooted in the centuries-old traditions of their nomadic civilization. However, traditional herbal medicine has not been adequately studied. During the Soviet period, traditional knowledge was banned, leading to its loss. Following the collapse of the Soviet Union, indigenous knowledge regained recognition[12]. Studies on traditional animal healing among the Kyrgyz have been published[6,9,11], but it is limited, with the exception of local publications. Ethnoveterinary research is essential for preserving

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traditional knowledge about medicinal plants. Such research documents local plant use, habitats, and sustainable harvesting, which can contribute to reducing rural poverty[13]. However, the lack of reliable information threatens Kyrgyzstan's biodiversity[14], and the growing reliance on natural resources exacerbates global biodiversity conservation issues.

Livestock farming holds deep traditional significance for the Kyrgyz people, having served as a cornerstone of their livelihood and culture for centuries. Many Kyrgyz families continue to engage in animal husbandry, maintaining elements of the semi-nomadic lifestyle shaped by the country's historical and climatic conditions. These factors have long supported the development and sustainability of livestock farming across the Kyrgyzstan[11].

In the study region, both crop and livestock farming remain the main sources of income for local residents. Agriculture ensures household food security, supplies the domestic market, and contributes to export activities. The area is notable for producing a wide variety of fruits and vegetables typical of the Kyrgyzstan, while households raise diverse livestock species (horses, cows, yaks, sheep, goats, pigs, donkeys, poultry, and fish) mostly on small and medium-sized mixed farms.

The present study documented the ethnoveterinary use of wild and domesticated plants by indigenous practitioners in the Kara-Koy Gorge, Kyrgyzstan, using established ethnobotanical methods. Detailed information was provided on herbal remedies, including scientific and vernacular names, origin, plant parts used, preparation methods, applications, and related disorders. The research also emphasized plant species of ethnocultural significance and included a cross-regional analysis situating the findings within data from nearby and distant areas. Additionally, the informant consensus factor for ethnoveterinary diseases and the use value of plant species were calculated.

Material and Methods

Study area

The study was conducted in the Kara-Koy settlement[10] and the Mazar pasture in the Kara-Koy Gorge (2,861-3,471 m above sea level) (Fig. 1a-b). From March to October, residents of 30 settlements with a total population of 118, 846[15] graze their livestock – including sheep, goats, cows, horses, and yaks – on the Mazar pasture (Fig. 1c-e).

Study methodology and informants

Researchers identified Kara-Koy residents with relevant expertise. They explained the study, obtained verbal consent, and scheduled interviews. Data collection, conducted between March 2021 and October 2022, involved informal, semi-structured interviews in Kyrgyz, lasting 2–4 hours, held outdoors (Fig. 2) or in yurts depending on weather.

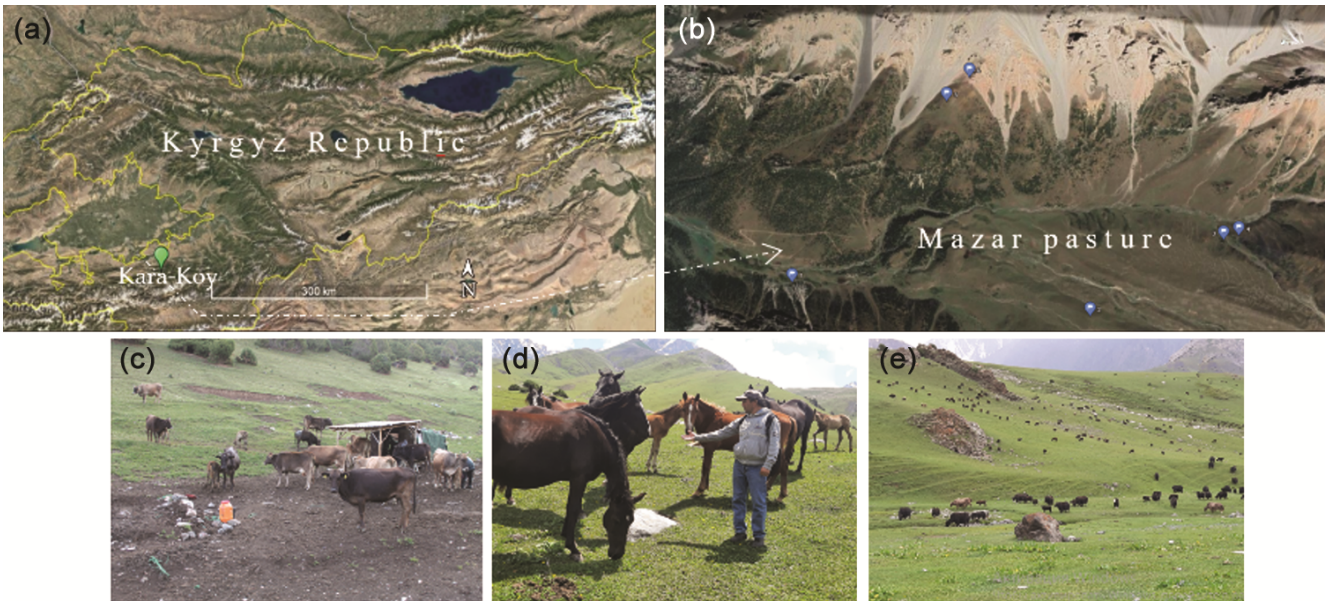

Fig. 1 — General satellite images of the Kyrgyz Republic (a) and study areas in the territory of the Mazar pasture in Kara-Koy Gorge. The locations where plant species are collected are marked (b) (Images taken using Google Earth (2021) and Google Map (programs: Airbus, Maxar Technologies, 2021)). Livestock grazing at Mazar pasture (c, d, e)

