Diversity of medicinal flora and traditional knowledge of Muzaffargarh District Punjab Province, Pakistan

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Research

Abstract

Background: Ethnomedicine is an important part of different cultures across the globe. It has a central role in providing new medicinal plants to phytochemical exploration and effective drug discoveries for centuries.

Methods: Ethnobotanical surveys were conducted to collect the ethnobotanical knowledge. We used a snowball technique for respondents sampling. Semi-structured interviews were for ethnobotanical data collection. Relative frequency citation (RFCs), fidelity level (FI), Use value (UV), and Informant consensus factor (ICF) were used to analyze the data.

Results: A total of 68 medicinal taxa belonging to 64 genera and 39 families. Fabaceae was the dominant family with (7 species,9.7%) followed by Moraceae (5 species, 6.9%) and Myrtaceae, and Cucurbitaceae with (4 species, 5.5%) each. In utilization trees (26) were dominant. Regarding part used leaves (23.61%) were frequently utilized. In Powder was ranked first in crude drug formulation using in (30 medications. In quantitative analysis, the maximum RFCs value was calculated for *Azadirachta indica* A.Juss. and *Phyla nodiflora* (L.) Greene. Highest FL100 was % totaled for *Capparis decidua* Edgew and *Triticum aestivum* L. Similarly, *Jasminum officinale* L. *and Leptadenia pyrotechnica* (Forssk.) Decne. Scored highest UV values. Maximum ICF was recorded for Dental and dermal disorders respectively.

Conclusion: The plant-based knowledge of the area is substantial but limited to aged people. Saturating allopathic drugs and rapidly changing life trends have strikingly declined the importance of ethnobotanical resources. Hence, the study urges for the revival and conservation of the ethnobotanical heritage at emergency basis.

Key words: medicinal plants, indigenous knowledge, arid lands, phytotherapy, ethnobotany

Background

There is a growing interest in exploring herbal remedies from plants and animals as a potential source of life-saving medicines. Medical ethnobotany in the modern world has provided excellent data on folk medicine and medicinal plants of different rural and urban regions (Casagrande *et al.* 2023). In various developed countries, with the growing demand for plant-based medicines, ethnobotany has provided a place to investigate plants with medicinal properties (Süntar 2020). The number of plant species utilized in traditional medicine worldwide ranges from 10,000 to 53,000 (McChesney *et al.* 2007), contributing to modern drugs' availability (Lahlou 2013). In developed countries, medicinal plants tested with ethnobotany have always been an important source of natural medicine for humans (Temitope & Felix 2012). In many parts of the modern world, ethnobotany has been applied in various inventive ways to develop herbal medicines. Pakistan is one of South Asia's floristically, ecologically, and ethnologically rich countries. It covers substantial coastal, desert, and mountain terrains.

A huge rural population (62.84 %) of different historical and socio-cultural backgrounds resides in these terrains such as Punjabi, Seraiki, Baluchi, Pashto, Brahvi, Sindhi, Balti, and Shina. Pakistan also has rich flora comprising more than 6000 plant species (Ali & Qaiser 1986, Ibrahim et al. 2019, Shinwari & Shinwari 2010). More than 15% are used for different ethnobotanical practices such as medicine, wild fruits, wild vegetables, dyes, and thatching. Significant but fragmented ethnobotanical literature has been reported from different parts of the country for instance (Abbas *et al.* 2016, 2017, 2021, 2022, Awan *et al.* 2021, Bibi *et al.* 2022, Ijaz *et al.* 2022, Majeed *et al.* 2021, Shaheen *et al.* 2023). In remote parts of Pakistan, knowledge of traditional medicine helps researchers to explore new medicinal plants with valuable medicinal properties. Ethnobotanical studies on medicinal plants have been carried out mostly across different parts of Northern Pakistan, i.e., Khyber Pakhtunkhwa, Gilgit Baltistan, Azad and Jammu Kashmir (Gillani *et al.* 2024, Manzoor *et al.* 2023, Mirzaman *et al.* 2023). The Punjab province has diverse sorts of climatic regions and has the potential to host a great diversity of plants (Jamil *et al.* 2022). More recently, in Punjab, the role of medicinal plants in traditional health services has diverted researchers' attention to ethnomedicines. Though considerable ethnobotanical literature has been found from the upper and central Punjab, the southern region has received very little attention ethnobotanically (Arshad *et al.* 2020, Jabbar *et al,* 2006, Shinwari & Qaiser 2011). The southern region is rich ethnically, ecologically and topographically. The local people use traditional medicine to cope with day-to-day illnesses (Kayani *et al.* 2024, Manzoor *et al.* 2023). In spite of this, areas of southern lowlands are still overlooked. Limited educational facilities, the absence of research centers, and no interest from natives may have been the possible reasons for unexplored medical ethnobotany. Most of the information is still in the hands of the traditional hakims and olden people and passed orally to the next generation. But traditional knowledge experiences several risks in the form of modern trends in every aspect of life. There was not any source to retain or safeguard this precious knowledge. On the other hand, ethnobotanical plants also bear unsustainable utilization, rampant urbanization, and a rapidly growing human population.

The current study had two objectives: 1) to assess the diversity of medicinal plants and 2) to analyze the status of traditional knowledge associated with the medicinal taxa.

