Quantitative ethnomedicinal studies of wild edible fruits used by the indigenous people of the Surghar range, Pakistan

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Research

Abstract

Background: Surghar range is one of Pakistan's backward and less explored areas with numerous wild edible fruit species. Indigenous people lack basic medical facilities and mostly depend upon wild edible fruits for their food requirements and health care.

Objectives: The present research work was aimed to document and preserve the valuable pool of indigenous knowledge about the medicinal uses of wild edible fruits of the Surghar range, Pakistan.

Methods: Ethnomedicinal information was collected from 55 respondents (aged 40-85 years) belonging to 16 different localities of the Surghar range, Pakistan. Research work was started in July 2021 and completed in January 2023. Compelling semi-structured interviews were conducted with the respondents, and complete data were recorded on questionnaires. Quantitative indices such as fidelity level (FL**)** and relative frequency of citation (RFC) were used to determine the medicinal significance of wild edible fruits of the Surghar range.

Results: This research work provided ethnomedicinal information about 43 wild edible fruits belonging to 16 families. These wild edible fruit species were used to treat 36 human and animal diseases in the Surghar range. Moraceae, with 7 species (16.27%), was recorded as the dominant dicot family. Arecaceae (6.97 %) was the dominant monocot family. The maximum RFC was reported for *Berberis lycium* (0.763), and the lowest value was calculated for *Morus macroura* (0.072). The highest FL was documented for *Grewia tenax* (69.23%), and the lowest was recorded for *Bauhinia variegata* (8.69%).

Conclusion: Recent research work demonstrated that all the wild edible fruit plants had medicinal potential but *Berberis lycium*, *Grewia tenax, Tinospora cordifolia*, *Salvadora persica*, *Cordia myxa,* and *Sideroxylon mascatense* were recorded as highly medicinal in the Surghar range. This research work will be useful for the local inhabitants to conserve these medicinal plants.

Keywords: Wild edible fruits, Relative frequency of citation, Fidelity level, Moraceae, Surghar range

Background

Ethnomedicine is a study of how indigenous cultures treat and prevent various diseases (Diliarosta *et al.* 2022). In developed countries, ethnomedicines are crucial for preserving the importance of cultures for rural inhabitants and playing a fundamental role by eradicating poverty and giving people a source of income in developing countries. They can also act as vital genetic resources for developing new crops with higher yields and flavors (Benítez *et al.* 2023). Ethnomedicines are derived from plants, mammals, birds, reptiles, fishes, and insects. However, traditional healing systems usually depend upon edible medicinal plants (Mussarat *et al.* 2021). According to the World Health Organization (WHO), in developing countries, about 80 % of the people depend upon medicinal plants to treat their diseases (Tahir *et al.* 2023). It is estimated that more than 50% of modern medicines are ethnomedicines (Faruque *et al.* 2018).

Non-cultivated, naturally growing plants used as food are called wild edible plants (WEPs) (Motti 2022). Those fruits which are obtained from uncultivated natural environment are called wild edible fruits (WEFs) (Nazar *et al.* 2022). It is estimated that above 700 million humans in all over the world are facing severe food deficiency, so WEFs are the best alternative source of food for these people (Dejene *et al.* 2020). These are enriched with beneficial minerals, vitamins, and antioxidant. In developing countries, WEFs are an inevitable source of their diet and a vital part of their healthcare practices (Yangdon *et al.* 2022). According to the Food and Agriculture Organization (FAO), 1 billion people worldwide use wild edible plants in their diet (Duguma 2020). Wild edible fruits are precious gift of God on our earth because they are free of cost, readily available, pollution free, and more nutritious than cultivated fruits. Nearly 300,000-500,000 plant species are present on the earth, of which 30,000 species are edible, and approximately 7000 are wild edible (Ansari *et al.* 2023).

The majority of the people in all over the world depend on the consumption of these plant resources for their means of subsistence. Moreover, it is crucial as a food supplement to the daily diet or as a famine food in emerging societies (Miranda 2021). Furthermore, it has been demonstrated that wild edible fruit resources are an indispensable component of ecosystem based adaptations and coping mechanisms to diminish global food scarcity (Antonelli 2023). Their respective cultural domains are the major places to start when examining locals' perspectives. These domains are also essential to comprehending cultural environments. Any locally specialized information preserved, documented, and transmitted within the community has applications essential for survival, and it depends on social transmission to family members or within the community (Shaheen *et al.* 2017). The first step in information acquisition is innovation, but the first step in knowledge transmission related to natural resources and their uses includes observation, familiarization with resources, and helping adults (Alyamini *et al.* 2023). Additionally, the knowledge and uses of wild edible fruits are dwindling as a result of the growth of the agriculture, trends for the cultivation of fruits in gardens, modern food industries, changes in climate, unfavorable perceptions of wild edible fruits and the lack of interest of younger generations towards wild edible fruits (WEFs) (Bharucha & Pretty 2010). Therefore, there is a dire need to document this indigenous ethnomedicinal knowledge of wild edible fruits before it is lost (Aziz *et al.* 2018).

