Traditional phyto-recipes used to cure various ailments by the local people of Shishi Koh valley, Chitral, Pakistan

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Research

Abstract

Background: Medicinal plants are used to cure a variety of ailments since ancient times. In last few decades an increase in interest in the use of medicinal plants is noted for discovering novel medicines and treatments to fulfill the needs of the increasing population. This study was aimed to document phyto-recipes used by the indigenous communities of Shishi Koh Valley, Chitral.

Methods: The data was collected during 2019-2020 through interviews (N=125) using semi-structured and close-ended questionnaires. The data obtained was quantitatively analyzed through the family importance value (FIV), familiarity index (FI) informant consensus factor (ICF) and consensus index in percent (CI%).

Results: During the field work we have collected 48 medicinal plant species belonging to 29 families. According to the result herbs are the most dominant life form (56%), followed by trees (29%). Leaves were the most frequent plant parts used in phyto-recipes. The 89 indigenous recipes were reported to cure different diseases. Asteraceae family was dominant with the highest family importance value (*FIV* = 0.616), whereas *Rumex hastatus* D. Don depicted maximum familiarity index (*FI* = 0.456). A decoction was the common mode of medicines preparation. The digestive disorders have the highest value of informant consensus factor (*ICF* = 0.93) and the least value of ICF was obtained for Skin problems (0.53).

Conclusion: The present study revealed the importance of the flora of this unexplored area. We recommended that in future the plants like *Rumex hastatus* D. Don having high FI should be studied for phyto-chemically, and pharmacologically to discover new drugs.

Key Words: Herbal Recipes; Medicinal Plants; Ethnomedicines; Shishi Koh Chitral; Pakistan

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Background

The management and utilization of resources are integral to the history of human civilization and culture, and human communities have used resources, particularly bio-resources since the dawn of civilization (Gras et al. 2021). Plant resources are essential to human cultures and have been used for thousands of years to promote human well-being. Many cultures around the world continue to rely on plants as their primary source of treatment, and they have developed their medicinal systems based on their theories, experiences, and beliefs (WHO, 2012). Local indigenous medical systems are especially common in rural communities around the world, for example, accounting for a significant portion of all health cares provided in the Himalayan regions (Zhu, 2016). Diverse ethnic communities in the Himalayas have their indigenous healthcare systems, and medicinal plant applications vary greatly depending on geography and ecology (Liu et al. 2016).

Ethnobotany must experiment with different methods over the last few decades, with a dual goal of documenting and safeguarding ancient human uses of plants, describing human lifestyles and attempting to improve human lifestyles (Pardo-de-Santayana et al. 2015). As a result, ethnobotanical research is dominated by the collection of plant uses associated with health, primarily medical and food uses, though other uses are also relevant. The documentation of traditional knowledge, particularly on the therapeutic uses of plants, has provided many significant modern-day pharmaceuticals since its inception (Dey et al. 2021). Based on the importance of folk local knowledge in protecting and improving health, several medicines have been developed, including the antiviral oseltamivir and the antimalarial artemisinin, to name just two well-known and recent examples (Tringali et al. 2012; Tu et al. 2016). The indigenous knowledge is depicted as a combined assortment of information, practice, and conviction, developing through adaptive procedures and cultural transmission throughout generations (Berkes et al. 2008). Folk medicine is used worldwide as it relies on locally accessible plants or the products derived from these plants (Awas and Demissew, 2009). Particularly ethno-botanical information is collected in different regions of South Asia (Das and Tag, 2006).

Documentation of ethnic data with the help of ethno-botanical research is noteworthy to support the conservation awareness of natural assets (Muthu, 2006). Hence, ethno-botanical studies are becoming increasingly important to developing healthcare and conservation plans in such regions (Ososki et al. 2002). Assessment of medicinal plants is critical for security, conservation, and valuable novel natural medicines (Heinrich and Gibbons, 2001; Mesfin et al. 2009). In the past few years, the use of medicinal plants information, research, and practice added significant consideration to the scientific community (Heinrich and Gibbons, 2001; Kayani et al. 2014). Numerous rural communities have ethnic knowledge of medicinal plant species (Manandhar, 1992; Johnston, 1996; Comerford, 1996; Milliken and Alber, 1996) and such data survives since it is passed on starting with one generation to the next (Manandhar, 1992; Jain and Saklani, 1991). Plants become the only source of medication and well-being in Pakistan's interior. However, from certain interior regions of Pakistan's Himalaya, such as Shishi Koh Valley, Chitral, information about the uses of plants as traditional medicines has not been reported. The present study aimed to gather and record data about the therapeutic plant species utilized by the indigenous community and assess the viability of species commonly cited. The accompanying objectives were:

(i) to have an in-depth understanding of the ethnopharmacology about the medicinal plants used in basic health care,
(ii) with a special focus to elucidate major diseases cured and mode of recipes preparations by indigenous communities.

Material and methods

Study area

Chitral is the northern most administrative district of the Khyber Pakhtunkhwa province of Pakistan. It is speared over 14850 Km^2, located at 35.99 °N and 71.98 °E. (https://web.archive.org; http://chitral.gov.pk/). It shares its borders with Gilgit- Baltistan to the east, with Kunar, Badakshan, and Nuristan provinces of Afghanistan to the north and west, and swat to the south (Ali et al. 2012)**.** The maximum population is rural, population density is 30 $Km^{2.}$ District Chitral is divided into small valleys by the Hindukush range. Shishi Koh Valley is located to the north last of the Chitral (Fig. 1). Geo coordinates are 35^0 35. 255` N latitude and $71^0$ 48. 466` E longitude (Wali 2017). The valley has 33 villages and a total population of 14925. The common languages spoken in the study area are Khowar (Chitrali), Gujro, Pashto, however Khowar language is speaking by half of the population. Geo-climatically, the area falls within a dry Mediterranean climate with no precipitation during the sweltering summers. Rainfall happens profoundly from spring brought about by western frontal systems. In the winter, the temperature occasionally falls

to -10°C. Topography is highly diverse comprised of steep mountains, massive glaciers making the realm inaccessible. Weather exhibits great seasonal fluctuations. Spring and autumn seasons are very short.