Materials and Methods

Study area

Muzaffargarh District (30° 4' 0'' North, 71° 12' 0'' East) is located in the south between River Indus (west) and Chenab (east) at an altitude of 122 m above sea level and covers an area of 8249 Km square as shown in (Fig.1). It borders Multan in the east, Dera Ghazi Khan and Rajanpur in the west, Layyah in the north, and Bahawalpur in the south (Ahmad *et al.* 2020). Administratively, the district falls under the Dera Ghazi Khan Division. Muzaffargarh means “Castle of Muzaffar '' established in 1794 by the Governor of Multan Nawab Muzaffar Khan. It became the Muzaffargarh district's county headquarters in 1861 (Hafeez *et al.* 2020). Muzaffargarh hosts a limited number of urban and major rural populations. The population was 2,635,903 in the 1998 census and 4322009 in the 2017 census, with an increase of 1686106 (%) (Habib *et al.* 2014, Ahmad & Afzal 2020). Saraiki is the most spoken language in the region, further divided into two different accents: Balochi and Saraiki accents. Other ethnic groups include Gujjar, Baloch, Rajput and Pushtoons. Generally, the social livelihood principally depends on government jobs. They mostly work in civil and armed forces departments as well as related to different micro and mega businesses. Besides, a significant part of the local population is engaged in agriculture, animal husbandry, farming, etc. Mostly, women are typical village housewives who are busy with household activities. Due to lack of education many people work as laborers in different mills, shops, and agricultural fields. The human community is composed of peasants, farmers and agro-pastoralists. They still live simple village life with tough and laborious life routines.

Climate is generally dominated by hot and dry summers and mild winters. The maximum summer temperature ranges up to 54 °C (129 °F), and the winter minimum temperature ranges about 1°C (30 °F). The area receives scanty annual rainfall up to 127 millimeters (5.0 inches) in July. Smog and dust storms are very common in the region (Ijaz *et al.* 2020) Phytogeographically, the studied region lies in the Saharo Sindian region, and its floristic composition is not fully diverse. The studied region hosts a subtropical type of vegetation that prevails with the xerophytic nature of plants. Considerable riparian vegetation can also be observed along the Banks of the Rivers Chenab and Indus.

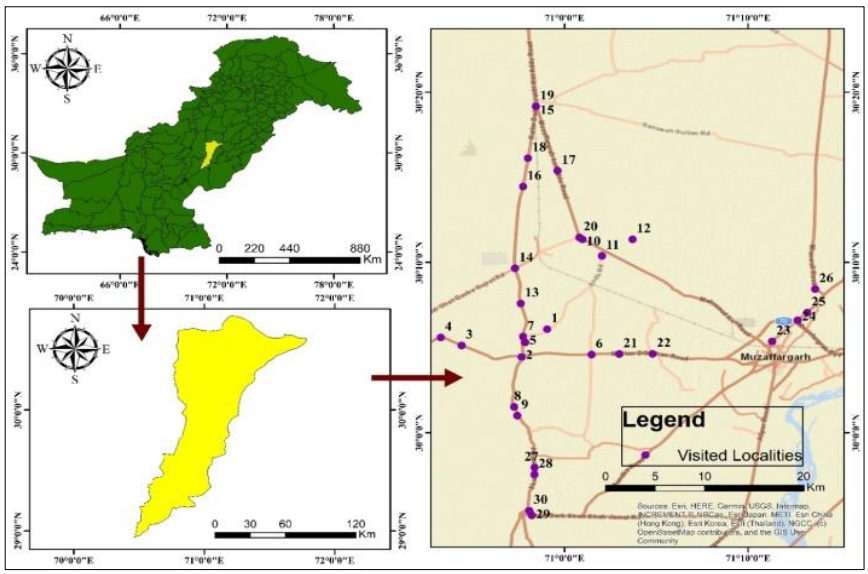

Figure 1. Map of the study area of visited localities.

Data collection

Ethnobotanical field surveys were carried out across different localities of Muzaffargarh from 2021-2022. Consecutive field trips were made in different localities to gather maximum data. Field visits, interview conduction, filling of questionnaires, plant collection, and pressing of plants were the various phases in the collection of ethnobotanical data; one of the visualizations is shown in Figure 2. The social and ecological profile of all visited localities, such as name, population, ethnic groups, language, altitude, longitude, latitude, and topography, were documented. The visited localities were Douna, Karam Dad Quershi, Pull nehr, Gazi ghat, Basti shadi khan, Chok Goder, Bisera, Noor kubra, Muzaffargarh city, Jesilvaan, Abas Wala , Khan pur biga shir, Basti Meer haji, Munir Abad, Shajmaal, Ali ki basti , Ajab Wala, Waan Wala, Chandrien, Shreef chajra, Kahji Wala, Turk Wala, Head kaloon, Qasba Gujrat, Mehmood Kot, Aara akber shah, Shelar ada, Basti Gurmani, Snawwan and Kot adu. Snowball techniques were adopted for the sampling of participants in the interview process. A total of one hundred sixty-eight (168) respondents were interviewed in the study area to collect ethnobotanical data. Verbal consent was interviews obtained from each interviewee before interviews were conducted. Semi-structured, in-depth and open-ended interviews were implemented (Martin 2010). Questionnaires were used as interview tools to communicate with the respondents.

Being a native of the study area, communication was made in Saraiki and Urdu languages for collection of Data during field work. The purpose and nature of the project were explained to everyone in simple language. The interview was taken in Urdu, Saraiki and Punjabi language, depending upon the participants' language and a image of interview conduction is given in (Fig.2). Men and women were given equal weightage to collect exact and authentic ethnobotanical data. All people were interviewed irrespective of gender, caste, social background, and livelihood. Mostly, interviews were taken at village gathering areas, schools, and bazaars. In the communication, the demographic of respondents and plant particulars were asked. Such as part used, drug formulation, mode of application, ailments treated and cultural uses of plants. They were also inquired to show a fresh or dry sample of the plant if available. All the samples offered and observed in the field were photographed. Then, a separate list of reported plant species was established by sorting questionnaires with their ethnic and cultural uses. The international society of ethnobiology (ISE) developed a code of ethics in 2006 which was strictly followed throughout research work. Verbal permission was also taken from authorities to visit the localities falling in the jurisdiction of the forest, wildlife, and agriculture departments. The reported ethnobotanical plants were collected from the site of the interview with the help of local guides. Newspaper or Blotting Paper, string, plastic bags, adhesive tape, plastic containers, measuring tape, GPS, and envelopes). Two to three plant samples were collected carefully without damaging the

intact fruits and seeds. The herbarium technique was described on plant pressing, plant drying, poisoning, mounting, identification, labeling, and deposition.