Other researchers such as Haq *et al.* (2023); Rehman *et al.* (2023); Shaheen *et al.* (2023); Shah *et al.* (2023); Ali *et al.* (2023); Rahim *et al.* (2023); Ayoub *et al.* (2023); Naheed *et al.* (2023); Mustafa *et al.* (2023); Ullah *et al.* (2023); Liaqat *et al.* (2023); Ahmad & Dastagir (2023) investigated the ethnobotany of flora of various regions in Pakistan (District Bajaur, District North Waziristan, District Lahore, Razmak valley, Lower Swat, Surghar range, Panjgur Balochistan, District Layyah, Dera Ghazi Khan, Punjab, South Waziristan, District Sudhnoti, Azad Jammu and Kashmir and Bajaur) and documented and preserved the valuable indigenous knowledge.

The present study was conducted at 16 biodiversity hot spots of the Surghar range enriched with medicinally important wild edible fruits. Areas enriched with biodiversity having a high extent of environmental collapse are known as Biodiversity Hotspots (Ali *et al.* 2017; Shah *et al.* 2023). It is the first comprehensive scientific approach to ethnomedicinal studies of wild edible fruits of the Surghar range that is still less explored. Rahim *et al.* (2023) and Shah *et al.* (2013) have studied the overall flora in the Surghar range, but a recent study focused on wild edible fruits, not all plants. They did not focus on fruit species. So, we desired to discern the answers to the following questions about fruits used to cure various diseases in this study: (1) What were the wild edible plant fruits used in the Surghar range? (2) Do they have other ethnobotanical uses i.e., in medicines and cosmetics? (4) What were the modes of preparation and administration of these fruits? (5) Which ailments were treated by using these fruits? Furthermore, the data were tested using quantitative ethnomedicinal indices to record the most potent fruits in the study area.

This study aimed to investigate and document the wild edible fruits used by the indigenous inhabitants of the Surghar range to treat them and their animals.

Materials and Methods

Description of the Surghar range

Surghar range is located in the easternmost extension of the Trans Indus salt range of northern Pakistan. It lies between 32.8453 ^{0}N latitudes and 71.1369 ^{0}E longitudes. It borders the southern upland of Kohat district and to north-south together with the eastern border of Bannu Bowl (Fayaz *et al.* 2014). Its height ranges from 216 m to 1475 m from sea level (Figure 1). The research area included 16 hilly communities of 2 Districts i.e., District Mianwali (Province Punjab) and District Karak (Province Khyber Pakhtunkhwa). The majority of the population depends upon the prescription of the local hakims and dwellers due to the non-availability of basic health facilities in Surghar range. Pashto is the predominant language spoken in Surghar range. Some communities also speak Saraiki. In addition to food and medicine, people of the study area also use these fruit plants as fuel, house building and fodder for cattle. Because of the huge difference in altitude, climatic conditions of the Surghar range vary. In higher altitudes, such as Kurd and Sho, the temperature always remains below 25^{o} C in summer. The indigenous people use quilts even in the nights of June and July. In these areas, winter is, however, more severe as compared to lower altitude areas (Shah *et al.* 2012). Such climatic variations in hilly areas ensure the production of the diverse and abundant wild medicinal vegetation with specific drug-making valuable ingredients. The area (Figure 1) is supplemented with the wealth of coal, silica, salt, gypsum, limestone, dolomite, green sand, and iron ores, so mining is mostly adopted as a source of livelihood. Recently, a huge oil and gas resource has been discovered in the Kurd and Sho areas of the Surghar range, where drilling is going on. Due to lack of modern medical facilities and poverty, indigenous people mostly use wild edible fruits to treat various diseases.