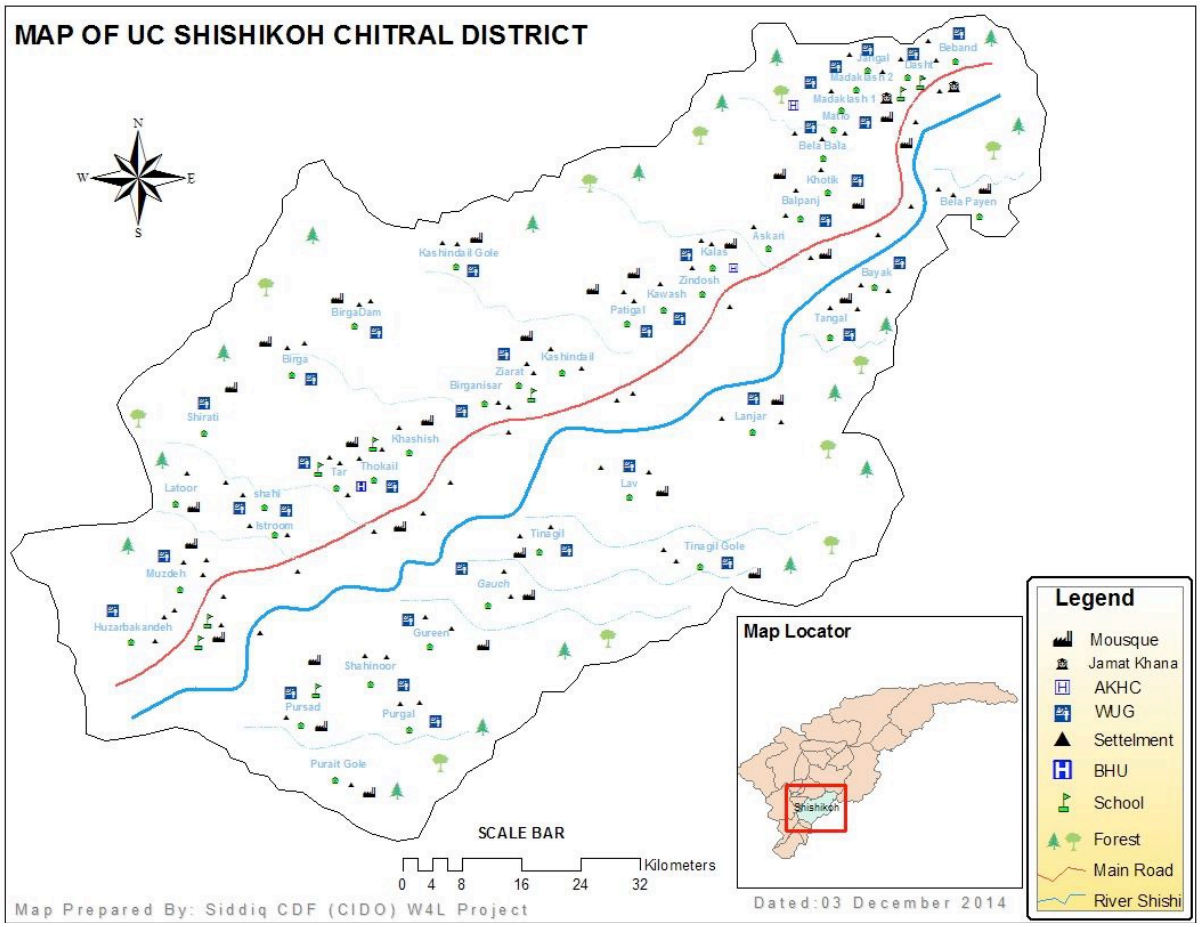

Figure 1. Map of the study area

Ethnomedicinal data collection

This survey was conducted from April 2019 to August 2020. The selection of informants was made through the snowball technique (Albuquerque et al. 2014; Junior et al. 2016) and a total of one-hundred and twenty-five (125) informants, including five *Hakeems* (traditional healers) (Table 1) who showed agreement to take part in this survey; were interviewed through a semi-structured questionnaire. The ethnicity of the participants and the language information given here are not disclosed, based on mutual agreement as stipulated under the Nagoya Protocol. The code of ethics of the International Society of Ethnobiology was followed (ISE, 2006). Additionally, one person from each indigenous community, who was well familiar with the traditions and norms of the community, was taken as a guide during all the field surveys.

Medicinal plants data was obtained through questions like, which plants are used to cure various illnesses, the plants' parts used to treat illness, preparation methods and herbal recipes administration, the site of collection, and availability of collected plant species. To collect ethnomedicinal data and plants local guides and researchers regularly visited the study area (Fig. 2).

Collection, identification, and preservation of medicinal plants

The plants described in Table 2 were collected from the study area. The collected plants were identified with the help of Flora of Pakistan. These identified plants used against different ailments were also verified and updated with the plant list (www.theplantlist.com). The dried and processed plant specimens were allotted voucher numbers and were then submitted to the herbarium - Department of Botany, Islamia College, Peshawar, Pakistan, for future reference. Voucher numbers of the submitted plant specimens are given after their botanical name.

Table 1: Demographic description of the informants

Demographic features	Number of people	Percent (%)
Age		
30-50	26	20.8
51-70	41	32.8
Above 70	58	46.4
Education Status		
Illiterate	21	16.8
Read & Write	27	21.6
Grade 1-10	47	37.6
Grade 11-above	30	24
Gender		
Male	68	54.4
Female	57	46.6

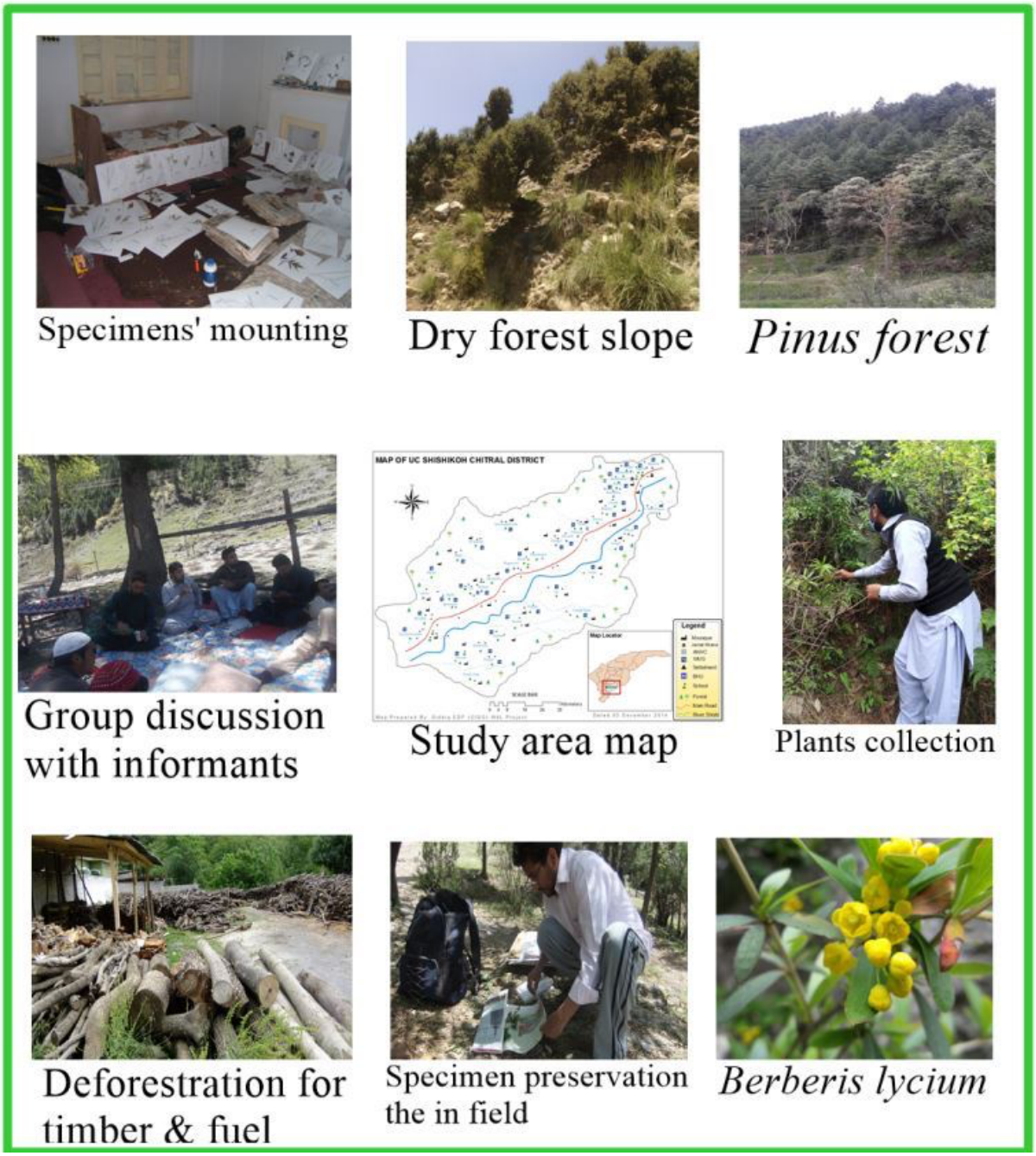

Figure 2. Schematic view of the research work

Familiarity index (FI)

To know the popularity of the ethnomedicinally important plant species in the community, Familiarity Index (FI) was used (Phillips, 1994; Tabuti, 2004; Khan and Ahmad, 2015). FI value of each species was calculated using the formula:

$$FI = FC/N$$

Where:
FC= Frequency of medicinal plant species
N= Number of total respondents

Family importance value (FIV)

The FIV was applied to the data to find out the most versatile family in terms of medicinal value. FIV of the reported taxa was calculated (Wali et al. 2019).

$$FIV = FC(family)/N \times 100$$

Where:
N= Number of all the participants
FC= Total number of informers citing that family

Informant consensus factor (ICF)

The informant consensus factor for different use classes was appraised, following the method of Khan and Ahmad (2015). This index was adopted to find out the homogeneity of the data about a particular group of diseases. The following formula was used:

$$ICF(0-1) = Nur - Nt/Nur - 1$$

Where:
Nur= Number of all the reports for use class
Nt= Total number of species used in this class

Consensus index (CI)

To ascertain the respondents' percentage of knowledge regarding the practice of medicinal plants for the cure of a disease, the Consensus index (CI) was calculated (Tardío and Pardo-de-Santayana, 2008).

$$CI = n/N \times 100$$

Where:
n= Informants' number referring the medicinal plant
N= Number of all informants

Results and Discussion

The findings of the present study revealed that the local population of the study area has still a rich source of herbal traditional knowledge. Furthermore, the current study validates the close relationship between the local population and the provisioning of plant ecosystem services.