Fig. 2 — Various moments from interviews with informants at the Mazar pasture (oral consent for publishing their photographs was obtained)

Interviews documented informant details and concentrating on therapeuticherbs, including vernacular names, uses, parts utilized, preparation procedures, and locations. Each informant was interviewed more than once to ensure accuracy. Verbal consent was obtained per the ethical guidelines of the International Society of Ethnobiology[16], and interviews were recorded using Dictaphones or phones. Fifty-eight informants contributed: 16 selected by researchers, 38 via snowball sampling, and 4 randomly. All expressed a wish to preserve their knowledge for future generations.

A total of 58 informants, including both men and women of various ages and professions, were interviewed. The informants' ages ranged from 48 to 91 years. Individuals under the age of 48 did not possess complete knowledge and therefore recommended consulting the older generation.

The ethnobotanical data were analyzed using two quantitative indices: the informant consensus factor (FIC) and the use value (UV)[17]. The FIC is determined as:

$$FIC = Nur - Nt / Nur - 1.$$

Where, Nur represents the number of use reports (URs) for each disease category, and Nt is the number of plant species utilized. FIC values range from 0 to 1, with a value of 1 indicating that few species are widely used among many informants, whereas 0 reflects disagreement regarding plant use for specific ailments. High FIC values suggest well-established knowledge and active information exchange, while low FIC values indicate random selection and limited sharing of ethnobotanical knowledge[18].

Calculation of the UV follows the formula[17,19]:

$$UV = \Sigma i / n.$$

Where, Ui is the number of URs per informant for a given species, and n is the total number of informants. High UV indicates frequent use and key importance within the community, while low UV reflects limited use.

Results and Discussion

Demographic characteristics and livestock of informants

The demographic characteristics of the local participants in the study were determined through face-to-face interviews (Table 1).A survey of 58 informants revealed that 74.1% were over 60 years old, with an average age of 66, underscoring the risk of losing traditional knowledge as its bearers age and emphasizing the importance of timely documentation[20]. Informants consisted of farmers, shepherds, veterinarians, and others[10], with 37 women and 21 men.

The predominance of female informants (63.8%) reflects local sociocultural traditions, although this proportion differs slightly from that reported in our previous study[11] as well as in other studies[9,21]. Most

informants acquire knowledge from family, community elders, while some study independently through books and online sources. Ethnoveterinary knowledge remains concentrated among older informants, indicating limited transmission to younger generations. The risk of traditional knowledge loss due to aging, urbanization, and insufficient documentation underscores the need for systematic preservation[20]. In the region, this practice is mainly transmitted orally among relatives, as reported in other studies[10,22].

Category of ailments

We identified 39 animal ailments in 12 categories based on organ systems and causes (Supplementary Table S1).

Plant material

Special attention was given to conducting field studies in collaboration with local informants (Fig. 2). As a result of this study, data on the traditional ethnoveterinary use of 92 wild and 5 cultivated (introduced) plants (Table 2a), and 8 lichens (Table 2b) were documented. The scientific names of the plant taxa and their families were verified using Plants of the World Online (https://powo.science.kew.org/).

Homemade single-species herbal/lichen remedy reports (HSH/LR)

The current research identified 843 HSH/LR referring to 97 plant species from 31 botanical families, and 8lichen species from 6 botanical families used in ethnoveterinary practices (Supplementary Table S2). Most frequently recorded were species from Asteraceae (116 HSHR) and Rosaceae (76 HSHR), followed by Polygalaceae (72 HSHR). The most used species were *Artemisia adsinthium* (17 HSHR) and *Elaeagnus rhamnoides* (16 HSHR). The dominance of plant species from the families Asteraceae and Rosaceae in herbal ethnoveterinary practices is attributed to their wide distribution and pharmacological potential[11,23,24].

Table 1 — The number and details of informants

Category		Total	%
Gender	Male	21	36.2
	Female	37	63.8
Age groups	I (48-50)	3	5.2
	II (51-60)	12	20.7
	III (61-70)	28	48.3
	IV (71-80)	10	17.2
	V (81-91)	5	8.6
Occupation	Farmer	23	39.6
	Shepherds	8	13.8
	Veterinarian	4	6.9
	Others	23	39.6

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs: Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				Use value (*)
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Amaranthaceae (2)											
Kraschenninnikovia ceratoides (L.) Gueldenst. (6) / TUKK_Am_1	Boz tersken / w|h	6				O [w, di]	5	1			0.10
Atriplex patula L. (14)/ TUKK_Am_2	Alabata / w|h	5			9	DS [c]; PD [enp, m]; ID [r]; IS [w]	3	6	3	[a]1, [b]1	0.38
Amaryllidaceae (6)											
Allium cepa L. (22)/TUKK_Amry_1	Piyaz /c|h	22				ID [p, s]; PD [h]				[e]13, [f]9	0.38
Allium platyspathum subsp. *amblyophyllum* (Kar. & Kir.) N.Friesen(16)/ TUKK_Amry_2	Uy taka piyaz / w|h	5			11	ID [c, sp, fmd, fr, n, ae]; IS [w]; PD [enp]; O [e, pb]	5	5	3	[a]2, [b]1	0.27*
Allium sativum L. (27)/ TUKK_Amry_3	Sarimsak / c|h	9			18	DS [c]; PD [enp]; O [e]; RS [hc]; ID [sh, fmd, n, ae, fr]	13	8	6		0.46
Allium korolkowii Regel (15)/ TUKK_Amry_4	Japayipiyaz / w|h	6			9	same as above	7	6	2		0.26*
Allium suworowii Regel (15)/ TUKK_Amry_5	Sasik matal / w|h	5			10	same as above	6	6	3		0.26
Allium tianschanicum Rupr. (18)/ TUKK_Amry_6	Koburgon / w|h	7			11	same as above	7	7	4		0.31*