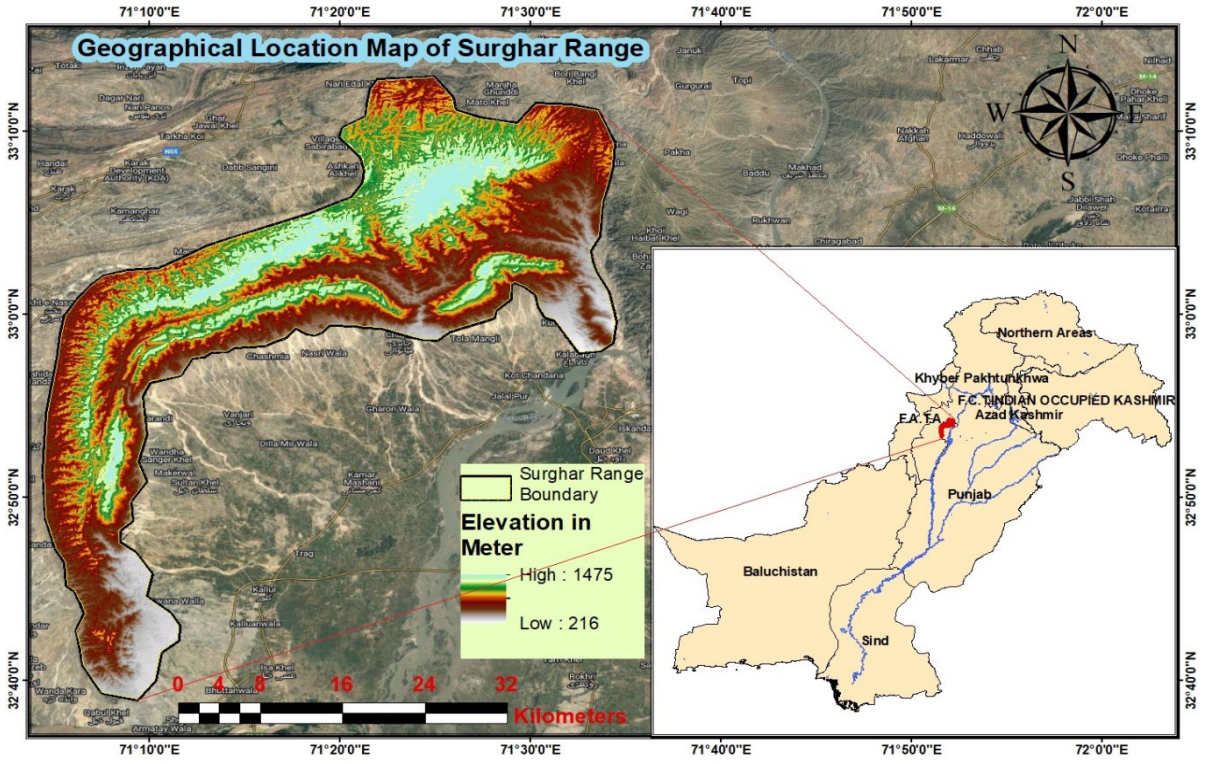


Figure 1. Map of the Surghar range

Plant collection and identification

Plants were collected, dried, pressed and mounted properly on herbarium sheets. The scientific names of collected plant specimens were recognized with the help of Flora of Pakistan (Nasir & Ali 1995-2002) and (Ali & Qaiser 1993-2011). The scientific names of the collected wild edible fruit species were further verified from the 'World Flora Online (WFO) website (https://worldfloraonline.org.). Voucher numbers were also allotted to collected plants and submitted to the Department of Botany, University of Science and Technology Bannu, KP, Pakistan. To avoid identification errors, the plants were collected in their flowering and fruiting periods. Different types of apparatus such as altimeters, cameras, newspapers, plant cutters, portable drier and press straps were used during the research work.

Ethnobotanical and socio-demographic data collection

A total of 43 wild edible fruit plants belonging to 16 families were documented. Twenty field trips (July 2021-January 2023) were arranged in 16 different communities of the study area. Four communities i.e. Makerwal, Chapri, Kurd and Sho were visited twice, whereas, remaining 12 communities were explored once. The numbers of collected WEFs from different communities of the Surghar range included Miana Wala (1), Mitha Khattak (2), Makerwal (4), Kurdi (1), Malla Khel (2), Karandi

(2), Gulla Khel (3), Zeri (1), Chashmia (2), Kutki (3), Kurd (5), Sho (6), Nasri (3), Chapri (4), Tola Mangli Khel (2) and Kala Bagh (2). The working plan was managed according to the flowering and fruiting periods of the plants. Effective and comprehensive semi-structured interviews of 55 respondents for 30 to 40 minutes were conducted. These were all men. Females were not interviewed due to the Islamic and cultural limitations. The age of the respondents ranged from 40 to 85 years. About 21 experts were illiterate and the remaining 34 were literate from primary to graduate level. Mostly, information was gathered from people above 50 years of age (Table 1). The complete information was noted on the questionnaires (Figure 2). Documented ethnomedicinal data were arranged systematically and a final checklist was prepared.

Table 1. Socio-Demographic information of the informants

Variable	Total number of informants	Category	Number	%
Gender	55	Male	55	100
Age		40-50	4	7.2
		50-60	8	14.5
		60-70	28	50.9
		70-85	15	27.2
Education level		Illiterate	21	38.1
		Primary	2	3.6
		Middle	5	9.09
		High	11	20
		Higher secondary	8	14.5
		Bachelor	3	5.4
		Masters	5	9.09
Occupation		Herbalists	8	14.5
		Nomads	7	12.7
		Practitioners	13	23.6
		Farmers	22	40
		Hakims	5	9.09

Quantitative analysis of the ethnomedicinal data of the Surghar range

Quantitative indices included relative frequency of citation (RFC) and fidelity level (FL).

Relative Frequency of Citation (RFC)

RFC is a very important tool for determining plant species' indigenous applications and pharmacological importance. It is calculated as;

$$RFC = FC/N$$

Where, FC represents the actual number of those indigenous people who use the plant species in ethnomedicinal practices, and N depicts the total number of informants (Ishtiaq *et al.* 2021).

Fidelity Level (FL)

FL is the % of respondents who mentioned using specific plants to treat a particular ailment in the study area.
It is determined as;

$$FL\ (\%) = Np/N \times 100$$

Np is the specific number of citations for a specific disease and N is the number of informants who mentioned the species for any disease (Amjad *et al.* 2020).