After the collection of plants, they were covered with absorbent paper and stored in a lime press. When time and transportation permit, the most common method is to compact each specimen as it is collected. Collected plants were dried in blotting papers under a field presser. After two-three-day, the blotting paper changed. The blotting papers were replaced by dried blotting papers, usually by placing them in the sun and using it again. It took about a week to complete the drying. Dried samples were carefully packaged. Dried samples were poisoned with mercuric chloride and absolute alcohol (2 g mercuric chloride and 100 g absolute alcohol) (Maden 2004). Poisoned samples were mounted on standard-size herbarium sheets. Specimens were mounted on standard-sized sheets of paper (29 X 43 cm) using masking tape and adhesive (Maden 2004). The preserved specimens were identified using the flora of Pakistan, the flora of China and other existing publications. The nomenclature of each taxon was checked. Finally, the identified and labeled specimens were deposited in the Herbarium, University of Education Dera Ghazi Khan Campus.

Figure 2. Interview conduction in the study area.

Data analysis

By organizing the field notebook and questionnaires, all information regarding locations, respondents, and plants that had been obtained was assembled. The information was compiled in an Excel Sheet (MS Office 2010). Ethnobotanical questionnaires were organized, and the acquired data were written in a notebook. The demographic information from the respondents was arranged, sorted, and compiled in an excel file. The data was entered on ethnobotanical questionnaires, which were subsequently incorporated into an excel sheet and kept in a field notebook. The entire data set was divided into various categories. There was a description of the number of plants, their names, families, and the number of herbs, shrubs, and trees. The name of the wild plant, how it is used and cultivated, and both were mentioned. The complete description of visited localities was given as in Table 1.

Table 1. Interview localities

Locality name	Locality code	Elevation (m)	Longitude (N)	Latitude (E)	No. of interviews
Douna	MZG01	124	70.98402	30.10158	10
Karam dad quershi	MZG02	118	70.96093	30.07428	8
Pull nehr	MZG03	120	70.90645	30.08558	4
Gazi ghat	MZG04	122	70.88744	30.09341	5
Basti shadi khan	MZG05	121	70.96415	30.08854	4
Chok goder	MZG06	123	71.0245	30.07662	6
Ajab Wala	MZG07	121	70.96222	30.09421	5
Waan Wala	MZG08	121	70.95408	30.02543	4
Chandrien	MZG09	122	70.95696	30.01687	5

Shreef chajra	MZG10	122	70.96872	30.99579	6
Kahji Wala	MZG11	124	71.03385	30.17328	3
Turk Wala	MZG12	122	71.06168	30.18953	3
Head kaloon	MZG13	124	70.96012	30.1267	4
Qasba Gujrat	MZG14	125	70.95487	30.16119	5
Mehmood Kot	MZG15	126	70.97388	30.31973	5
Aara akber shah	MZG16	126	70.9623	30.24122	5
Shelar ada	MZG17	125	70.9935	30.25668	5
Basti Gurmani	MZG18	124	70.9667	30.26899	5
Snawwan	MZG19	126	70.97388	30.31973	6
Kot adu	MZG20	127	70.01339	30.1913	6
Bisera	MZG21	120	71.04961	30.07725	7
Noor kubra	MZG22	121	71.0798	30.07734	6
Muzaffargarh	MZG23	121	71.1884	30.08958	7
Jesilvaan	MZG24	120	71.21162	30.1103	6
Abas Wala	MZG25	120	71.22036	30.11776	5
Khan pur biga shir	MZG26	123	71.22745	30.14075	5
Basti Meer haji	MZG27	119	70.97268	29.96602	7
Munir Abad	MZG28	116	70.97256	29.95919	7
Shajmaal	MZG29	115	70.97016	29.91931	8
Ali ki basti	MZG30	114	70.96787	29.92382	6

Note: *MZG (Muzaffargarh)

Quantitative indices

Data was further analyzed using ethnobotanical indices i.e., the emic classification, conversion of data into use reports (UR), use value (UV), Fidelity level (FL) and informant consensus factor (ICF).

Use report (UR)

It was one use–report every time a plant was mentioned as being employed for a specific purpose. If an informant used a plant for more than one purpose in the same category, it was still counted as a single use-report. When at least two informants reported the same plant for the same purpose, it was termed a multiple use-report (Bibi *et al.* 2014).

Use value (UV)

The use value was calculated to provide a quantifiable estimate of a species' relative relevance in a given area. The number of uses and the number of people who cite a plant determine its usage value. It's a term that's used to describe which species a population considers to be the most important (Phillips & Gentry, 1993; Phillips *et al.* 1994).

UV is determined using the formula below.

$$UV = (\Sigma Ui)/N$$

For a given species, Ui is the number of use-reports cited by each informant.

The total number of informants is denoted by the letter N.

Fidelity level (FL)

The data was analyzed using the Fidelity Level (FL) created by Friedman, Yaniv, Dafni, and Palewitch (Friedman, Yaniv, Dafni, Palewitch, 1986). The proportion of informants who indicated using a certain plant for a specific purpose. The total number of people who said they used the plant for any reason (regardless of the category) (Friedman *et al.* 1986).