… *Contd.*

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value (Contd.)

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs									Use value (*)
		Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Apiaceae (9)											
Angelica brevicaulis (Rupr.) B.Fedtsch. (2)/ TUKK_Ap_1	Kiska sabak min tamir / w|h			2		MS [jd]	2				0.03*
Angelica multicaulis Pimenov (5)/ TUKK_Ap_2	Kop sabaktuu min tamir / w|h	5				DS [c]; RS [hc]	5				0.09*
Conium maculatum L. (10)/ TUKK_Ap_3	Baltirkan / w|h	10				DS [c]; RS [hc]; O [w]	10				0.17
Cuminum cyminum L.(4)/ TUKK_Ap_5	Zire / w|h	4				DS [gd]	4				0.07
Prangos pabularia Lindl.(10)/ TUKK_Ap_6	Ayuuchach / w|h	4			6	PD [enp, m]; ID [ae, c, r]	2	5	2	[a]1	0.17
Ferula assa-foetida L.(22)/ TUKK_Ap_7	Chayir / w|h	9		2	11	DS [gd]; RS [rd]; PD [enp, ecp]; IS [w]; ID [fmd, r]; PD [m]	6	13	3		0.38
Ferula foetida (Bunge) Regel (19)/ TUKK_Ap_8	Chayir / w|h	7			12	Same as above	5	8	6		0.33
Ferula kuhistanica Korovin (17)/ TUKK_Ap_9	Chayir / w|h	8			9	Same as above	4	6	5	[b]2	0.29
Ferulakokanica Regel &Schmalh. (13)/ TUKK_Ap_10	Chayir / w|h	5			8	Same as above	3	6	4		0.22
Araceae (1)											
Arum korolkowii Regel (4)/ TUKK_Ar_1	Kuchala/ w|h	4				O [w]	4				0.07
Asteraceae (12)											
Taraxacum campylodes G.E.Haglund(15) / (TUKK_As_3)	Kaakim / w|h			2	13	IS [w]; PD [ecp, m]; ID [r, fmd, sp]; O [pb]	3	7	3	[C]2	0.26
Achillea millefolium L. (13)/ TUKK_As_4	Kaz tanday / w|h	5			8	DS [gd, st]; PD [m]; ID [r]; IS [w]	5	6	2		0.26
Onopordum acanthium L. (14) / TUKK_As_5	Too tiken / w|h			3	11	ID [r]; IS [w]; PD [ecp]	4	7	3		0.24
Artemisia dracunculus L. (21)/ TUKK_As_8	Shiraaljin / w|h	9		3	9	DS [gd]; RS [rd]; PD [enp, ecp, m]; ID [r]; IS [w]	3	9	3	[a]2, [b]1, [e]2, [f]1	0.36
Artemisia adsinthium L. (40)/ TUKK_As_9	Ermen / w|h	10	8	5	17	PD [enp, m, ecp]; ID [c, p, s, n, ae, sp, fmd, r, fr]; IS [w]	7	16	5	[a]3, [b]2, [c]2, [d]1, [e]2, [f]2	0.71
Arctium lappa L.(26)/ TUKK_As_10	Chon uygak / w|h	10		4	12	DS [gd]; RS [rd]; US [ud]; ID [sp, fmd, ae, r]; IS [w]; MS [jd]	5	9	4	[a]3, [e]3, [f]2	0.45
Arctium tomentosum Mill. (18)/ TUKK_As_11	Jeleluuuygak / w|h	6		2	10	Same as above	2	8	2	[a]1, [e]3, [f]2	0.31*
Bidens tripartita L.(6)/ TUKK_As_12	It uygak / w|h	4			2	RS [hc]; CS [ha]; IS [w]	6				0.10
Matricaria chamomilla L.(22)/ TUKK_As_13	Tegerek bash gul / w|h	12		2	8	DS [gd]; ID [r]; CS [ha]; RS [rd]; IS [w, sb]; PD [m]; O [e];	9	13			0.38
Tussilago farfara L. (16/ TUKK_As_14	Ogoyene / w|h	8		2	6	DS [gd, ld]; US [ud], RS [rd]; O [e], IS [w]	11	5			0.28
Inulahelenium L. (12)/ TUKK_As_15	Karandiz / w|h	4			8	DS [gd]; RS [rd]; PD [enp, m]; IS [w]; ID [sp, fmd, fr, ae, r]	2	8	2		0.21
Inula orientalis Lam. (13)/ TUKK_As_16	Sari bash chop / w|h	4			9	Same as above	2	9	2		0.22

… *Contd.*

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value (Contd.)