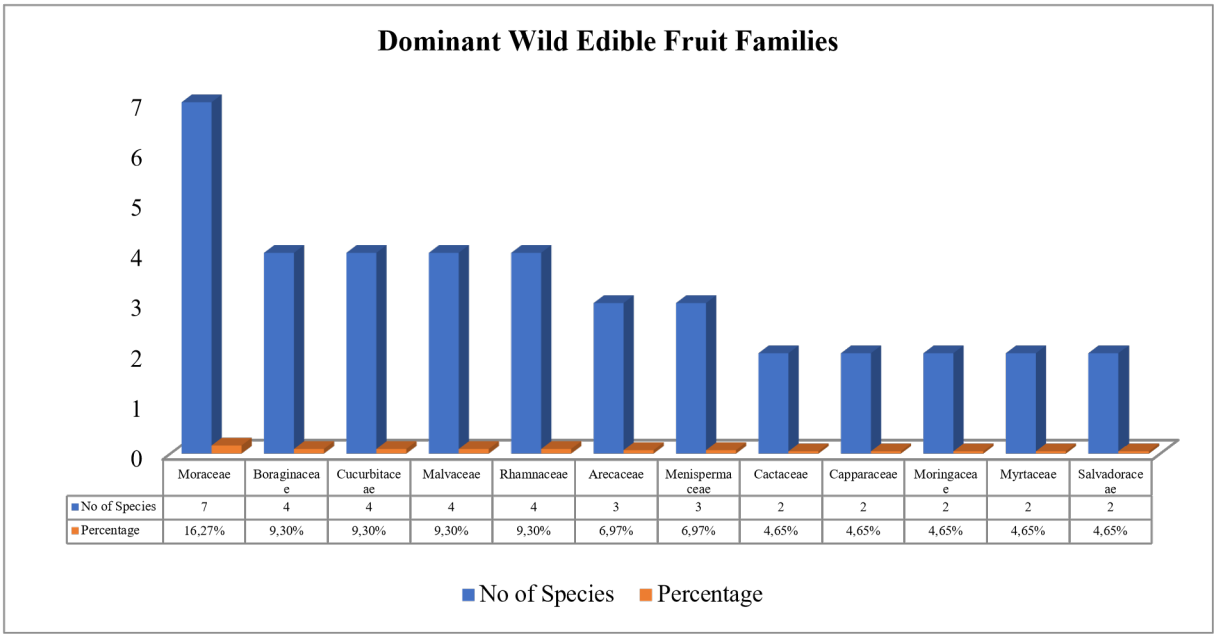
Results and Discussion

Diversity of the reported wild edible fruits of the Surghar range

This study reported the ethnomedicinal uses of 43 wild edible fruit species belonging to 23 genera and 16 families in the Surghar range, Pakistan. The indigenous people have been using this precious knowledge of ethnomedicines from the times of their ancestors, and still, they are using it for their health care practices. Out of 43 documented wild edible fruit plants, dicots were found dominant, contributing to 15 families (93.75%), 21 genera (91.30%) and 40 species (93.02%). Monocots were represented by only one family Arecaceae (6.25%), 2 genera (8.69%), and 3 species (6.97%). Moraceae with 7 species (16.27%) was found as the dominant dicot family. Four dicot families such as Boraginaceae, Cucurbitaceae, Malvaceae, and

Rhamnaceae possessed 4 plant species each (9.30%). Menispermaceae possessed 3 plant species (6.97%). Five dicot families,

Cactaceae, Capparaceae, Moringaceae, Myrtaceae and Salvadoraceae, retained 2 species each (4.65%) (Table 2 & 3; Figure 3). The 4 remaining families, including Berberidaceae, Fabaceae, Oleaceae and Sapotaceae possessed only one species each (2.32%). Indigenous people used the wild edible fruits of all these families as medicine and food (Figure 4). They also used the wood of these plants for fuel, furniture and construction purposes. Several botanists such as Sathyavathi *et al.* (2011); Shah *et al.* (2013); Shivprasad *et al.* (2016); Kayabasi *et al.* (2018), and Shah *et al.* (2023a) documented similar findings in their ethnobotanical studies.



	Moraceae	Boraginaceae	Cucurbitaceae	Malvaceae	Rhamnaceae	Arecaceae	Menispermaceae	Cactaceae	Capparaceae	Moringaceae	Myrtaceae	Salvadoraceae
No of Species	7	4	4	4	4	3	3	2	2	2	2	2
Percentage	16,27%	9,30%	9,30%	9,30%	9,30%	6,97%	6,97%	4,65%	4,65%	4,65%	4,65%	4,65%

Figure 3. Dominant wild edible fruit families of the Surghar range, Pakistan

Growth forms

A recent ethnomedicinal study revealed that trees (55.81%) and shrubs (34.88%) were the dominant growth forms in the study area. The remaining documented plants were herbs (9.30%). Similar findings about growth forms were also documented by Abbasi *et al.* (2013); Hamayun (2003); Shah *et al.* (2015); and Shah *et al.* (2020) in their studies.

Mode of preparation and administration of wild edible fruits

The indigenous people use wild edible fruit plants in different ways. The details have been mentioned in Table 2. It was observed that most commonly medicinal plants (81.39 %) were utilized in the form of raw fruits. These were also used in cooked form (9.30 %), powder (9.30 %), pickle (6. 97 %), juice (4.65 %) and decoction (2.32 %). The mode of administration was oral, as the fruits were edible and considered a good source of nutrients and medicine. The current study was supported by the results of Bano *et al.* (2014); Chothe *et al.* (2014); Teklehaymanot and Giday (2010), who reported similar findings in their studies.

Figure 4. A-E: Different wild edible fruit species of the Surghar range. A-*Olea ferruginea;* B- *Sideroxylon mascatense;* C-*Salvadora persica;* D- *Capparis decidua;* E- *Citrullus colocynthis*

Diseases treated by wild edible fruits in the Surghar range

We documented 36 diseases for which indigenous people use wild edible fruit plants. Most common diseases were constipation, sterility, jaundice, diabetes mellitus, respiratory disorders, skin diseases, dyspepsia, inflammation, abdominal pain, body weakness, fever, cold, body worm, blood disorders, gas problems, wound infection, arthritis, body heat, liver problem and kidney/urinary problems. In addition, many other disorders such as piles, nervous disorder, scurvy, diarrhea, stomach-ache, dysentery, acidity, leucorrhoea, abortion, allergy, throat infection, toothache, anorexia, obesity, cough and vomiting were also recorded (Table 2 & 3). Due to poverty, high cost of allopathic medicines and lack of modern medicinal facilities, indigenous people mainly use wild edible fruits for their health issues. The results of Aziz *et al.* (2018); Chaachouay *et al.* (2019); Dastagir *et al.* (2022); Kumar *et al.* (2017); Rajasab *et al.* (2004) are consistent with the current study.