During interviews with participants, demographic characteristics were determined and documented. A total of 125 participants were interviewed; out of them, seven were between the age group of 30-35, 19 were 36-50, and 58 were above 70. All the informants were natives of Shishi Koh Valley. Among the informants, 57 were female and 68 were male (Table 1). When the informants were asked because why they use medicinal plants, most of them replied that they use these medicinal plants mainly because most of the remedies are part of their culture. While documenting and collecting the indigenous knowledge about medicinal plants it was noticed that the illiterate informants have more understanding of therapeutic plants this may be due to negligence of educated persons for the use of indigenous medicinal plants to cure diseases and giving preference to the modern healthcare system (Shah et al. 2016). Generally, males mainly collect medicinal plants, and herbal medicines are prepared by females. It was also observed that all (males and females) are aware from the uses of the medicinal plants. The disparity between men and women stemmed from the fact that women are confined primarily to their houses and do not have access to remote locations (Haq et al. 2020; Asif et al. 2021). Most of the data regarding the uses of medicinal plants were gathered from informants in the age range of 40 to 65 years. The process of knowledge regarding the medicinal plants' recipes is shrinking gradually as the younger generations prefer modern medicine over the traditional medicinal system, Similarly, results were also reported by Bano et al. (2014); Kayani et al. (2014); Wali et al. (2019) and Jan et al. (2021) from the surrounding areas.

Table 2. Qualitative and quantitative ethnomedicinal information of medicinal plants used among the local communities of Shishi-Koh Valley

Botanical name Voucher No.	Family	Local Name	Part Used	Utilization Mode	FI	CI	Preparation and administration	Diseases cured	Recorded literature uses for Diseases
Adiantum venustum D. Don (Ch-343)	Pteridiaceae	Sumbul	Lv, Sh	Pw, Pl	0.20	++	1. The leaves are collected and stored in a shady to dry and then grinded. This powder is chalked through a silk cloth. After that 2-4g powder are taken with a glass of water once a day before breakfast to cure fever. 2. The dried shoot is grinded and mixed with mustard oil. Then it is applied on the head at night to overcome baldness.	Cardiac problems and baldness	Sher et al. (2011)
Allium cepa L. (Ch-344)	Alliaceae	Threshto	Bb, Lv	Ol, Dt	0.392	+++	3. The bulb of *Allium cepa* is wormed to get oil like secretion which is used for coughing reflexes of children. 4. The green leaves are used to decrease blood pressure. 5. The wormed bulb applied on the effected skin for treatment of skin lesions through bandage. 6. The leaves of *Allium cepa* are also used as a salad which is helpful in the digestion of food.	Skin diseases, whooping cough, digestion stimulation, blood pressure lowering	Jan et al. (2009), Ahmed et al. (2014) and Shah et al. (2016)
Allium sativum L. (Ch-345)	Alliaceae	Wreszhnu	Bb	Pl, Pt	0.352	+++	7. The bulb is wormed and used as a poultice on boils to discharge pus.	Tooth ache, skin diseases, blood	Jan et al. (2009), Ahmed et al. (2014) and Shah et al. (2016)

							8. It is also taken directly to lower high blood pressure. 9. The bulbs are grinded and mixed with mustard oil, a little amount of salt and lemon juice. A paste is formed which is applied on the effected tooth through cotton.	pressure, flu, and cough	
Althaea rosea L. (Ch-346)	Malvaceae	Layn	Fl	Pl	0.304	+++	10. The petals from flowers are dried, grinded and the powder is mixed with guar. The poultice made is applied to the boils to draw out the puss. After two or three times of application the patient would rid of the boil.	Boils	Jan et al. (2009)
Artemisia indica Willd. (Ch-347)	Astaraceae	Droon	Lv	Ju	0.28	+++	11. The fresh leaves of *Artemisia indica* L. are chapped; the paste is soaked in water for some minutes. The mixture is filtered through a silk cloth. The filtered juices are used for the treatment of stomach problems such as gastritis.	Gastric problems	Ashraf et al. (2010)
Artemisia parviflora Roxb. ex. D. Don (Ch-348)	Asteraceae	Kharkhalij	Sd	Sp, Pw, Et, Tb	0.184	++	12. Seed are collected, cleaned, dried and are roasted in a fry pan until they become reddish-brown. Then the seeds are ground and mixed with soup (made up of many things such as pyaz, tomato, garlic, oil, salt,	Anti-diabetic, Abdominal Pain, Anthelmintic	Hayat et al. (2009) and Khan et al. (2011)

								and water as required). The soup is given to the children for nappy rash. If the baby is unable to take the soup (kali) orally then it is given to her/his mother so that the baby may be dosed by the mother. 13. One teaspoon full of powdered seeds is taken with a glass of water to cure abdominal pain. 14. A glass of 2gram seeds extract is drunk once a day to cure diabetes.		
Berberis lycium Royle. (Ch-349)	Berberidaceae	Chounch	Rt, Lv, Ft	Pt, Ju, Dc	0.248	++		15. Young leaves are collected, crushed and a paste is obtained, which is mixed with soup and is given for chronic fever. 16. Juice is extracted from the ripen fruits by crushing them the juice is filtered through a silk cloth. The juice is used as blood purifier. 17. Roots are chopped into small pieces, and then boiled in water for 2-4 hours. Then it is given to the patient for back ache, dyspepsia and muscular pain. 18. The decoction is further boiled about 8 hours and a thicken paste is obtained, small tablets are made from this	Back ache, blood purification, urinary tract infection, chronic fever, dyspepsia and muscular pain	Jan et al. (2009), Abbasi et al. (2010), Shah et al. (2014), Barkatullah et al. (2015), Ijaz et al. (2016) and Shah et al. (2016)

								paste are given to the patient having urinary tract infection two times a day for three consecutive days.	
Cannabis sativa L. (Ch-350)	Canabinaceae	Boung	Lv	Di, Pw,	0.216	++	19. 20.	The fresh leaves are warmed and put on the affected area bitten by scorpion. The dried powder of leaves called gharda is mixed with wheat flour and given to cattle to treat flatulence and abdominal pain.	Weakness, antidote, and abdominal pain	Shah et al. (2014), Barkatullah et al. (2015), Ijaz et al. (2016), Ijaz et al. (2016) and Shah et al. (2016)
Capparis spinosa L. (Ch-351)	Capparidaceae	Kaveer	Fl, Ft	Di, Tb	0.088	+	21. 22.	20-40g unexpended or half expended floral buds of this plant are collected. Then put in an earthen vessel and kept on the roof in bright sun for at least 7 days. The floral buds are dried and used as a food. The dry fruit is collected and mashed up with a few drops of water in pestle and motor to form a thick paste. From this paste small ball are made, dried, and stored. Then these balls are used for face pack to clean and clear the face from pimples and used as well as sun block.	Typhoid, malaria, and sunburn	Shah & Khan (2006), Sher (2010) and Bano et al. (2014)
Carthamus tinctorius L. (Ch-352)	Asteraceae	Pom	Fl	Pw	0.096	+	23.	The orange / reddish / brownish florets are collected, dried and ground. The powder is	Wheals and Cough	Shah et al. (2014)

								mixed with milk and used. The dose is usually taken at night before sleeping.	
Carum capticum L. (Ch-353)	Apiaceae	Shonch much	Sd	Pw, Pt	0.112	++	24. 25.	The seeds are collected when mature and are crushed. The powder is mixed with boiled egg to make paste which is given to the patients of dysentery twice a day. The seeds are crushed and taken orally with water for the treatment of gastric.	Gastric, Fever and Dysentery	Ahmad et al. (2006) and Adnan et al. (2014)
Carum carvi L. (Ch-354)	Apiaceae	Hojoj	Sd	Dc	0.152	++	26.	Seeds of this plant are collected, dried and are boiled in water with a little bit of salt and the decoction (half cup) is given to the patients of abdominal pain, dyspepsia, indigestion, nausea and as stomachache.	Abdominal pain, dyspepsia and condiment	Shah & Khan (2006) and Khan & Khatoon (2008)
Cichorium intybus L. (Ch-355)	Asteraceae	Kasthi	Rt	Dc, Sn	0.056	+	27. 28.	The roots are chopped and boil in water. This decoction is filtered and is given to the patient of abdominal pain. In case of chronic typhoid and malaria roots of 7 different plants from different places are collected, chopped, and soaked in water. Then keep under the sky for a single night. Suspension is used to cure chronic typhoid and malaria.	Malaria, typhoid, and abdominal pain	Shah et al. (2014) Barkatullah et al. (2015) and Shah et al. (2016)