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs									Use value (*)
		Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Berberidaceae (4)											
Berberis oblonga (Regel) C.K.Schneid. (10)/ TUKK_Be_1	Kizil suyruborukaragat / w|sh	7		3		DS [gd]; RS [hc]; MS [jd]	6	4			0.17*
Berberis kaschgarica Rupr (6)/ TUKK_Be_2	Kara borukaragat / w|sh	4		2		Same as above	4	2			0.10
Berberis integerrima Bunge (7)/ TUKK_Be_3	Kara suyruborukaragat / w|sh	5		2		Same as above	4	3			0.12
Berberis nummularia Bunge (6)/ TUKK_Be_4	Kizil borukaragat / w|sh	4		2		Same as above	4	2			0.10
Betulaceae (3)											
Betula pendula Roth (19)/ TUKK_Bet_1	Ak kayin / i|tr	4			15	RS [hc]; IS [w]; PD [m]; ID [sp, fmd, fr, r]	5	10	4		0.33
Betula alajica Litv.(15)/ TUKK_Bet_2	Kayin / i|tr	3			12	Same as above	3	9	3		0.26*
Betulaprocurva Litv. (11)/ TUKK_Bet_3	Iyrikayin / i|tr	2			9	Same as above	3	6	2		0.19*
Brassicaceae (1)											
Capsella bursa-pastoris (L.) Medik. (13)/ TUKK_Br_4	Koychu bashtik /w|h	9			4	CS [ha]; RPS [god]; US [ud]; IS [w]	8	5			0.22
Caprifoliaceae (2)											
Valeriana officinalis L. (9)/ TUKK_Cap_2	Dari chop /w|h	9				NS [c]	9				0.15
Acanthophyllum pungens (Bunge) Boiss. (3)/ TUKK_Cap_10	Koy tiken/w|h	3				PD [enp]	3				0.05*
Convolvulaceae (2)											
Convolvulus lineatus L. (8)/ TUKK_Co_1	Pechek/w|h				8	IS [w]	4	2		[b]2	0.14
Convolvulus arvensis L. (6)/ TUKK_Co_2	Chirmook/w|h				6	IS [w]	3	2		[b]1	0.10
Crassulaceae (2)											
Rhodiola linearifolia (Royale) Fu (11)/ TUKK_Cr_1	Altin tamir/w|h	3		2	6	O [w]; IS [w]; MS [jd]	11				0.19*
Sedum ewersii Ledeb.(5)/ TUKK_Cr_2	Koen chop /w|h			5		MS [f]	5				0.9*
Cupressaceae (3)											
Juniperus Pseudosabina Fish. &C.A.Mey(16)/ TUKK_Cup_1	Oruk archa /w|tr	3	9		4	O [cidc]; ID [sp, fmd, ae, n]; IS [w]	3	3	7	[c]2, [d]1	0.45
Juniperus polycarpos var. *seravschanica* (Kom.) Kitam. (27)/ TUKK_Cup_2	Kara archa/ w|tr	5	16		6	Same as above	5	6	11	[c]3, [d]2	0.46
Juniperus semiglobosa Regel(24)/ TUKK_Cup_3	Archa/w|tr	3	17		4	Same as above	4	6	10	[c]2, [d]2	0.41*
Elaeagnaceae (1)											
Elaeagnus rhamnoides (L.) A.Nelson (28) / TUKK_El_1	Chichirkanak / w|sh	19			9	DS [c, gd]; IS [w, sb]	22	6			0.48*
Ephedraceae (1)											
Ephedra equisetina Bunge (23)/ TUKK_Ep_1	Chekende / w|sh	8		7	8	PD [enp, ecp]; IS [w]	15	8			0.40
Grossulariaceae (1)											
Ribes nigrum L. (19)/ TUKK_Gg_1	Japayi kara karagat / w|sh	19				DS [gd]; RS [hc]	12	7			0.33*

… *Contd.*

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value (Contd.)