Quantitative analysis of ethnomedicinal data of wild edible fruits

Relative Frequency of Citation (RFC)

The maximum values of relative citation frequency basically represent two aspects; (i) the indigenous people have ethnomedicinal knowledge. (ii) they have received this precious knowledge from their ancestors (Bibi *et al.* 2022). In the current study, the relative frequency of citations ranged between 0.763 to 0.072. The maximum relative frequency of citation was reported for *Berberis lycium* (0.763) followed by *Tinospora cordifolia* (0.727) and *Salvadora persica* (0.709%). After that, *Cordia myxa* (0.690%) and *Grewia tenax* (0.618%) possessed high relative frequency of citation values. Four wild edible fruit species such as *Cordia dichotoma*, *Ficus carica*, *Sideroxylon mascatense* and *Ziziphus jujuba* had the same relative frequency of citation values (0.6). The lowest RFC value was calculated for *Morus macroura* (0.072) (Table 2). The results of many workers, such as Abidullah *et al.* (2023); Faruque *et al.* (2018); Khanum *et al.* (2022) and Rehman *et al.* (2022) supported the present study.

Fidelity Level (FL)

The maximum value of fidelity level represents the similar mode of utilization for a particular ailment. Fidelity level is used to determine the highly recommended wild edible plant for a specific class of diseases (Srithi *et al.* 2009). In the current study, values of fidelity level were calculated between 69.23% to 8.69%. The highest fidelity level was documented for *Grewia tenax* (69.23%). The second high value was observed for *Salvadora persica* (64%). Same value (62.06%) was documented for

Sideroxylon mascatense and *Tinospora cordifolia*. The lowest fidelity level was recorded for *Bauhinia variegata* (8.69%) (Table 3). It was observed that wild edible fruits with maximum fidelity level values were believed to be more useful as compared to those with low values. Various workers including; Bano *et al.* (2014); Chaachouay *et al.* (2019); Khan *et al.* (2014); Khanum *et al.* (2022); Tugume *et al.* (2016); Shah *et al.* (2023a); Shah *et al.* (2023b) also worked on fidelity level and documented similar findings.

Conclusion

The conclusions of this research demonstrate that the Surghar range is enriched with wild edible and medicinal fruit plants. Lack of proper transportation and dangerous hilly slopes are major hurdles in exploring the Surghar range flora. A total 43 wild edible fruits belonging to 23 genera and 16 families were documented which were used to treat 36 diseases in the study area. The most frequently occurring diseases were constipation, sterility, jaundice, diabetes mellitus, respiratory disorders, skin diseases, dyspepsia, inflammation, abdominal pain, body weakness, fever, cold, body worm, blood disorders, gas problems, wound infection, arthritis, body heat, liver problem and kidney/urinary problems. Moraceae with 7 species (16.27%) recorded as the most dominant dicot family. Arecaceae (6.97 %) was the most prevailing monocot family. The maximum relative frequency of citation (RFC) was reported for *Berberis lycium* (0.763) and the lowest value was calculated for *Morus macroura* (0.072). The highest fidelity level was documented for *Grewia tenax* (69.23%) and the lowest value was recorded for *Bauhinia variegata* (8.69%). Various anthropological activities such as deforestation, transportation and fires are severely affecting the wild edible fruits of the study area. It was observed that ethnomedicinal knowledge about wild edible fruits is confined to farmers, practitioners, herbalists and hakims. The unique uses of these fruits are speedily declining so; there is a dire need to conserve this ethnomedicinal knowledge before it is lost forever.

It is a comprehensive ethnomedicinal study of the wild edible fruits of the Surghar range, Pakistan. Rahim *et al.* (2023) and Shah *et al.* (2013) have studied the overall flora in the Surghar range, but a recent study focused on wild edible fruits not all plants. So, it is the first-ever ethnomedicinal study of WEFs in the study area. This research has dual importance as it explored those wild edible fruits that retain nutraceutical potential. These wild plants are edible, contain important nutrients and also used to treat several diseases in different hamlets of the Surghar range. In future, this study will be helpful for further research in the various branches of Biology especially in the fields of Pharmacology, Economic Botany, Pomology, Nutritional Science and Phytochemistry. The documented fruits should be investigated for pharmacological and phytochemical studies which will be helpful to phytochemists, pharmacists and industrialists to evolve novel drugs.