FL was calculated using the following formula,

$$FL\ (\%) = (Ip/Iu)\ 100$$

Where *Ip* is the number of people who separately suggested that a plant be used for a specific purpose. *Iu* represents the total number of people who cited the plant for whatever reason. High FL values (around 100%) are obtained for plants for which practically all use-mentions pertain to the same purpose, indicating that the plants (and their usage for that reason) are most desired, whereas low FLs are obtained for plants utilized for a variety of purposes. The details of the participant`s background are given in Table 2 during the interview procedure.

Informant consensus factor (ICF)

The informant consensus factor (ICF) was used to assess the degree of agreement among the participants. This quantitative method is based on Trotter, Logan, and Etkin's (1986) famous study, which developed the Informant Agreement Ratio (IAR). The Informant Consensus Factor was coined to describe it (Trotter *et al.* 1986).

ICF is computed using the following formula:

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

The number of informant use reports in each category is referred to as Nur.

The number of taxa utilized for a given category is denoted by Nt.

When only one or a few plant species are reported to be used by a large proportion of informants for a given category, high ICF values (approaching 1.00) are found, Low ICF levels, on the other hand, imply that informants are split on which plant to employ.

Jaccard Index (JI)

All the documented plant taxa and their utilization were assessed by available literature using Jaccard Index (JI) (Fletcher & Islam 2018). The literature for comparative assessment was selected from different parts of Pakistan and its neighboring regions**.**

Results

Participants' background

A total of 168 respondents, including 115 men and 53 women, were questioned to gather information about various medicinal plants. The respondents were divided into seven groups based on their age: 30–40 years (38 people), 41–50 years (25 people), 51–60 years (27 people), 61–70 years (12 people), 71–80 years (8 people), 81–90 years (4 people), and 91–100 years (1 person). More indigenous knowledge is possessed by middle-aged individuals between the ages of 40 and 60 than by younger individuals. This could occur due to young people's lack of interest in conventional medicine and aging-related memory loss in the elderly. The majority of them work as farmers, company owners, laborers, housewives, and hakeem, as well as government and private employees. Urdu, Punjabi, Balochi, and Saraki languages made up the majority of the respondents. The comprehensive background details of the participants in the interview process are given in Table 2.

Table 2. Background of participants in the interview process.

Variables	Categories	Number of persons	Percentage
Sex Ratio	Women	53	31.54
	Men	115	68.45
Age Group	30-40	38	22.61
	41-50	25	14.88
	51-60	27	16.07
	61-70	12	7.14
	71-80	8	4.76
	81-90	4	2.38
	91-100	1	0.59
Education level	Illiterate	32	19.04
	Primary	25	14.88
	Middle	55	32.73
	SSC	22	13.09
	HSSC	9	5.35
	Graduation	19	11.3
	Master	6	3.57
Social livelihood	Farmer	32	19.04
	Businessman	42	25
	Hakim	5	2.97
	Housewives	42	25
	Labor	21	12.5
	Govt. Servant	26	15.47
Language	Balochi	3	1.78
	Punjabi	10	5.95
	Seraiki	104	61.9
	Urdu	51	30.35

Note: *SSC (Secondary School Certificate), ***HSSC** (Higer Secondary School Certificate), ***%** (Percentage).

Medicinal flora

A total of 68 ethnobotanical plants "from 64 genera and 39 families" were collected. Table 6 contains a list of all registered species, including their botanical name, local name, family name, habit, origin, locality, parts used, and formulation. The Fabaceae family has the greatest number of species, with a total of 7, followed by the Moraceae family, which has 5 species. Each of the families Myrtaceae, Poaceae, and Cucurbitaceae consists of four species. Figure 2 displays a total of 26 trees, 22 herbs, and 20 shrubs, representing their respective growth habits. The documented flora was gathered from eight distinct habitats, namely roadside, hilly regions, open agricultural land, home gardens, sand dunes, water bodies, wasteland, and weed-infested areas given as in Table 3.

Table 3. Habitats of the reported medicinal plants.

Habitat types	Number of species
Open agriculture land	36
Home garden	16
Roadside and hilly areas	5
Hilly areas	3
Sand dunes and roadside	2
Water bodies and wasteland	2
Hilly areas and wasteland	2
wasteland	2

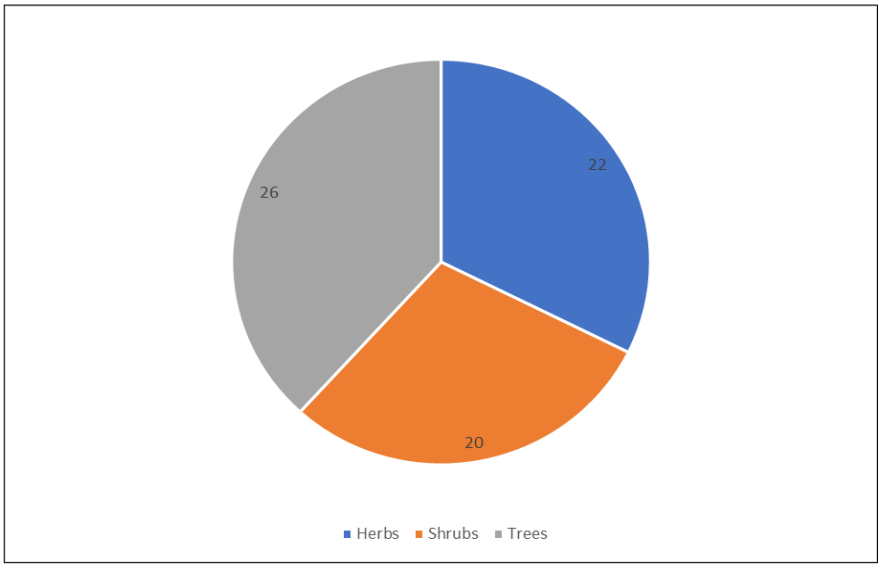

Figure 2. Habit of the ethnomedicinal plants.