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs									Use value (*)
		Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Hypericaceae (1)											
Hypericum perforatum L. (7)/ TUKK_Hy_1	Eshenchay, sari chop chay/w|h	7				DS [gd]; RS [rd]	5	2			0.12
Lamiaceae (12)											
Origanum vulgare L.(9)/ TUKK_La_4	Kuron chop chay/w|h	9				DS [ld]; RS [hc]	9				0.15
Ziziphora clinopodioides Lam. (4) / TUKK_La_5	Koko meren/w|h	4				PD [enp]	4				0.07
Thymus pulegioides subsp. *pannonicus* (All.) Kerguélen (5)/ TUKK_La_6	Kiyikot/ w|h	5				PD [enp]	5				0.09
Mentha arvensis L. (3)/ TUKK_La_7	Talaajalbiz/w|h			3		MS [jd]	3				0.05
Mentha longifolia var. *asiatica* (3)/ TUKK_La_8	Tokoyjalbiz/w|h			3		Same as above	3				0.05
Mentha × *piperita* L. (5)/ TUKK_La_9	Jalbiz/w|h			5		Same as above	5				0.09
Salvia officinalis L.(11)/ TUKK_La_10	Dari shalfey/w|h	7			4	RS [hc]; DS [ld]; US [kd]; IS [w]	11				0.19
Melissa officinalis L. (16)/ TUKK_La_11	Dari melisa/w|h				16	IS [w]; PD [m]; ID [r]	5	11			0.27
Dracocephalum imberbe Bunge (5)/ TUKK_La_12	Boznach/w|h	5				O [w]	5				0.09*
Dracocephalum ferganicum Lazkov (6)/ TUKK_La_13	Boznach/w|h	6				Same as above	6				0.10*
Dracocephalum stamineum Kar. & Kir.(3) / TUKK_La_14	Boznach/w|h	3				Same as above	3				0.05*
Dracocephalum origanoides Steph. ex Willd. (3)/ TUKK_La_15	Boznach/w|h	3				MS [gd]	3				0.05*
Leguminosae (4)											
Medicago sativa subsp. *varia* (Martyn) Arcang. (6)/ TUKK_Le_4	Tian-Shan bedesi/w|h	6				O [e]; MS [jd]	6				0.10*
Trifolium repens L. (9)/ TUKK_Le_5	Soylomobede/w|h	6		3		RS [hc]; IS [w]	9				0.15
Trifolium pratense L. (21)/ TUKK_Le_6	Uy bede/w|h	21				RS [hc]; MS [jd]	21				0.36
Melilotus officinalis (L.) Pall. (12)/ TUKK_Le_7	Dari kashkabede/w|h	5		7		RPS [m]		12			0.21
Liliaceae (1)											
Gagea capusii A. Terracc. (9)/ TUKK_Li_1	Kaz piyaz/w|h	2		7		O [e]; IS [w]	9				0.15*
Malvaceae (1)											
Althaea officinalis L. (19)/ TUKK_Ma_1	Gulkayir/w|h	5			14	RS [c]; ID [sp, fmd, n, ae]	7	3	9		0.33
Orchidaceae (1)											
Dactylorhiza umbrosa (Kar. & Kir.) Nevski (4)/ TUKK_Or_1	Kulunchak gul / w|h	4				DS [hc]	4				0.07*
Orobanchaceae (2)											
Pedicularis physocalyx Bunge (7)/ TUKK_Oro_1	Koroz gul /w|h	7				PD [ecp]	7				0.12*
Pedicularis kaufmannii Pinzger (6)/ TUKK_Oro_2	Koroz gul /w|h	6				Same as above	6				0.10*

… *Contd.*

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value (Contd.)

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs									Use value (*)
		Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Papaveraceae (1)											
Papaver nudicaule L. (8)/ TUKK_Pa_2	Sari kizgiltapiyim/w|h	8				RS [hc]	8				0.14*
Plantaginaceae (2)											
Plantago major L. (24)/ TUKK_Pl_2	Baka jalbirak/w|h	24				RS [hc]; DS [c]; IS [w]	24				0.41
Plantago media L. (21)/ TUKK_Pl_3	Baka jalbirak/w|h	21				Same as above	21				0.36
Polygalaceae (7)											
Polygonum aviculare L. (22)/ TUKK_Pol_2	Tosholmokimizdik/ w|h	15			7	RS [rd]; DS [gd]; PD [enp]; IS [w]	16	6			0.38
Persicaria vivipara (L.) Ronse Decr.(16)/ TUKK_Pol_3	Jorgomushkimizdik/ w|h	4			12	DS [gd]; IS [w]; ID [sp, fmd, n]	3	4	6	[a]3	0.27*
Persicaria hydropiper (L.) Delarbre (8)/ TUKK_Pol_4	Suu kimizdik/w|h	2		2	4	CS [ha]; IS [w]; MS [jd]	8				0.14
*Rumex acetosa*L. (11)/ TUKK_Pol_5	Kozu kulak /w|h	11				ID [c, p]; DS [d]			4	[e]5, [f]2	0.19
*Rheum wittrockii*C.E. Lundstr. (9)/ TUKK_Pol_6	Ishkin/w|h	9				RS [rd]; DS [gd]	9				0.15
Persicaria alpina (All.) H.Gross (18)/ TUKK_Pol_7	Kumay kimizdik/w|h	18				Same as above	18				0.31*
Rumex confertus Willd. (10)/ TUKK_Pol_8	At kulak /w|h	10				ID [s]; PD [enp]				[e]4, [f]6	0.17
Primulaceae (1)											
Cortusa matthioli subsp. *turkestanica* (Losinsk.) Iranshahr & Wendelbo (8)/ TUKK_Pr_1	Kop konguroo gul /w|h				8	IS [w]; ID [r]; T [w]	3	5			0.14*
Ranunculaceae (4)											
Ranunculus acris L. (9)/ TUKK_Ra_1	Uuluu gul /w|h				9	PD [m]; T [w]; ID [r]	2	7			0.15
Ranunculus polyanthemos L. (5)/ TUKK_Pol_2	Kop bashtuu gul /w|h	5				DS [hc]	5				0.09
Thalictrum minus L. (9)/ TUKK_Pol_3	Chop gul /w|h				9	IS [w]	9				0.15
Aconitum soongaricum (Regel) Stapf (18) / TUKK_Pol_4	Uukorgoshun/ w|h			18		MS [f, jd, bd]	18				0.31
Rosaceae (7)											
Rosa fedtschenkoana Regel (22)/ TUKK_Ro_2	It murun / w|sh	22				DS [gd, d, ld]; ID [c]; O [w]	6	11	5		0.38*
Rosa majalis Herrm. (17)/TUKK_Ro_3	It murun / w|sh	17				Same as above	4	9	4		0.29*
Rosa canina L. (18)/ TUKK_Ro_4	It murun / w|sh	18				Same as above	6	9	3		0.31
Sorbus tianschanica Rupr. (20)/ TUKK_Ro_5	Chetin / w|sh	11			9	DS [gd]; O [e]; CS [ha]; RS [p]; IS [w, sb]; ID [r]	15	5			0.34
Crataegus sanguinea Pall. (13)/ TUKK_Ro_6	Dolono / w|tr	13				RPS [ud]; RS [rd]	13				0.22*
Crataegus × *tianschanica* Pojark. (11)/ TUKK_Ro_7	Dolono / w|tr	11				Same as above	11				0.19*
Crataegus ferganensis Pojark (11)/ TUKK_Ro_8	Dolono / w|tr	11				Same as above	11				0.19*