Table 2. Ethnomedicinal study of wild edible fruits of Surghar range, Pakistan

Family	Botanical Name/ Voucher Number	Local Name	Habit	Altitude (m)	Treated diseases	Method of preparation	RFC
Arecaceae	*Nannorrhops ritchiana* (Griff.) Aitch. Hussain.Bot-01(USTB)	**pathaa**	Shrub	275	Constipation, abdominal pain	Six ripened fruits are eaten twice a day either empty stomach or after meal.	0.272
	Phoenix dactylifera L. Hussain.Bot-02(USTB)	**khaji**	Tree	300	Body weakness, constipation, abdominal pain	Fruits are eaten twice a day.	0.454
	Phoenix sylvestris (L.) Roxb. Hussain.Bot-03(USTB)	**jangli khaji**	Tree	310	Dysentery, fever, liver diseases, body worm	Usually 5-8 fruits are consumed twice a day after meal.	0.381
Berberidaceae	*Berberis lycium* Royle Hussain.Bot-04(USTB)	**zirlargy**	Shrub	1400	Jaundice, body heat, body weakness	Fruits are first soaked in water for 24 hours and then heated for 3 hours. The mixture is then added with a small amount of sugar and used to treat the disease.	0.763
Boraginaceae	*Cordia dichotoma* G. Forst. Hussain.Bot-05(USTB)	**lasura**	Tree	700	Respiratory disorders ,inflammation, diabetes mellitus, body worm	Unripen fruit is used to form pickles by native people that is eaten with meal. Fruit is eaten twice a day to get relief from mentioned diseases.	0.6
	Cordia sinensis Lam. Hussain.Bot-06(USTB)	**gondy**	Tree	670	Dyspepsia, abdominal pain, jaundice	Fruit is eaten three times a day to treat said problems.	0.290
	Cordia myxa Forssk. Hussain.Bot-07(USTB)	**lasoori**	Tree	650	Acidity, jaundice, abdominal pain, gas problems	Fruit is eaten and used to make pickle that is used twice a daily to treat said diseases.	0.690
	Ehretia obtusifolia Hochst. ex DC. Hussain.Bot-08(USTB)	**peeluk**	Shrub	600	Stomach-ache, fever, dyspepsia, skin problems	Fruit is eaten 3 times a day, such as after breakfast, lunch and dinner for a week.	0.254
Cactaceae	*Opuntia stricta* (Haw.) Haw. Hussain.Bot-09(USTB)	**zokaam**	Shrub	300	Liver problems, body weakness, inflammation	It is eaten in raw form.	0.163
	Opuntia ficus-indica (L.) Mill. Hussain.Bot-10(USTB)	**zokaam**	Shrub	310	Throat infection, dyspepsia, jaundice, respiratory infection	Half glass of fruit juice is used 2 times a day for 8 days to treat described diseases.	0.145

Capparaceae	*Capparis decidua* Edgew. Hussain.Bot-11(USTB)	**kirrhaa**	Tree	1000	Arthritis, abdominal problems, body weakness	Fruit commonly called "Dela'' is eaten and consumed twice a day.	0.490
	Capparis spinosa L. Hussain.Bot-12(USTB)	**kirrhaa**	Shrub	990	Scurvy, arthritis	Fresh fruits are consumed after lunch and dinner on daily basis.	0.345
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad. Hussain.Bot-13(USTB)	**marran**	Herb	400	Diabetes mellitus, inflammation, abdominal pain, body worm, constipation	Fruit is used in both forms (fresh as well as in cooked form).	0.581
	Cucumis melo L. Hussain.Bot-14(USTB)	**jangli kutchri**	Herb	350	Abdominal pain, constipation	It is eaten in crude form.	0.454
	Cucumis melo var. *agrestis* Naudin Hussain.Bot-15(USTB)	**cheebur**	Herb	380	Gas problems, diabetes mellitus, heat, blood disorders	Fruit is dried in a shade, fine powder is prepared, and 1 tea spoon twice a day is taken regularly.	0.563
	Momordica balsamina L. Hussain.Bot-16(USTB)	**jangli karela**	Herb	800	Blood disorders, diabetes mellitus, skin diseases	Fruits are used as cooked vegetable and used in both forms (fresh and dry) for treatment of diseases.	0.581
Fabaceae	*Bauhinia variegata* L. Hussain.Bot-17(USTB)	**ouliar**	Tree	300	Body heat, fever, dyspepsia, inflammation	Fruits are used to make pickle that is eaten one time in a day.	0.272
Malvaceae	*Grewia asiatica* L. Hussain.Bot-18(USTB)	**phalsa**	Shrub	300	Wound infection, respiratory problem, sterility, body weakness	Fruit is eaten before breakfast and after lunch for 10 days to treat diseases.	0.490
	Grewia erythraea Schweinf. Hussain.Bot-19(USTB)	**injary**	Shrub	310	Inflammation, diabetes mellitus, fever	It is eaten in crude form.	0.454
	Grewia tenax (Forssk.) Fiori Hussain.Bot-20(USTB)	**injary**	Shrub	300	Sterility	Its fruit is sexual tonic and eaten on daily basis for 2-3 weeks.	0.618
	Grewia villosa Willd. Hussain.Bot-21(USTB)	**phalsa**	Shrub	320	Anorexia, jaundice, wound healing	Fresh and ripened fruits are consumed for described diseases.	0.309
Menispermaceae	*Cocculus hirsutus* (L.) W.Theob. Hussain.Bot-22(USTB)	**faredy booty**	Shrub	520	Cough, inflammation, liver disorders	It is eaten in raw form	0.218