Part(s) used, drug formulation and administration

Plant components and their numerous applications (for example, using more than one part of the plant as a medicine source) are determined by local community availability and indigenous knowledge. The plant parts used were divided into 12 groups depending on their types and numbers, including branches, bulbs, flowers, fruits, leaves, roots, seeds, bark, stems, and whole plants. Whereas, flowers, root and leaves i.e. *Calotropis procera* (Aiton) Dry and. (Apocynaceae), Bark, leaves and flowers i.e. *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) were three parts used categories. Leaves and fruit i.e. *Solanum nigrum* L. (Solanaceae), *Ficus carica L.* (Moraceae), *Psidium guajava* L. (Myrtaceae)*)*, Root and leaves i.e. *Salvadora oleoides* Decne. (Salvadoraceae), Seed and fruit i.e. *Syzygium cumini* (L.) Skeels (Myrtaceae), Leaves and seeds i.e *Ricinus communis* L. (Euphorbiaceae), *Melia azedarach* L. (Meliaceae), Fruit and bark i.e. *Morus alba* L. (Moraceae), *Punica granatum* L. (Lythraceae), *Ficus religiosa* L. (Moraceae), Stem and leaves i.e. *Bauhinia variegata* L. (Fabaceae), *Datura stramonium* L. (Solanaceae), Stem and branches i.e. *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) were two categories parts used. The rest of details about used categories based on used plants parts are given in Table 4.

The dominant used plant parts were leaves (17species), Fruit (7 species), Bark (4 species), seed (11 species), stem (4 species), flowers (2 species), root (2 species), bulb (2 species), whole plant (1species) as given in Table 5. In order to treat different ailments, the residents of the research region employ nine types of medicine formulations, as listed in (6). The Powder was dominant (14 medications) followed by eaten fresh and infusion (4 medications), powder and infusion (7 medications),

infusion and paste (3medications), eaten fresh and juice (3 medications), powder and eaten fresh (4 medications), powder and decoction (1 medication), paste and powder (2 medications), decoction and juice (1medication), juice and infusion (1 medication), infusion and ash (1medication), ash and eaten fresh (1 medication), ash and paste (1 medication), eaten dried and powder (1 medication), infusion (9 medications), eaten fresh (5 medications), paste (3 medications), juice (2 medications), decoction (3 medications), ash (1 medication) were shown in (Fig.3). The mode of applications was divided into three groups. Around 85.29% were taken orally, 4.41% were applied topically, and 10.29% were used as oral and topically.

Table 4. Used categories based on used parts.

Plant Name	**Used Categories**	**Used Parts**
Vachellia nilotica (L.) P.J.H.Hurter & Mabb.	3 parts used category	Bark, leaves & flowers
Calotropis procera (Aiton) Dryand.	3 parts used category	Flowers, roots & leaves
Syzygium cumini (L.) Skeels	2 parts used category	Seed & fruit
Solanum nigrum L.	2 parts used category	Leaves & fruit
Ricinus communis L.	2 parts used category	Leaves & seed
Punica granatum L.	2 parts used category	Fruit & bark
Salvadora oleoides Decne.	2 parts used category	Root & leaves
Leptadenia pyrotechnica (Forssk.)	2 parts used category	Stem & branches
Ziziphus jujuba Mill.	2 parts used category	Leaves & bark
Psidium guajava L.	2 parts used category	Fruit & leaves
Ficus religiosa L.	2 parts used category	Bark & fruit
Mangifera indica L.	2 parts used category	Seed & fruit
Morus alba L.	2 parts used category	Fruit & bark
Bauhinia variegata L.	2 parts used category	Stem & leaves
Datura stramonium L.	2 parts used category	Stem & leaves
Melia azedarach L.	2 parts used category	Seed & leaves
Ficus carica L.	2 parts used category	Leaves & fruit
Zygophyllum paulayanum (J.Wagner & Vierh.) Christenh. & Byng	2 parts used category	Stem & leaves
Phoenix dactylifera L.	1 part used category	Fruit
Azadirachta indica A.Juss.	1 part used category	Leaves
Eucalyptus camaldulensis Dehnh.	1 part used category	Leaves
Moringa oleifera Lam.	1 part used category	Leaves
Saccharum officinarum L.	1 part used category	Stem
Mentha spicata L.	1 part used category	Leaves
Aloe vera (L.) Burm.f.	1 part used category	Bark
Rosa chinensis Jacq.	1 part used category	Flowers
Daucus carota L.	1 part used category	Root
Cucurbita pepo L.	1 part used category	Seed
Zygophyllum creticum (L.) Christenh. & Byng	1 part used category	Stem
Dalbergia sissoo Roxb. ex DC.	1 part used category	Leaves
Tribulus terrestris L.	1 part used category	Stem
Momordica charantia L.	1 part used category	Leaves
Foeniculum vulgare Mill.	1 part used category	Seed
Citrullus colocynthis (L.) Schrad.	1 part used category	Fruit
Ocimum basilicum L.	1 part used category	Leaves
Tamarix aphylla (L.) H. Karst.	1 part used category	Leaves
Cassia fistula L.	1 part used category	Seed
Cichorium intybus L.	1 part used category	Leaves
Ficus benghalensis L.	1 part used category	Leaves
Vitis vinifera L.	1 part used category	Fruit
Hordeum vulgare L.	1 part used category	Seed
Allium cepa L.	1 part used category	Bulb
Gossypium herbaceum L.	1 part used category	Seed
Cenchrus americanus (L.) Morrone	1 part used category	Seed
Citrus limon (L.) Osbeck	1 part used category	Fruit
Sesamum indicum L.	1 part used category	Seed
Brassica rapa L.	1 part used category	Root
Raphanus raphanistrum subsp. *sativus* (L.) Domin	1 part used category	Root
Cassytha filiformis L.	1 part used category	Root