… *Contd.*

Table 2a — List of 1226 URs for 795 HSHR: route of administration, categories of use, target animals and use value (Contd.)

Botanical family (Total plant species) / Plant species name (Total URs) / Voucher specimen number	Local name/ Origin	Number indicates the frequency of the URs									Use value (*)
		Routs of administration				Categories of use / Abbreviation of ailment categories (Supplementary Table S1)	Target animals				
		Internal		External							
		O	Ih	I	A		Ho	Ca	Sh	Oth	
Scrophulariaceae (1)											
Scrophularia kiriloviana Schischk. (6)/ TUKK_Sc_1	Gazzak chop /w|h			2	4	IS [w]; MS [jd]	6				0.10
Solanaceae (1)											
Hyoscyamus niger L. (8)/ TUKK_So_1	Mendubana/w|h			8		O [e]; MS [jd]	8				0.14
Urticaceae (1)											
Urtica dioica L. (10)/ TUKK_Ur_1	Chalkan/w|h	4			6	DS [gd]; IS [w]	10				0.17

(*) – previously unreported plant species; O – oral, Ih – inhalation, I – intact skin, A – altered skin; w – wild, i - introduced; c – cultivated; h – herb, sh – shrub, tr – tree, li – lichen; Ho – horse, Ca - cattle, Sh – sheep, Oth (others) – [a]goat, [b]donkey, [c]dog, [d]cat, [e]chicken, [f]turkey.

Table 2b — List of 48 URs for 48 HSLR: route of administration, categories of use, target animal and use value

Botanical family (Total lichen species) / Lichen species name (Total URs) / Voucher specimen number	Number indicates the frequency of the URs				Use value (‘)
	Local name/ Origin	External administration	Category of use	Target animal	
		Altered skin		Horse	
Acarosporaceae (1)					
Acarospora cervina A. Massal. (6)/ TUKK_AcE_1	Boz enilchek / lichen	6	IS [w]	6	0.10’
Lecanoraceae (3)					
Lecanora muralis (Schreber) Rabenh. (6)/ TUKK_LeE_1	Enilchek / lichen	6	IS [w]	6	0.10’
Rhizoplaca chrysoleuca (Sm.) Zopf. (6)/ TUKK_LeE_2	Enilchek / lichen	6	IS [w]	6	0.10’
Rhizoplaca melanophthalma (DC.) Leuckert et Poelt (6)/ TUKK_LeE_3	Enilchek / lichen	6	IS [w]	6	0.10’
Megasporaceae (1)					
Aspicilia calcarea (L.) Mudd (6)/ TUKK_MeE_1	Enilchek / lichen	6	IS [w]	6	0.10’
Parmeliaceae (1)					
Parmelia pulla Ach. (6)/ TUKK_PaE_1	Enilchek / lichen	6	IS [w]	6	0.10’
Rhizocarpaceae (1)					
Rhizocarpon geographicum (L.) DC. (6)/ TUKK_RhE_1	Enilchek / lichen	6	IS [w]	6	0.10’
Teloschistaceae (1)					
Xanthoria elegans (Link) Th. Fr (6)/ TUKK_TeE_1	Enilchek / lichen	6	IS [w]	6	0.10’

(‘) – previously unreported lichen species

Of the 105 species, herbs dominated (75 wilds, 2 cultivated), followed by shrubs (11 species), trees (6 wilds, 3 introduced), and lichens (8 species). Most commonly used plant parts were aerial parts (262 HSHR), whole plants (171 HSHR), roots (158 HSHR), fruits (105 HSHR), and leaves (56 HSHR). Extraction methods included decoction (479 HSHR), fresh use (196 HSHR), infusion (104 HSHR), and burning (42 HSHR), with uses such as ash (8 HSHR), fat mixtures (21 HSHR), and smoke (13 HSHR).

A total of 1274 URs were documented for 843 HSH/LR. Most species treat integumentary (50 species), respiratory (44 species), and digestive (43 species) diseases. Usage by animal: horses (701 URs), cattle (339 URs), sheep (135 URs), and other domestic animals (99 URs), including chickens (32 URs), turkeys (24 URs), goats (16 URs), dogs (11 URs), donkeys (10 URs), and cats (6 URs). Administration routs were mainly internal (648 URs oral, 50 URs inhalation) and external (468 URs altered skin, 108 URs intact skin).

Data analysis

Table 3 provides a quantitative analysis of the collected data, including plant species, URs, and

mention frequencies for each species in animal disease categories, as well as the number of disease types and plants used in their traditional treatment.