Convolvulus arvensis L. (Ch-356)	Convolvulaceae	Mishk	Lv	Pt	0.328	+++	29.	The fresh leaves are boiled in water and chopped. The paste is mixed with tomato, onion, ginger, garlic, salt (as required) and then fried in oil. This gravy is used for curing constipation usually 2-3 times a day.	Constipation	Zabihullah et al.(2006) and Khan & Khatoon (2008)
Coriandrum sativum L. (Ch-357)	Apiacae	Danu	Sh, Lv, Sd	Di	0.36	+++	30.	The fresh leaves, dried shoot and dried seed are mixed in small amount with food, and eaten as appetizer, carminative and diuretic agent.	Appetizer, Carminative and Diuretic	Jan et al. (2009), Ahmed et al. (2014), Shah et al. (2016), Shah et al. (2016)
Crataegus songarica C. Koch. (Ch-358)	Rosaceae	Ghoni	Bk	Et	0.096	+	31.	5-6g bark is soaked in water for some hours and a small amount of this extract is given to pregnant women once in 24 hours to reduce labor pain usually at night before sleeping.	Labour pain	Shah & Khan (2006), Ali & Qaiser (2009) and Haq et al. (2011)
Cucurbita maxima Duch ex lam. (Ch-359)	Cucurbitaceae	Alok	Ft, Sd	Ju, Dc	0.208	++	32. 33.	The fruit are placed in warm ash until it becomes brown. It is then cooled down and juice is extracted from it which is given to infants (0ne tea spoon) 2-3 times a day to treat pneumonia and cough. The seeds are boiled in water and filtered. Sugar is added to it and taken to cure cough, in a day 2-3 dozes.	Cough and Pneumonia	Khan & Khatoon (2008) and Jan et al. (2009)
Cydonia vulgaris L. (Ch-360)	Rosaceae	Boop	Ft	Sn	0.368	+++	34.	The fresh fruit is boiled in water and a small	Cough and Pneumonia	Ishtiaq et al. (2015)

							amount of sugar is added to it, the suspension is used for cough and pneumonia.		
Daucus carota L. (Ch-361)	Apiaceae	Kheshgoom	Rt, Sd	Di, Et	0.344	+++	35. The seed are boiled in water for some times and a small amount of sugar is added. This decoction is used for the treatment of abdominal pain (twice a day). 36. Roots are used as salads which improve eyesight.	Eye disorder and abdominal pain	Shah & Khan (2006) and Jan et al. (2008)
Eleagnus angustifolia L. (Ch-362)	Elaegnaceae	Shounjur	Bk, Ft, Gm	Dc, Di, Pt, Te	0.216	++	37. The fruit of *Eleagnus angustifolia* L. about 3-4kg of fruit is boiled in water for an hour. It is filtered through silky cloth and a little amount of sugar is added. This is used against dyspepsia and blood purification. One glass of it is once a day before sleeping by adults one glass per day, while for children one spoon is enough. 38. The warmed fruit are eaten to treat throat problems. 39. The gum of this tree is locally called luchak. The gum is first dipped in water for one or two hours, and the paste is used to cure bifurcation of hairs and to remove dandruff.	Dyspepsia, purification of blood and Dandruff	Qureshi et al. (2007), Khan & Khatoon (2008) and Khan et al. (2011)

							40.	Herbal tea is made from the bark and then used to enhance digestion.	
Ephedra gerardiana Wall ex Stapf. (Ch-363)	Ephedraceae	Somani	Sh	Dc	0.288	+++	41. 42.	The young branches of this plant are chopped and boiled in water, and after by crushing a thin brown /radish juice is obtained locally called gholja. This juice is then applied to the aching back. It is also considered very effective against edema. The extraction is also used by females especially girls in the spring season, as a sun block to retain a white skin thought.	Edema, Skin, Lumbago, and Gastric	Khan et al. (2011) Shinwari & Gilani (2003) Ahmad et al. (2009) and Khan et al. (2013)
Ficus carica L. (Ch-364)	Moraceae	Koyet	Ft, Lt	Di	0.144	++	43. 44.	The dried fruit are first dipped in water and then it is filtered through silk cloth. The filtrate is used to inhibit cough reflex and cleaning of stomach. This doze is taken twice a day. The milky latex obtained from fruits as well as leaves of this plant are used for the ejection of throne from the foot palm. It is used in morning time not effective in the evening time.	Stomach, coughing and ejection of throne from the body	Abbasi et al. (2013), and Ijaz et al. (2016)
Foeniculum vulgare Miller. (Ch-365)	Apiaceae	Bodyoung	Lv, Sd	Dc, Di, Sp	0.392	+++	45.	The fresh leaves are chewed to relive toothache and cough.	Toothache, Cough, Abdominal	Shah et al. (2016)

							46.	The seeds are boiled and mixed with 2-3 spoons of sugar. The mixture is used at night for the treatment of cough and abdominal pain.	pain and Lumbago	
							47.	The seeds are fried in butter and by addition of a little bit flour and water; a soup is made which is used against flue, bronchitis, and lumbago.		
Fumaria indica L. (Ch-366)	Fumariacae	Shathara	Sh	Te	0.264	+++	48.	The shoots are dried in a shady place, crushed, and mixed with water or made an herbal tea. This mixture is given to the patient of abdominal pain.	Abdominal pain	Ahmed et al. (2014), Shah et al. (2014), and Shah et al. (2016)
Glycyrrhiza glabra L. (Ch-367)	Fabaceae	Moyu	Rt	Dc	0.136	++	49.	The roots boiled in water, then filter through silk cloth. After that a small amount of sugar is added. This decoction is called moyouough and is taken orally to treat abdominal pain.	Abdominal pain	Khan & Khatoon (2008) and Walter (2011)
Iris germanica L. (Ch-369)	Iridacaea	Sosun	Rt	Pl, Dc	0.232	++	50.	The poultice from dried root is placed over inflamed parts of the body as rheumatism.	Rheumatism and fever	Haq et al. (2010)
							51.	1-2 g roots are boiled in water. Then filtered to the extract and a small amount of sugar is added and is drunk as antipyretic to reduce temperature and fever.		

Juniperus excelsa M. B. (Ch-368)	Cupressaceae	Sarroz	Sh, Ft	Et	0.168	++	52.	2-4gm dried shoots and fruit are soaked in water for an hour, the aqueous extract obtained from crushed fruits as well as from shoots is filtered through a silk cloth. A small amount of sugar is added to the extract. The extract of shots is used for anemia while the fruit extract is used for abdominal pain.	Anathematic and Abdominal pain	Hussain et al. (2006) and Khan et al. (2011)
Juglans regia L. (Ch-370)	Juglandaceae	Bermogh	Bk, Ft	Pl, Pw	0.288	+++	53. 54.	The white bark of this plant is placed in shady place to dry. The dried bark is crushed and chocked through cotton cloth. This powder is mixed with yogurt, and then applied to the infected area of the skin especially for itches. The seeds of walnut are wormed and introduced to the umbilical cord of the infants to heal wound quickly.	Skin disease and wound healing	Abbasi et al. (2013) and Haq et al. (2011)
Linum usitatissimum L. (Ch-371)	Linaceae	Shentaki	Sd	Bd, Pl	0.192	++	55.	The seeds are firstly fried in pan; then are grinded. Now this powder is mixed with other ingredient such as mamaki, fat, bark powder of pomegranate and water to make dough, this is baked on the lower side of tawa, these bread is taken 3	Lumbago, Physical vigour and Boils	Khan & Hanif (2006), Dilshad et al. (2008) Husain et al. (2008)

								times in a day for the treatment of lumbago. 56. The seeds are grinded and fried; an oily paste locally called shintinki ghazaghazi is made which is applied to boils.	
Matricaria chamomilla L. (Ch-373)	Astaraceae	Shirisht	Fl	Dc, Bd	0.224	++		57. The inflorescence is dried, grinded and boiled in water and the decoction is given to the patients with abdominal pain, jaundice, fever and indigestion. 58. The dried flowers (4-5) are mixed with flour to make bread. It is very effective against abdominal pain.	Abdominal pain, Fever and Indigestion	Jabbar et al. (2006), Bano et al. (2014)
Mentha langifolia L. (Ch-374)	Lamiaceae	Bane	Wp	Te, Di	0.376	+++		59. Herbal tea made from the root, called benogh which cures fever and indigestion. 60. The fresh and dried leaves are also eaten as digestive and stomachic agent. 61. The fresh leaves are placed on forehead of patients to recover from unconsciousness.	Febrifuge, Stomachic, unconsciousness	Husain et al. (2008), Abbasi et al. (2010), Shah et al. (2016)