Fumaria parviflora Lam.	1 part used category	Leaves
Alhagi maurorum Medik.	1 part used category	Stem
Albizia lebbeck (L.) Benth.	1 part used category	Bark
Bombax ceiba L.	1 part used category	Bark
Cordia myxa L.	1 part used category	Leaves
Chenopodium album L.	1 part used category	Leaves
Triticum aestivum L.	1 part used category	Seed
Citrus aurantium L.	1 part used category	Fruit
Cucumis melo L.	1 part used category	Fruit
Allium sativum L.	1 part used category	Bulb
Convolvulus arvensis L.	1 part used category	Root
Grewia asiatica L.	1 part used category	Fruit
Sesbania grandiflora sensu Miq.	1 part used category	Seed
Jasminum officinale L.	1 part used category	Flowers
Neltuma glandulosa (Torr.) Britton & Rose	1 part used category	Bark
Melaleuca citrina (Curtis) Dum.Cours.	1 part used category	Seed
Morus nigra L.	1 part used category	Seed
Phyla nodiflora (L.) Greene	1 part used category	Leaves
Salsola imbricata Forssk.	1 part used category	Leaves

Table 5. Comparative plant part utilization.

Part(s) used	Number of species	%
Leaves	17	25.00
Seeds	11	16.18
Fruit	7	10.29
Bark	4	5.88
Stem	4	5.88
Bark, leaves & flowers	3	4.41
Leaves & fruits	3	4.41
Fruits & bark	3	4.41
Leaves and seeds	2	2.94
Stem & leaves	2	2.94
Stem and branches	2	2.94
Flowers	2	2.94
Root	2	2.94
Bulb	2	2.94
Fruit, flowers & leaves	1	1.47
Root & leaves	1	1.47
Seeds & fruits	1	1.47
Whole plant	1	1.47

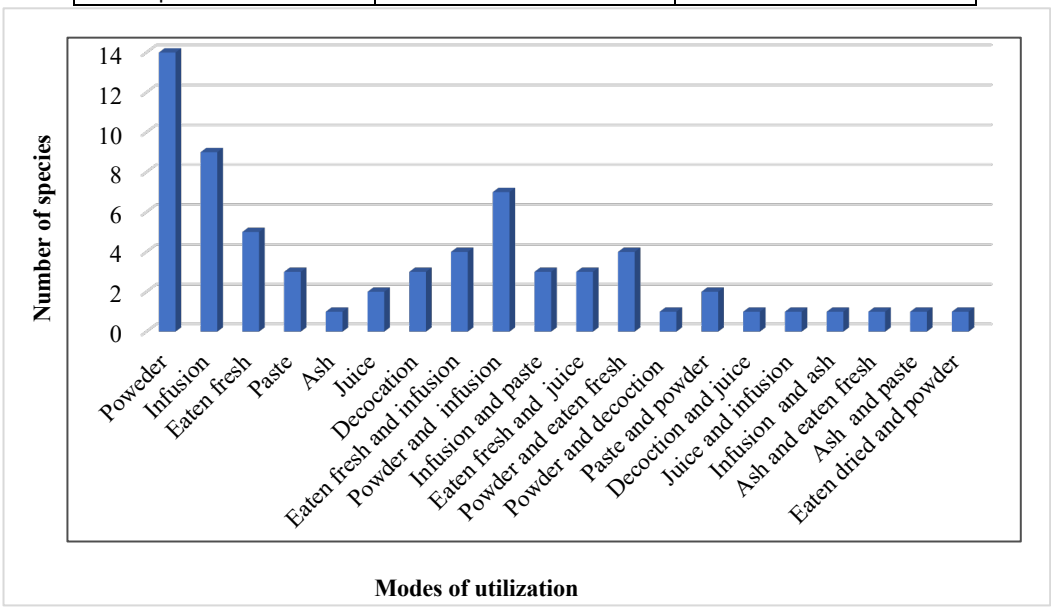

Figure 3. Different modes of drug formulation.