Fig. 3 explains the UV indexes of 105 plant and lichen species utilized for treating ethnoveterinary diseases. Among these, 16 plant species (15.2%) have lower UV indexes ranging from 0.03 to 0.9, while 9 plant species (8.6%) have higher UV indexes ranging from 0.40 to 0.71.

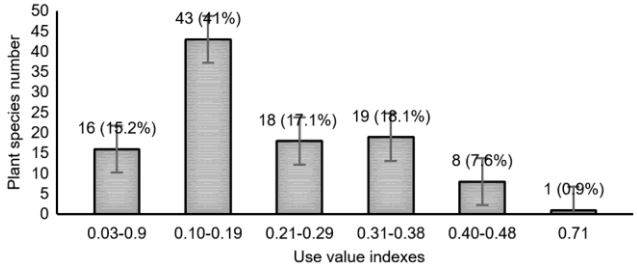

Fig. 3 — The UV indexes of the 105 plant and lichen species utilized for treating animal diseases in the Kara-Koy

The most frequently used ethnoveterinary plants in the region included *Artemisia absinthium* (UV = 0.71), *Elaeagnus rhamnoides* (0.48), *Allium sativum* and *Juniperus polycarpos* var. *seravschanica* (0.46).

Table 4 shows the FIC value for 12 animal ailment categories, ranging from 1 to 0.73. The highest FIC value is for the nervous system (1), followed by the infection diseases (0.83), digestive system (0.81), reproductive system (0.81), integumentary system (0.80), etc.

Forty new plant and lichen species (Fig. 4) belonging to 24 families, traditionally used by locals in veterinary practices, have been documented. Notably, these species are absent from the Web of Science, Scopus, and Google Scholar databases. The UV values of these plants and lichens range from 0.03 to 0.90.

The newly identified plant species for treating animal ailments in this study largely belong to genera and species widely recognized across various cultures

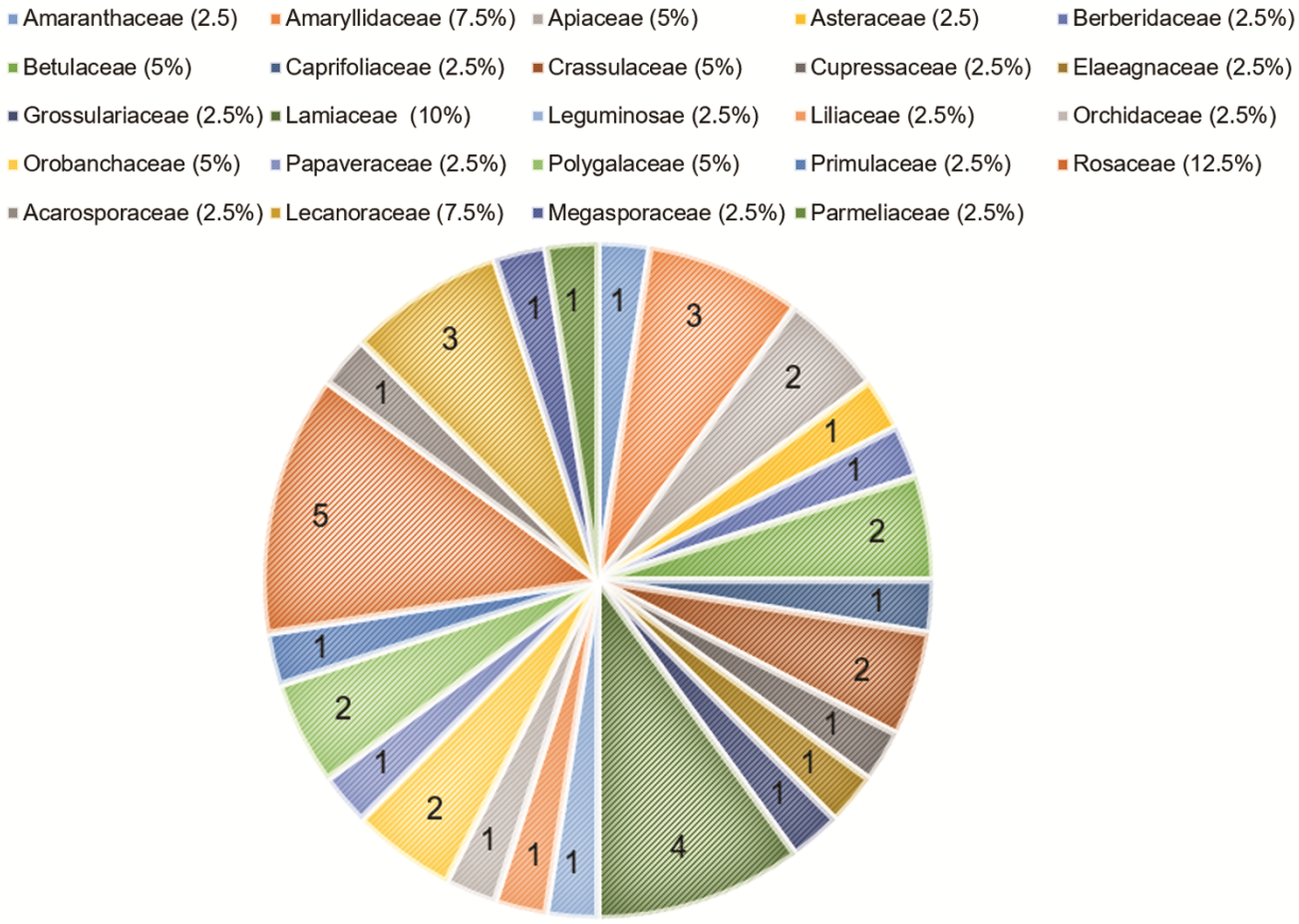

Fig. 4 — New plant and lichen species for ethnoveterinary use presented in the current study with UV indexes (a) and their botanical families as a percentage (b)