Morus alba L. (Ch-375)	Moraceae	March	Ft	Pt, Dc	0.24	++	62. The fruit is placed in sun light until the fruit is completely dry. The dried fruit is boiled in water (1 L) for an hour, and then cooled. Now it is filtered through silk cloth. This preparation is called (shereni) and is treat gastritis (half teaspoon). 63. The dried fruit is crushed. This powder is mixed with fruit of walnut and mixed with 2-3 eggs. This paste is a taken once usually at night to treat of rheumatism.	Gastric problem and Rheumatism	Ahmed et al. (2014), Abbasi et al. (2013), Husain et al. (2008) and Qureshi et al. (2011)
Peganum harmala L. (Ch-376)	Rutaceae	Ispandor	Sd	Pw	0.256	+++	64. The seeds are dried and grinded into powder and about 10g of powder is mixed with a cup of water and given to the children as anthelmintic.	Anthelmintic	Shah et al. (2014) and Barkatullah et al. (2015)
Papaver somniferum L. (Ch-377)	Papaveraceae	Afyun	Sd, Lt	Te, Di	0.352	+++	65. Opium (latex) is taken in small doses orally or smoked neat or in a cigarette as pain killer or sedative for scorpion bite. 66. Seeds (small amount) are mixed with tea and are given to patients having nasal and chest congestion, bronchitis and sunstroke.	Cough, sedative, chest congestion and anesthetic	Khan (2008) and Shah et al. (2016)

Prunus amygdalus L. (Ch-378)	Rosaceae	Dalum	Rt, Ft	Dc, Pt	0.312	+++	67. 68.	The roots (about 30 g) are boiled in water and filter through a silk cloth. One cup of decoction is used twice a day (morning and evening) for the cure of diabetes mellitus. The dried fruit rind is ground to powder. The powder is mixed with mustered oil to form a paste. The paste is applied over effected part of the body as vulnerary.	Diabetes mellitus and vulneray	Abbasi et al. (2013)
Prunus armenica L. (Ch-379)	Rosaceae	Zuli	Ft	Sy	0.52	++++	69.	The ripe fruit is placed under sun light to dry it. The dried fruit is sacked in water and sweet syrup formed; this syrup is used for curing cough and constipation (0ne teaspoon).	Cough and constipation	Abbasi et al. (2013)
Punica granatum L. (Ch-380)	Punicaceae	Badam	Sd	Pw	0.432	++++	70.	Seeds are mixed with milk and eaten as brain tonic.	Brain tonic	Abbasi et al. (2013), Shah et al. (2014), Ijaz et al. (2016) and Shah et al. (2016)
Rosa alba L. (Ch-381)	Rosaceae	Gulab	Fl	Et, Dc	0.368	+++	71. 72.	The fresh leaves are and crushed due to which extract is produced. 2-3 drops of this extract is used for the cure of eye diseases. The petals of the flowers (20 flowers) are placed in a shady area to get dried petals are boiled in water and taken to treat of	Eye disease and abdominal pain	Ahmad et al. (2004) and Ahmad et al. (2009)

								abdominal pain, usually take once a day (one cup).	
Rosa webbiana Wall ex Royle. (Ch-382)	Rosaceae	Throny	Lv, Fl	Pl, Te	0.312	+++	73. 74.	The fresh leaves (about 20 leaves) are heated in a pan. The dried leaves are crushed and is mixed with yogurt, then applied around the smallpox. This poultice is used thrice a day. The petals are dried, crushed and a powder is formed one or two tea poon powder mixed with tea. This is used for the treatment of stomach problem.	Stomach problem and smallpox	Khan et al. (2011) and Ullah et al. (2013)
Rubus fruticosus L. (Ch-383)	Rosaceae	Acho	Ft	Di, Sy	0.216	++	75. 76.	The fresh fruits are eaten to increase the amount of blood. The fruits are added in a juicer, dark red syrup is formed. This syrup is used twice or thrice a day for the treatment of anemia (2 tea poon).	Anemia	Abbasi et al. (2013), Ibrar & Hussain (2009) and Shah et al. (2016)
Rumex hastatus D. Don (Ch-384)	Polygonaceae	Chrekonzur	Lv	Pt	0.456	++++	77.	The fresh leaves are boiled in water and then chopped; the paste is mixed with tomato, onion, ginger, garlic and salt (as required) and then fried in oil. The gravy is used as laxative; this doze is usually taken thrice a day (2 teaspoons).	Laxative	Haq et al. (2011), Ijaz et al. (2016), Khan et al. (2013) and Shah et al. (2016)

Silene conoidea L. (Ch-385)	Caryophyllaceae	Appoper	Sd, Lv	Pl, Pt	0.248	++	78. 79.	The fresh and dried leaves are boiled in water and chopped. The paste is mixed with onion, tomato, ginger, garlic, and salt (as required), and then fried in oil. This gravy is used as stomachic (2-3tea spoons). The seed are first dried then crushed. This powder is mixed with milk and then applied on the effected skin especially face to remove the permanent marks and to make skin fair.	Stomachic and Skin disease	Shinwari and Khan (2000), Haq et al. (2011) and Abbasi et al. (2013)
Sisymbrium irio L. (Ch-386)	Brassicaceae	Khelikheli	Sd	Pt	0.424	++++	80.	Seeds are dried, and ground into a powder. A thin paste is made from the powder by addition of few drops of water. The paste is applied to the aching part of the body suffering from stabbing pain; the paste is also used against sunburn to clear facial pimples.	Stabbing pain, Diarrhea, Bloody stool, Bronchitis and Skin disease	Ijaz et al. (2016)
Solanum nigrum L. (Ch-387)	Solanaceae	Pirmilik	Lv, Ft	Pt, Pl	0.304	+++	81.	The fresh leaves are boiled in water and then chopped. The paste is mixed with tomato, onion, garlic, ginger, salt (as required) and then fried in oil; this gravy is used as antipyretic to control fever (1 teaspoon).	Antipyretic, Skin disease and Ophthalmic	Jan et al. (2009), Ullah et al. (2013) and Shah et al. (2006)

							82.	The poultice is applied on face as sunscreen to avoid sunburn.		
Sophora mollis (Royle) Baker (Ch-388)	Fabaceae	Besho	Sh	Ol	0.216	++	83.	The dried shoot is burnt due to which oil is obtained. This oil is applied on the effected part of the skin, three or four times a day.	Skin disease	Durrani & Razaq (2010), Ullah et al. (2013) and Khan et al. (2011)
Trachydium roylei Lindl (Ch-389)	Apiaceae	Mushin	Lv	Di	0.248	++	84. 85.	The fresh leaves of this plant are crushed and applied on the scorpion sting. Sometime the leaves are warmed and then applied on the scorpion sting after every thirty mints.	Antidote	Hussain et al. (2015) and Sher et al. (2016)
Trigonella foenum-graecum L. (Ch-390)	Fabaceae	Sugon	Lv, Sd	Pt, Dc	0.232	++	86. 87.	The fresh leaves (4-5) are boiled and then chopped. The paste is mixed with onion, ginger, tomato, turmeric and coriander. The mixture is fried in oil. The gravy formed is taken twice a day (1 teaspoon) for the treatment of rheumatism. The seeds of this plant are boiled in water, and a small amount of sugar is added to form decoction. It is given at the time of delivery to reduce pain (half cup spoon).	Rheumatism	Ahmad et al. (2009)
Vitis vinifera L. (Ch-391)	Vitaceae	Droach	Ft, Lv	Ju, Di	0.192	++	88.	The ripe fruits of this plant are collected, and juice is extracted from	Typhoid and dyspepsia	Matin et al. (2001), Qureshi et al. (2010) and

		it. This juice is drunk to cure typhoid and to heal dyspepsia. The juice is taken once a day.	Adnan et al. (2014)
		89. The gently warmed leaves in cattle's ghee are placed over inflamed parts of the body to remove inflammation.	