Treated diseases and herbal therapies

Residents of the Muzaffargarh district utilize medicinal plant species to cure a variety of ailments. By using the emic classification method, these ailments were divided into 205 categories, including (12 species) abdominal disorders, (5 species) respiratory disorders, (3 species) dermal problems, (11 species) miscellaneous including cold, cough, fever, and vomiting, (2 species) urinary tract disorders, (5 species) cardiovascular disorders, (6 species). Bone and joint problems, (8 species) hepatic disorders, (2 species) tooth problems, (6 species) diabetes, (3 species) gastrointestinal-intestinal disorders, (3 species) optical disorders, (2 species) brain disorders, (1 species) tonics. Digestive disorders (i.e., constipation, dyspepsia, upset stomach, dysentery, stomach acid and ulcers), skin diseases (pimples, pustules, ringworms), respiratory diseases (bronchitis), asthma, pneumonia) osteoarthritis (back pain, osteoarthritis). Gastrointestinal (GI) disorders can be caused by household hygiene conditions and eating habits. In addition, regular consumption of tea, red paper and low-fiber foods can be the cause of gastrointestinal infections. Osteoarthritis can be related to difficult terrain and a hard-working lifestyle. Osteoporosis can be associated with a difficult environment and a demanding lifestyle. Flowers, roots and leaves of *Calotropis procera* (Aiton) Dryand. (Apocynaceae) has therapeutic importance to treat wounds, worms, hemorrhoids, blood, paralysis, leukorrhea and joint pain diseases. Bark, leaves and flower of *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) are used to treat allergies, cough, vomiting, old fever, typhoid, leukorrhea, and jaryan diseases. Leaves of *Moringa oleifera* Lam. (Moringaceae) are used to treat Joints pain, blood pressure, stomach, liver, back pain, sugar, and flu diseases. Leaves and bark *Ziziphus jujuba* Mill. (Rhamnaceae) are used to treat Cough, asthma, old fever, jaundice, liver metabolism and stomach ulcer and details of all treated diseases and therapies given in Table 6. The rest of medicinal plants are respectively, as seeds of *Sesamum indicum* L. (Pedaliaceae) has treat for Cardiac muscle, stomach, leaves of herb *Fumaria parviflora* Lam. (Papaveraceae) used to treat Stomach heat, allergies, and blood purification, *Solanum nigrum* L. (Solanaceae) has the potential to treat liver worm, andhepatitis A, B, C, D diseases, seed and fruits of *Syzygium cumini* (L.) Skeels (Myrtaceae) are used to treat sugar, liver, diarrhea, heart diseases, branches of *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) are used to treatment of flu disease, seeds of *Melaleuca citrina* (Curtis) Dum.Cours. (Myrtaceae) are used for the treatment of asthma, fruits of *Phoenix dactylifera* L. (Arecaceae) are used to treat eye, heart, brain, liver, blood, energy providing, and joints pain diseases, leaves of *Azadirachta indica* A.Juss. (Meliaceae) are used to treat many diseases Wound, allergy, sugar, and blood purification, leaves of *Eucalyptus camaldulensis* Dehnh. (Myrtaceae) are used to treat different diseases of flu, cough, and joint pain, leaves of *Moringa oleifera* Lam. (Moringaceae) are used to treat different diseases of Joints pain, blood pressure, stomach, liver, back pain, sugar and flu, juice and eaten fresh of *Saccharum officinarum* L. (Poaceae) are used to treat different diseases of jaundice, and liver, leaves of *Mentha spicata* L. (Lamiaceae) are used to treat diseases of vomiting, diarrhea, and stomach, leaves and seeds of *Ricinus communis* L. (Euphorbiaceae) are used for the treatment of wounds, constipation, family planning, and gas, bark and fruits of *Punica granatum* L. (Lythraceae) are used to treat T.B, cough, asthma, and liver diseases, stem and bark of *Aloe vera* (L.) Burm.f. (Asphodelaceae) are used for stomach digestion, asthma, cough, kidney stone, and liver diseases, flowers of *Rosa chinensis* Jacq. (Rosaceae) are used for the treatment of heart, liver, and abdominal diseases, root and leaves of *Salvadora oleoides* Decne. (Salvadoraceae) are used for the treatment of diseases like teeth, and abdominal pain, roots of *Daucus carota* L. (Apiaceae) are used to treat different diseases of the liver, eye, and heart, stem and branches of *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) are used to treatment of flu, seeds of *Cucurbita pepo* L. (Cucurbitaceae) are used to treatment of stomach, heart, abdomen pain, and brain diseases, stem of *Zygophyllum creticum* (L.) Christenh. & Byng (Zygophyllaceae) is used for different diseases of allergy, fever, blood cleaning, stomach, kidney stone, and asthma, leaves of *Dalbergia sissoo* Roxb. ex DC. (Fabaceae) are used for treating blood cleaning, cholesterol levels, and allergy, stem of *Tribulus terrestris* L. (Zygophyllaceae) is used for the treatment of different diseases leukorrhea, jaryan, kidney stone, and urethral stone, leaves of *Momordica charantia* L. (Cucurbitaceae) are used for the treatment of jaundice, and liver diseases, seeds of *Foeniculum vulgare* Mill. (Apiaceae) are used for the treatment of stomach, abdomen digestion andconstipation, fruits of *Citrullus colocynthis* (L.) Schrad. (Cucurbitaceae) are used for the treatment of stomach pain, hemorrhoids, jaundice, and joints pain, leaves and seeds of *Ocimum basilicum* L. (Lamiaceae) are used for the treatment of heart, stomach, constipation, old fever diseases, leaves of *Tamarix aphylla* (L.) H. Karst. (Tamaricaceae) are used for the the treatment of hemorrhoids, constipation, skin disease, and wound, seeds of *Melaleuca citrina* (Curtis) Dum.Cours. (Myrtaceae) are used for the treatment of asthma and shoots of *Capparis decidua* are used to treat toothache. Examples of some common medicinal plants reported from localities are given in (Fig.4). The complete account of ethnobotanical flora of Muzaffargarh District, Punjab Pakistan is represented in Table 6.

Quantitative data analysis

The homogeneity of traditional knowledge of medicinal plants used by the local inhabitants of the Muzaffargarh district was assessed using quantitative indices such as frequency of citation (RFCS) fidelity level (FI), Use value and Informant consensus factor (ICF). The reported species' relative frequency of citations (RFCs) ranged from 0.17 to 0.005. The highest value of frequency of citation was for *Azadirachta indica* A.Juss. (Meliaceae) (0.17) followed by *Eucalyptus camaldulensis* Dehnh.