Table 3 — The quantitative analysis of the collected data

Category of diseases (n)	NPS	NURs	FURs	Treated disease number / Used plant and lichen species number					
Integumentary system (2)	50	253	2 - 16	1/47	2/3	-	-	-	-
Respiratory system (3)	44	163	2 - 8	1/44	-	-	-	-	-
Digestive system (5)	43	218	2 - 14	1/36	2/5	3/3	-	-	-
Infection diseases (9)	39	230	3 - 18	1/20	2/6	3/3	4/5	5/1	9/1
Parasitic diseases (4)	36	153	2 - 14	1/20	2/4	3/6	-	-	-
Musculoskeletal system (3)	19	82	2 - 18	1/18	-	3/1	-	-	-
Reproductive system (3)	7	32	4 - 12	1/5	-	-	-	-	-
Urinary system (2)	5	16	2 - 3	1/7	-	-	-	-	-
Cardiovascular system (1)	4	14	2 - 3	-	2/5	-	-	-	-
Tumor (1)	2	5	2 - 3	1/2	-	-	-	-	-
Nervous system (1)	1	9	1 - 1	1/1	-	-	-	-	-
Others:	26	99			-	-	-	-	-
Causing infertility in dogs and cats	3	15	-	1/3	-	-	-	-	-
Decreased immunity	1	2	-	1/1	-	-	-	-	-
Edema	11	35	2 - 4	1/13	-	-	-	-	-
Poisonous bites	2	5	2 - 3	1/2	-	-	-	-	-
Weakness	11	42	2 - 6	1/10	-	-	-	-	-

NPS - number of plant and lichen species; NURs – number of use reports; FURs – frequency of use reports for each plant species.

Table 4 — FIC values of categories of the veterinary diseases

Category of animal diseases	Number of species	Number of URs	FIC value
Nervous system	1	9	1.00
Infection diseases	39	230	0.83
Digestive system	43	218	0.81
Reproductive system	7	32	0.81
Integumentary system	50	253	0.80
Parasitic diseases	36	153	0.77
Musculoskeletal system	19	82	0.77
Cardiovascular system	4	14	0.77
Tumors	2	5	0.75
Others	26	99	0.74
Respiratory system	44	163	0.73
Urinary system	5	16	0.73

globally, while some of these species appear to be unique to our region. This highlights both the global relevance and the local distinctiveness of ethnoveterinary practices, reflecting their diversity and adaptability shaped by ecological and cultural factors. The expanded use of medicinal plants in Kara-Koy calls for further research into their pharmacological and ecological significance.

Conclusions

The study provides a comprehensive overview of ethnoveterinary practices in southern Kyrgyzstan, particularly in the Kara-Koy region, documenting the use of 105 plant and lichen species to treat 39 different animal ailments. It highlights the significant biodiversity and adaptability of local traditional knowledge, especially among species from the Asteraceae and Lamiaceae families.

One of the key findings is the identification of 40 plant and lichen species used in ethnoveterinary medicine that have not been previously reported in the scientific literature, underscoring the need for further research into their pharmacological and ecological potential. Despite the widespread use of these plants in folk veterinary practices, their scientific investigation remains limited.

The results of the study demonstrate that some plants, such as *Matricaria chamomilla* and *Arctium lappa*, are used to treat multiple ailments. High FIC values confirm the effectiveness of plant-based remedies in local healing practices. Furthermore, the study documented the use of plants such as *Artemisia absinthium* and *Allium sativum* to treat infectious diseases in animals, as supported by ethnobotanical studies in other regions.

A comparison with previous studies reveals notable differences in the plant and lichen species used, reflecting the influence of local ecological and cultural factors. The medicinal plant diversity in Kara-Koy exceeds that of other Kyrgyz pastures, likely due to specific ethnoveterinary traditions. The identification of unique species and their applications provides a basis for further research to scientifically verify their efficacy and assess their potential integration into veterinary practice. Overall, this study highlights the importance of preserving and investigating traditional knowledge as a valuable resource for contemporary science and medicine.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_24(12)(2025)1131-1143_SupplData.pdf

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Conflict of Interest

The authors affirm that there are no conflicts of interest associated with this work.

Author Contributions

NA- Conceptualization, Data collection, Formal analysis, Resources, Roles/Writing - original draft, Writing - review & editing; AT- Data collection, Formal analysis, Supervision; KC- Data collection, Formal analysis, Software; EA- Data collection, Formal analysis; KT- Data collection, Formal analysis; YB- Data collection, Formal analysis; AI- Formal analysis, Supervision.

Ethics Statement

Ethical approval was not required for the present study.

Prior Informed Consent

We explained the purpose of the study to all participants and obtained their verbal informed consent prior to conducting the interviews, in accordance with the Code of Ethics of the International Society of Ethnobiology (ISE, 2008). The use of facial photographs in this study was also verbally approved in advance by the individuals to whom they belong.

Data Availability

Data generated and analyzed in this study can be obtained from the corresponding author upon reasonable request.

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