	Cocculus pendulus (J.R.Forst. & G.Forst.) Diels Hussain.Bot-23(USTB)	**zumur**	Shrub	530	Body worm, fever	Juice of fruit is prepared. Half glass of juice is given to the patient before a breakfast for a week.	0.436
	Tinospora cordifolia (Willd.) Hook.f. & Thomson Hussain.Bot-24(USTB)	**pahary gillu**	Shrub	375	Fever, diabetes mellitus	Fruits are dried in a shade and grinded to form a fine powder. A teaspoon is taken with water after breakfast and one after dinner until the recovery from disease.	0.727
Moraceae	*Ficus benghalensis* L. Hussain.Bot-25(USTB)	**boar**	Tree	600	Sterility, jaundice, body weakness, dysentery	Unripen fruits are used usually as salad to control the mentioned diseases. Ripened fruits are also used for ethnomedicinal purposes	0.581
	Ficus racemosa L. Hussain.Bot-26(USTB)	**ambar**	Tree	610	Nervous disorder, cough, liver problem	Fruits are cooked and eaten as vegetable in lunch for three days to cure health issues.	0.218
	Ficus religiosa L. Hussain.Bot-27(USTB)	**pepul**	Tree	650	Skin diseases, Abdominal pain	It is eaten in raw form.	0.109
	Ficus carica L. Hussain.Bot-28(USTB)	**pahari injeer**	Tree	740	Piles, constipation, body weakness	It is eaten in raw form.	0.6
	Morus alba L. Hussain.Bot-29(USTB)	**spin tout**	Tree	330	Constipation, body worm	It is eaten in raw form.	0.272
	Morus macroura Miq. Hussain.Bot-30(USTB)	**shatoot**	Tree	390	Diabetes mellitus, inflammation	It is eaten in raw form.	0.072
	Morus nigra L. Hussain.Bot-31(USTB)	**tour tout**	Tree	350	Respiratory problem, diabetes mellitus	Fruits are eaten early in the morning and night after a meal for a week to treat said disorders.	0.2
Moringaceae	*Moringa oleifera* Lam. Hussain.Bot-32(USTB)	**sohunjana**	Tree	290	Obesity, arthritis, wound healing, inflammation	Fruits powder is used as 1 tea spoon 3 times a day for approximately 10-14 days for said disorders	0.490
	Moringa peregrina Fiori Hussain.Bot-33(USTB)	**sohunjana**	Tree	300	Skin problem, Constipation, wound healing	Fruits are dried in shade and powder is prepared that is given to patient as 1 tea spoon 2 times a day for 1-2 weeks, depending upon recovery from disease.	0.472

Myrtaceae	*Psidium guajava* L. Hussain.Bot-34(USTB)	**umrood**	Tree	230	Vomiting , abdominal pain, dyspepsia, constipation	It is eaten in raw form.	0.454
	Syzygium cumini (L.) Skeels Hussain.Bot-35(USTB)	**jamun**	Tree	265	Diarrhea, gas problem, dyspepsia, constipation	Five fruits are eaten thrice a day for the treatment of mentioned diseases.	0.6
Oleaceae	*Olea ferruginea* Royle Hussain.Bot-36(USTB)	**shoun**	Tree	1150	Sterility, diabetes mellitus, anthelmintic, gum disorders	It is eaten in raw form.	0.509
Rhamnaceae	*Ziziphus jujuba* Mill. Hussain.Bot-37(USTB)	**beri**	Tree	590	Leucorrhoea, cough, abdominal pain	It is eaten in raw form.	0.6
	Ziziphus mauritiana Lam. Hussain.Bot-38(USTB)	**beri**	Tree	550	Abortion in animals including women, dysentery in goats and sheep	It is eaten in raw form.	0.436
	Ziziphus nummularia (Burm.f.) Wight & Arn. Hussain.Bot-39(USTB)	**kirkiran**	Shrub	700	Cold, skin diseases	Ten fruits are eaten twice a day to treat said diseases.	0.381
	Ziziphus oxyphylla Edgew. Hussain.Bot-40(USTB)	**beri**	Shrub	670	Jaundice, abdominal pain, inflammation	It is eaten in raw form.	0.309
Salvadoraceae	*Salvadora oleoides* Decne. Hussain.Bot-41(USTB)	**jaal**	Tree	860	Toothache, wound healing, joint pain, piles		0.509
	Salvadora persica L. Hussain.Bot-42(USTB)	**peelo**	Tree	850	Allergy, skin diseases, constipation, body worms, dyspepsia	Fruits are used thrice a day for 7 days to relief the diseases.	0.709
Sapotaceae	*Sideroxylon mascatense* (A.DC.) T. D.Penn. Hussain.Bot-43(USTB)	**gurgura**	Tree	1000	Kidney problems, constipation, dyspepsia	It is eaten in raw form.	0.6

Table 3. FL values of the wild edible fruits against particular diseases.