Shoot=Sh, Root=Rt, Leaves=Lv, Fruit=Ft, Seed=S d, Flower=Fl, Latex=Lt, Bark=Bk, Whole plant=Wp, Gum=Gm, and Decoction=Dc, Direct=Di Extract=Et, Juice=Ju, Powder=Pw Poultice=Pl, Paste=Pt, Tablet=Tb, Tea=Te, Oil=Ol, Soup=Sp, Suspension=Sn, Syrup=Sy, Bread=Bd, Cl=Consensus index, +=10%, ++ ≤ 11-25%, +++ ≤ 26-40%, ++++ ≤ 40 & above

The results of the present study recorded a total of 48 medicinal plant species belonging to 29 families. The local people prepare a total of 89 indigenous recipes from these 48 plant species. The respective uses of plant species and ways of use are present in Table 2. In comparing the plant composition of Shishi Koh Valley, almost similar species were recorded by other ethnobotanical studies of the Himalayas such as Haq and Singh (2020) reported 57 plant species from Kashmir Himalayas, India, and 49 ethnobotanically important plants by Jabeen et al. (2015) form Pakistan Himalayas. The dominant family in this study concerning species number was Rosaceae (N=7) followed by Asteracaeae (N=5). Similar, results were reported by Khan and Ahmad (2015) from the Swat and Barkatullah et al. (2015) from the Malakand Pass Hills which are having geographic contiguity with the study area. The dominance of families was also comparable to research conducted in other regions of the Himalaya, where Rosaceae and Asteraceae were identified as the leading families in other studies (Haq et al. 2019; Haq et al. 2020a; Asif et al. 2021). According to the life form, the maximum documented species were herbs (56%), followed by trees (29%), and shrubs (15%). Jan et al. (2017) also reported herbs as a dominant habit from Chinglai Valley, Buner, similarly Wali et al. (2019) have also mentioned herbs as the leading life form from Laspur Valley, Chitral and Haq and Singh (2020) have also mentioned herbs as the leading habit from Northwestern Himalaya, India.

As per usage of the plant's parts to treat various disorders, leaves (21.73%) were used most, followed by seeds (20.28%) and fruits (18.84%) (Fig.3). Leaves are used more frequently than other medicinal plants parts, this may be due to its easy collection and the presence of various secondary metabolites (Verpoorte et al. 2002; Ghorbani 2005; Mukherjee and Wahile, 2006; Yesilada and Küpeli, 2007; Cakilcioglu and Turkoglu 2010; Ahmad et al. 2014; Latif et al. 2015; Haq et al. 2020a). The availability in significant quantities and easy preparation of medicines also make leaves the most frequently used plant part (Telefo et al. 2011; Latif et al. 2015; Jan et al. 2020). The use of leaves and other aerial parts of medicinal plants are safe and sustainable from the conservation point of view (Giday et al. 2003). In addition, leaves are commonly used for medicines due to the high content of bioactive constituents (Yousuf et al. 2020; Hassan et al. 2021).

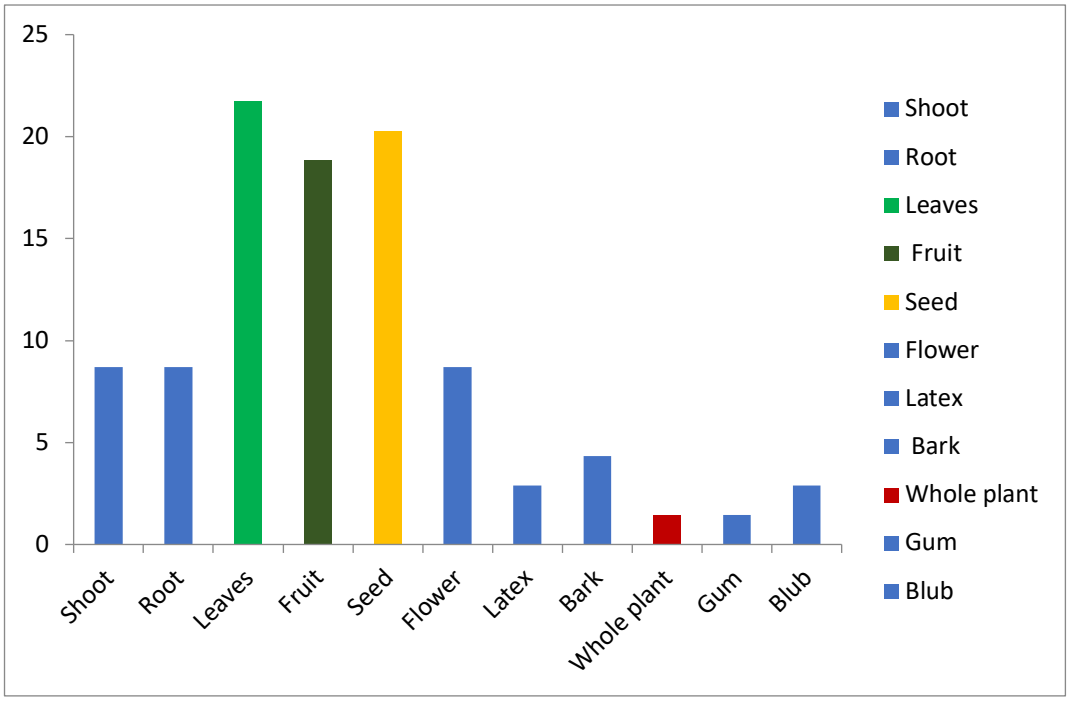

Figure 3. Percentages of various Plant parts used and their number of uses

In the preparation modes, decoctions form (N=14) was mostly used, followed by direct (N=12) (Fig.4). Decoctions are often prepared because the local people believe they are more effective than any other kind, and it is also believed that the mountain water used in the decoction has healing properties, resulting in a synergetic effect. Other researchers also reported the maximum usage of decoctions (Naveed et al. 2013; Okoli et al. 2007; Asif et al. 2021). In ethno-botanical practice, decoctions are often one of the significant forms of preparation as they are easy to prepare (Bano et al. 2014). Another reason for the frequent use of decoction may be that the boiling can cause rushing of biological reactions resulting in the better accessibility of various active compounds (Zhang et al. 2005; Bussmann, 2006; Han et al. 2007; Ijaz et al. 2016).