Family	Botanical Name/ Voucher Number	Treated Disease	FL%
Arecaceae	*Nannorrhops ritchiana* (Griff.) Aitch. Hussain.Bot-01(USTB)	Constipation	22.22
	Phoenix dactylifera L. Hussain.Bot-02(USTB)	Body weakness	55.55
	Phoenix sylvestris (L.) Roxb. Hussain.Bot-03(USTB)	Dysentery	21.87
Berberidaceae	*Berberis lycium* Royle Hussain.Bot-04(USTB)	Jaundice	61.70
Boraginaceae	*Cordia dichotoma* G.Forst. Hussain.Bot-05(USTB)	Respiratory disorders	58.13
	Cordia sinensis Lam. Hussain.Bot-06(USTB)	Dyspepsia	15.62
	Cordia myxa Forssk. Hussain.Bot-07(USTB)	Acidity	61.36
	Ehretia obtusifolia Hochst. ex DC. Hussain.Bot-08(USTB)	Stomach-ache	20.00
Cactaceae	*Opuntia stricta* (Haw.) Haw. Hussain.Bot-09(USTB)	Liver problem	11.42
	Opuntia ficus-indica (L.) Mill. Hussain.Bot-10(USTB)	Throat infection	12.00
Capparaceae	*Capparis decidua* Edgew. Hussain.Bot-11(USTB)	Arthritis	57.14
	Capparis spinosa L. Hussain.Bot-12(USTB)	Scurvy	29.62
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad. Hussain.Bot-13(USTB)	Diabetes mellitus	56.81
	Cucumis melo L. Hussain.Bot-14(USTB)	Abdominal pain	21.73
	Cucumis melo var. *agrestis* Naudin Hussain.Bot-15(USTB)	Gas problems	59.09
	Momordica balsamina L. Hussain.Bot-16(USTB)	Blood disorders	56.52
Fabaceae	*Bauhinia variegata* L. Hussain.Bot-17(USTB)	Body heat	8.69
Malvaceae	*Grewia asiatica* L. Hussain.Bot-18(USTB)	Wound infection	40.00
	Grewia erythraea Schweinf. Hussain.Bot-19(USTB)	Inflammation	33.33
	Grewia tenax (Forssk.) Fiori Hussain.Bot-20(USTB)	Sterility	69.23
	Grewia villosa Willd. Hussain.Bot-21(USTB)	Anorexia	35.71
Menispermaceae	*Cocculus hirsutus* (L.) W.Theob. Hussain.Bot-22(USTB)	Cough	30.00
	Cocculus pendulus (J.R.Forst. & G.Forst.) Diels Hussain.Bot-23(USTB)	Body worm	29.62
	Tinospora cordifolia (Willd.) Hook.f. & Thomson Hussain.Bot-24(USTB)	Fever	62.06
Moraceae	*Ficus benghalensis* L. Hussain.Bot-25(USTB)	Sterility	59.25
	Ficus racemosa L. Hussain.Bot-26(USTB)	Nervous disorder	25.00

	Ficus religiosa L. Hussain.Bot-27(USTB)	Skin diseases	10.25
	Ficus carica L. Hussain.Bot-28(USTB)	Piles	58.33
	Morus alba L. Hussain.Bot-29(USTB)	Constipation	16.66
	Morus macroura Miq. Hussain.Bot-30(USTB)	Diabetes mellitus	13.33
	Morus nigra L. Hussain.Bot-31(USTB)	Respiratory problem	27.90
Moringaceae	*Moringa oleifera* Lam. Hussain.Bot-32(USTB)	Obesity	43.24
	Moringa peregrina Fiori Hussain.Bot-33(USTB)	Skin problem	36.84
Myrtaceae	*Psidium guajava* L. Hussain.Bot-34(USTB)	Vomiting	37.50
	Syzygium cumini (L.) Skeels Hussain.Bot-35(USTB)	Diarrhea	56.00
Oleaceae	*Olea ferruginea* Royle Hussain.Bot-36(USTB)	Sterility	53.57
Rhamnaceae	*Ziziphus jujuba* Mill. Hussain.Bot-37(USTB)	Leucorrhoea	55.55
	Ziziphus mauritiana Lam. Hussain.Bot-38(USTB)	Abortion	35.29
	Ziziphus nummularia (Burm.f.) Wight & Arn. Hussain.Bot-39(USTB)	Cold	30.76
	Ziziphus oxyphylla Edgew. Hussain.Bot-40(USTB)	Jaundice	35.71
Salvadoraceae	*Salvadora oleoides* Decne. Hussain.Bot-41(USTB)	Toothache	43.47
	Salvadora persica L. Hussain.Bot-42(USTB)	Allergy	64.00
Sapotaceae	*Sideroxylon mascatense* (A.DC.) T.D.Penn.Hussain.Bot-43(USTB)	Kidney problems	62.06

Declarations

Ethics approval and consent to participate: Consent was obtained from all participants before conducting interviews.

Availability of data and materials: Request for data can be directed to the first author.

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Author contributions: SH, FU and AS designed research work. SH collected the ethnomedicinal data of wild edible fruits of the Surghar range. AS and IU identified the collected wild edible fruits. SH and FU, NUU wrote the manuscript. NUU, AS, SR and IG analyzed the data and formulated the table. IU, SM and IAS read and analyzed the manuscript.

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Questionnaire

Quantitative ethnomedicinal studies of wild edible fruits used by the indigenous people of the Surghar range, Pakistan

Community name: ……. ……. Altitude: …… …….

Climate: …… Soil type: ……

Vegetation type: Herb……. Shrub…… Bush……. Tree…… Grass……Vine……..

Color of the flower: …… Color of the fruit: ……

Flowering season: ……Fruit season: ……

Vernacular name: ……

Voucher No: ……

Family name: ……

Ethnomedicinal uses: …… Part used: ……

Preparation:……

Informer name: ……Age of informant:……Education…… •

Date:……

- Collector: Shahzad Hussain, Ph.D.Scholar, University of Science and Technology Bannu, KP, Pakistan. Figure 2. Questionnaire form for ethnomedicinal information of wild edible fruits in the Surghar range.