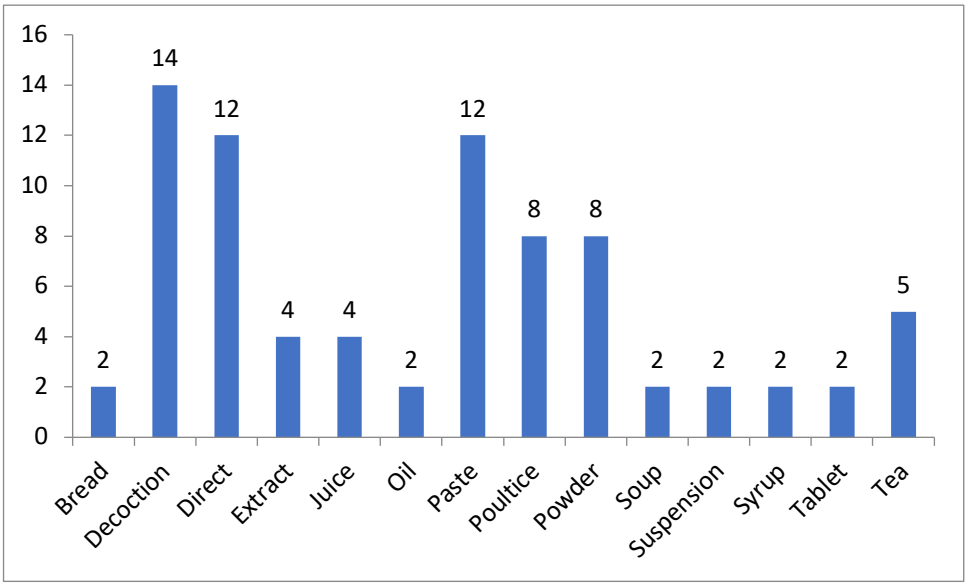

Figure 4. Common modes of preparations of medicines

Questionnaires and analytical tools were implemented to assess the ethno-therapeutic data quantitatively for the treatment of different illnesses in the study area. For example, the general uses of the identified medicinal plants in various diseases have been evaluated with the help of the familiarity index (FI) (Khan and Ahmad, 2015; Tabuti et al. 2004). Those species which were used by locals more frequently for curing different diseases have the high value of FI. Familiarity Index (FI) value was maximum for *Rumex hastatus* D. Don (0.456) followed by *Punica granatum* L. (0.432), *Sisymbrium irio* L. (0.424) and *Foeniculum vulgare* Mill. (0.392). The least FI values are calculated for *Cichorium intybus* L. (0.056) and *Crataegus songarica* K. Koch (0.96), (Table 2 and Fig.5). It is essential to point out that the use of *Prunus armeniaca* L. was reported by Abbasi et al. (2013), *Rumes hastatus* D. Don by Barkatullah et al. (2015); Ijaz et al. (2016); Shah et al. (2016) and *Punica granatum* L. by Abbasi et al. (2013); Barkatullah et al. (2015); Ijaz et al. (2016); Shah et al. (2016); Shah et al. (2014); Amjad et al. (2015), *Sisymbrium irio* L. by Ijaz et al. (2016), *Allium cepa* L. by Ahmad et al. (2010); Shah et al. (2014); Jan et al. (2009) *Foeniculum vulgare* Mill. by Shah et al. (2014). Similarly, different uses of other plants are also reported by various researchers from different areas, which are listed in Table 2.

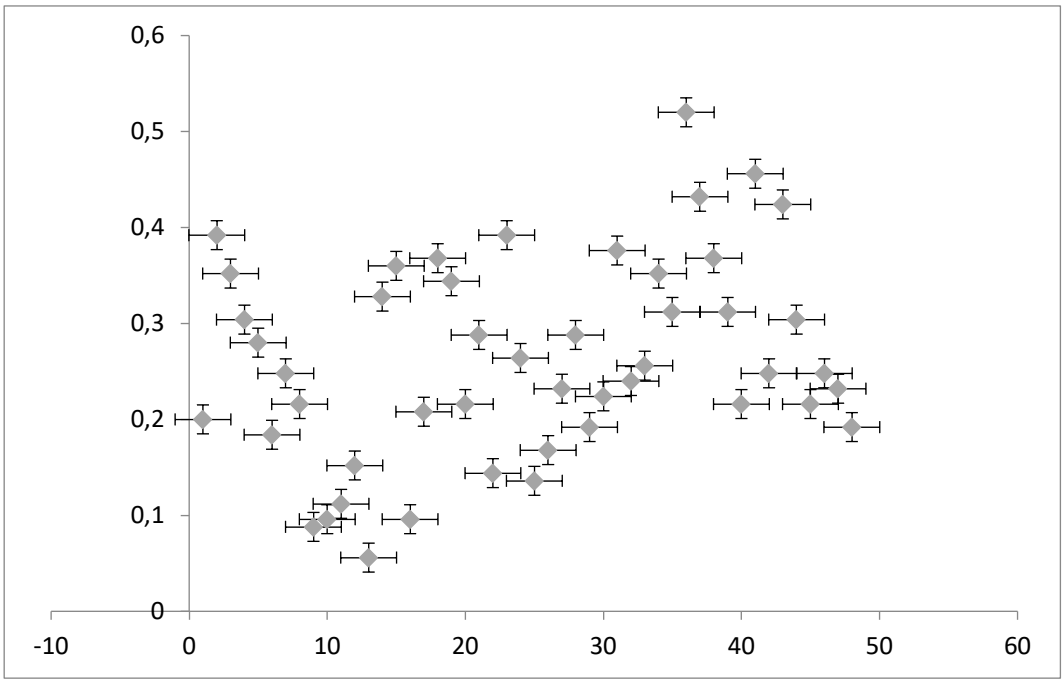

Figure 5. Familiarity Index of medicinal plants based on informant reports

The results obtained through index family importance value reveals that Asteraceae with FIV value (0.616) is the leading family, followed by Rosaceae (0.552). Conversely, Capparidaceae with FIV (0.088) has the least value (Table 3 and Fig.6). The result of this survey about the maximum usage of family Asteraceae agrees with other studies like Bano et al. 2014; Menendez-Baceta et al. 2015. The high value of FIV for these families is because of their cosmopolitan distribution in the study area and the high medicinal value. Percentage of informants interviewed for folk knowledge about medicinally important plant species in practice to cure various diseases and botanical taxa's Consensus Index (CI) are cited in Table 2, which shows the 'CI' values are high for *Prunus armeniaca* L., *Punica granatum* L., *Rumex hastatus* D.Don and *Sisymbrium irio* L. (++++) and lowest for *Capparis spinosa* L., *Carthamus tinctorius* L., *Cichorium intybus* L. and *Crataegus songarica* K. Koch (+). The Consensus Index (CI) for the reported therapeutic plant species is ranging from 5.6-52%. The result obtained through calculation from CI reveals that the high respondent percentage has been noted for *Prunus armenica* L. (52%), followed by *Rumex hastatus* D. Don (45.6%). It is also important to point out that some species have very low CI value because of the low cultural importance of these species in the preparation of folk remedies. This indicates that indigenous people have little trust in these plants for the treatment of diseases. The result shows the importance of some cultural aspects like the history of medicinal plants, linguistic, belief, human awareness, and access to folk knowledge about the use of therapeutic plants (Tardío and Pardo-de-Santayana, 2008; Abbasi et al. 2013). But in the present work, the study area has comparatively uniform ecological features, cultural-history, and linguistic (only Chitrali) which are believed to encourage indigenous populations to deliberate the medicinal information of plants as valuable heritage.

Table 3. Familiarity Index Value of the medicinally important families

Family	**Species No.**	**FC**	**N**	**FIV**
Alliaceae	2	39	125	0.312
Apiacae	6	63	125	0.504
Astaraceae	5	77	125	0.616
Berberidaceae	1	32	125	0.256
Brassicaceae	1	53	125	0.424
Canabinaceae	1	27	125	0.216
Capparidaceae	1	11	125	0.088
Caryophyllaceae	1	31	125	0.248
Convolvulaceae	1	41	125	0.328
Cucurbitaceae	1	26	125	0.208
Cupressaceae	1	20	125	0.160
Elaegnaceae	1	27	125	0.216
Ephedraceae	1	36	125	0.288
Fabaceae	3	52	125	0.416
Fumariacae	1	33	125	0.264
Iridaceae	1	29	125	0.232
Juglandaceae	1	36	125	0.288
Lamiaceae	1	47	125	0.376
Linaceae	1	23	125	0.184
Malvaceae	1	38	125	0.304
Moraceae	2	49	125	0.392
Papaveraceae	1	44	125	0.352
Polygonaceae	1	57	125	0.456
Pteridiaceae	1	25	125	0.2
Punicaceae	1	54	125	0.432
Rosaceae	7	69	125	0.552
Rutaceae	1	32	125	0.256
Solanaceae	1	38	125	0.304
Vitaceae	1	24	125	0.192

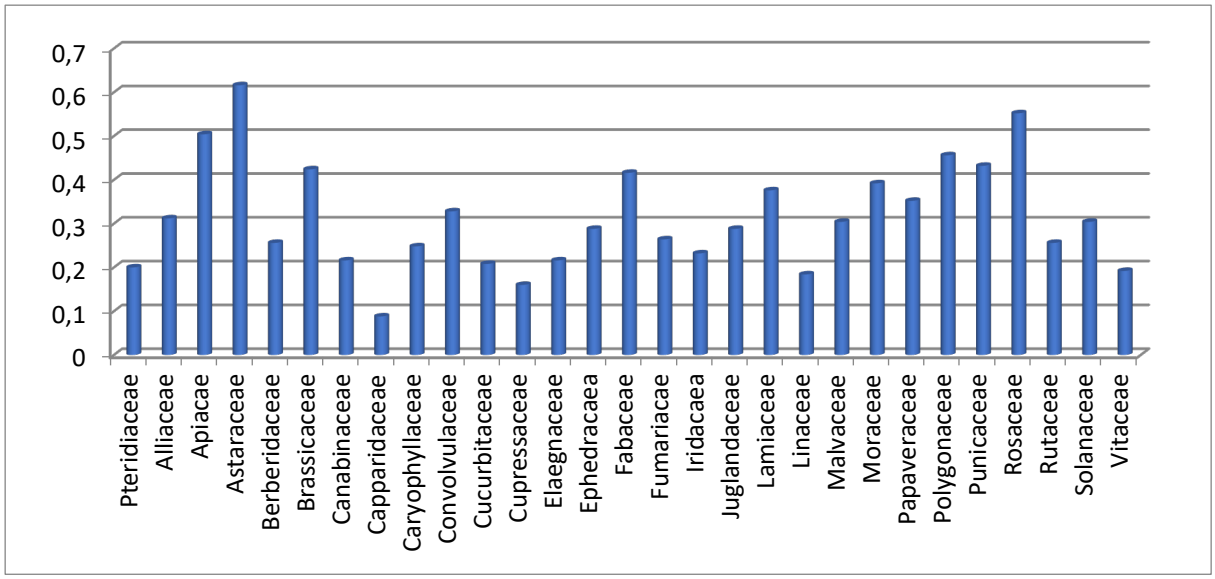

Figure 6. Family Importance Value of Various Families Based on Informants Reports

Indigenous species documented from the study area were grouped in 13 classes of remedial practices (as stated by informants) (Table 4 and Fig.7). Key classes and informant's consensus for the practice of therapeutic plants against various ailments were elucidated through the ICF a computed index. The range of ICF (informant consensus factor) was 0-1. Digestive disorders (0.93) have the highest ICF and the least value of ICF was obtained for Skin problems (0.53). ICF (informant consensus factor) has been calculated for each disease group, ranging from 0.53 to 0.93. Results concern to the digestive disorder are similar to results documented for digestive disorders from Pakistan by Shah et al. (2015) (from Tor Ghar); Murad et al. (2013) (from district Karak); Ishtiaq et al. (2012) (from Leppa Valley Muzaffarabad) and Kayani et al. (2015) and from other parts of the world (Fakchich et al. 2014; Baydoun et al. 2015; Eddouks et al. 2016). The reason for the high value of ICF for digestive disorders might be that the people of rural areas use water from open streams and springs for their daily life needs without considering any hygienic protective measures (Ishtiaq et al. 2006a, 2007a, 2010b). It is revealed from the literature that ethno-medicinal studies conducted in the different areas documented the use of therapeutic plants for the cure of digestive disorders (Keyani et al. 2015). The results documented about the use of plants for digestive disorders in terms of high agreement of informants show that the digestive system diseases are more common than others in the study area. It was observed that for most of the disease categories high ICF value was obtained, which shows that there was a high level of homogeneity in consensus among the members of the community regarding the use of a specific medicinal species.

Table 4. ICF values of different diseases categories

Diseases Categories	**Nur**	**Nt**	**ICF**
Boils	18	3	0.62
Bones & Muscles Problems	21	9	0.60
Digestive Disorders	67	28	0.93
Endocrine and Liver Diseases	13	3	0.83
Eye disease	9	3	0.75
Fever, Typhoid & Malaria	26	7	0.76
Heart & Blood	19	7	0.66
Kidney & urinary problems	11	2	0.90
Mouth & Teeth Problems	7	2	0.83
Other diseases	29	8	0.75
Respiratory diseases	49	7	0.87
Skin problems	27	13	0.53
Insect bites	15	3	0.85

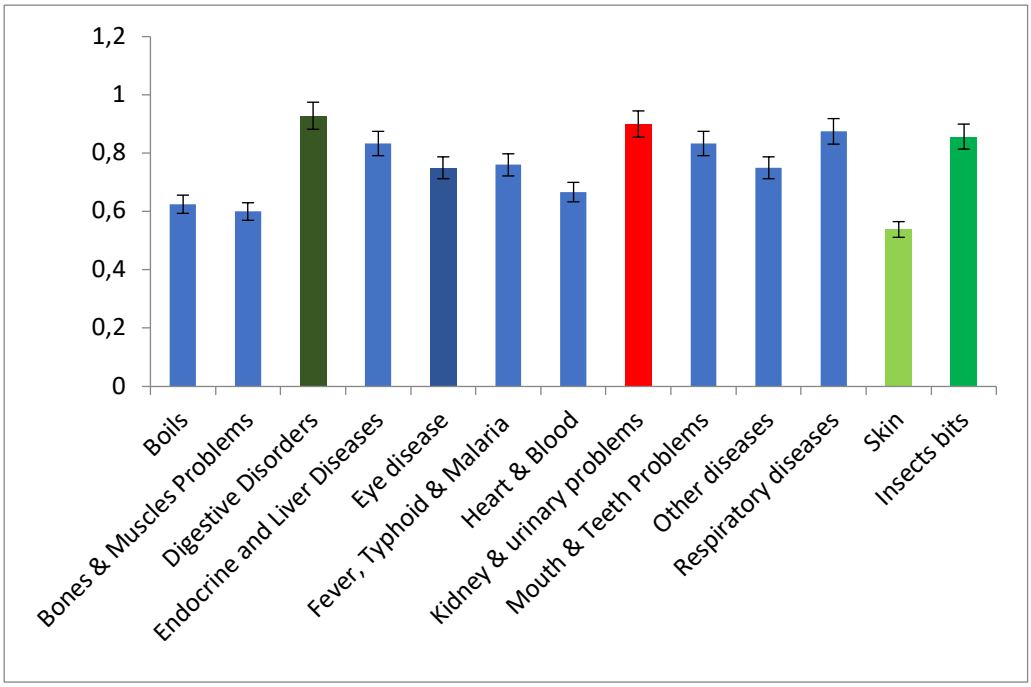

Figure 7. ICF for Diseases Categories based on Informant Reports

Conclusion

This study emphasizes the importance of ethnobotanical uses of highly important wild plants and the vanishing treasure of traditional knowledge associated with their use. In the present work 48 plant species belonging to 31 families were collected. The study found that the highest number of plant species were herbs followed by trees (21 sp.). The Rosaceae and Asteraceae were found as the leading families in the studied area. The medicinal plant species with the highest FI values are *Rumex hastatus* (*FI* = 0.456), followed by *Punica granatum* (0.432), *Sisymbrium irio* (0.424) and *Foeniculum vulgare* (0.392). The highest FIV was calculated for Asteraceae (66.4), followed by Fumariaceae (62.4). A minimum value of FIV was documented for Capparidaceae (8.8). Even though, advanced healthcare services are accessible in the study area; however, the native people still use indigenous folk plants-based medicines to cure various diseases. Numerous imperative therapeutic plants are close to endangerment because of misuse. The risks for the loss of folk medicinal plants' information from the study area are constantly existent due to decreased forest area and adaptation of the modern healthcare system of local people. It is the need of time to record/document the treasured conventional information about the medicinal plants of the study area. Based on the present study results, we suggest that a research project should be designed to develop awareness in the local community about the conservation of medicinal plants.

Declarations

Ethicas approval: and Consent to participate: This ethnomedicinal study was approved by the ethical committees of the Department of Botany, Islamia College Peshawar, Pakistan, and Biodiversity Action Plan (BAP-2010-2020) for Pakistan. Prior permission was sought from the Forest Department of the study area for the collection of plants and ethnomedicinal data in the area. All participants were asked for their Prior Informed Consent before interviews were conducted. All participants shown in images agreed to have their images published.

Funding: No funding body for this research work.

Availability of data and materials: The raw data without names of participants are available from the authors.

Author's contributions: SW and HAJ designed the study; SW and FR conducted the fieldwork, SMH, UY, and GA conducted the main statistical analysis and wrote the manuscript, HAJ, and RB revised the data analysis and the manuscript; all authors read, corrected, and approved the manuscript. All data was generated in-house, and no paper mill was used. All authors agree to be accountable for all aspects of work ensuring integrity and accuracy.

Conflict of interests: The authors declare that they have no competing interests, and it is certified that we have no commercial associations (e.g, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

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