(Myrtaceae) (0.16), *Phoenix dactylifera* L. (Arecaceae) (0.14), *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) (0.13), and *Moringa oleifera* Lam. (Moringaceae) (0.10), The lowest value of frequency of citation was recorded for *Salsola imbricata* Forssk. (Amaranthaceae), *Capparis decidua*, *Neltuma glandulosa* (Torr.) Britton & Rose (Fabaceae), *Phyla nodiflora* (L.) Greene. (Verbenaceae) (0.005). The fidelity level indicates the most frequently mentioned species by locals to treat a given illness (FI). The reported species' fidelity levels ranged from 100 percent to 20%. Twenty-eight species of fidelity level is 100 % for example *Capparis decidua, Triticum aestivum* L. (Poaceae), *Momordica charantia* L. (Cucurbitaceae), *Allium cepa* L. (Amaryllidaceae), *Phyla nodiflora* (L.) Greene. (Verbenaceae), *Neltuma glandulosa* (Torr.) Britton & Rose (Fabaceae), *Grewia asiatica* L. (Malvaceae). *Dalbergia sissoo* Roxb. ex DC. (Fabaceae) with 57% while *Melaleuca citrina* (Curtis) Dum.Cours. (Myrtaceae) and *Jasminum officinale* L. (Oleaceae) with 50%. Whereas lowest fidelity level was calculated for *Azadirachta indica* A.Juss. (Meliaceae) 20%. The availability, distribution, and extensive information on the therapeutic applications, dosages, and recipes of these species can be linked to their high level of fidelity Use value of the mentioned species ranged between 1.5 to 0.090. The highest use value 1.5 were recorded of *Jasminum officinale* L. (Oleaceae) followed by *Salsola imbricata* Forssk. (Amaranthaceae), *Datura stramonium* L. (Solanaceae) 1.33, *Chenopodium album* L. (Amaranthaceae), *Neltuma glandulosa* (Torr.) Britton & Rose (Fabaceae), *Morus nigra* L. (Moraceae)1, *Zygophyllum creticum* (L.) Christenh. & Byng (Zygophyllaceae) 0.85, *Phoenix dactylifera* L. (Arecaceae), *Ricinus communis* L. (Euphorbiaceae) 0.28. The lowest use value of *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) 0.090. Twelve major illness categories were reported in the current investigation. According to ICF data the species' informative consensus factor (ICF) is said to range from 1 to 0.285. Dental disorders and body energize infectious problems received the highest ICF scores (1), followed by sexual diseases (0.666) and gastrointestinal (GIT) disorders 0.486. Muscle and skeletal dysfunction had the lowest ICF score 0.285 are given in Table 7.

Figure 4. Common medicinal plants a) *Ficus carica L.* (Moraceae) b) *Syzygium cumini* (L.) Skeels (Myrtaceae) c) *Cordia myxa* L. (Boraginaceae) d) *Ficus religiosa* L. (Moraceae) e) *Ocimum basilicum* L. (Lamiaceae) f) *Ricinus communis* L. (Euphorbiaceae)

Table 6. Ethnobotanical flora of Muzaffargarh District, Punjab Pakistan

Botanical name/Family/Voucher number	RFCs	FL	UV	Local name	Habit/Source	Habitat	Part(s) used	Ethnobotanical use(s)	Treated Body system (s)	Drug formulation	MoA
Phoenix dactylifera L./Arecaceae/**MG-01**	0.1488	80	0.28	**Khajoor**	Tr/Cult.	Open agricultural land	Fruit	Eye infection, heart, brain, liver, blood, energy providing, joints pain	VS, CS, NS, BCS, CS	Eaten fresh, infusion	Oral
Azadirachta indica A.Juss. / Meliaceae/**MG-02**	0.1786	20	0.133	**Neem**	Tr /Cult.	Open agricultural land, home gardening	Leaves	Wound, allergy, sugar, blood cleaning	DS, DS	Powder, infusion	Oral, topical
Eucalyptus camaldulensis Dehnh./ Myrtaceae/**MG-03**	0.1667	86	0.107	**Sufaida**	Tr /Cult.	Open agricultural land	Leaves	Flu, cough, joint pain	RP, SS	Infusion, paste	Oral
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. /Fabaceae/**MG-04**	0.1369	74	0.304	**Kikker**	Tr /Wild	Roadside, hilly areas	Bark, leaves, flowers	Allergy, cough, vomiting, old fever, typhoid, leukorrhea, jaryan	DS, RP, IS	Powder, infusion	Topical, oral
Moringa oleifera Lam. /Moringaceae/**MG-05**	0.1071	89	0.333	**Swanjna**	Tr /Cult.	Open agricultural land, home gardening	Leaves	Joints pain, blood pressure, stomach, liver, back pain, sugar, flu	SS, BCS, DS, HP, SS	Powder, infusion	Oral
Saccharum officinarum L./ Poaceae/**MG-06**	0.0952	87.5	0.125	**Ganna**	Sh /Cult.	Open agricultural land	Stem	Jaundice, liver,	HP	Eaten fresh, juice	Oral
Mentha spicata L. / Lamiaceae/**MG-07**	0.0893	87	0.2	**Pudina**	He/ Wild/cult.	Open agricultural land	Leaves	Vomiting, diarrhea, stomach	DS, DS	Infusion, powder	Oral
Syzygium cumini (L.) Skeels /Myrtaceae/**MG-08**	0.1012	82.4	0.235	**Jamman**	Tr /Cult.	Open agricultural land, home gardening	Seed, fruit	Sugar, liver, diarrhea, heart	HP, ES, CS	Powder, eaten fresh	Oral
Solanum nigrum L. /Solanaceae/**MG-09**	0.0357	67	0.833	**Makaoo**	Sh /Wild	Open agricultural land	Leaves, fruit	Liver worm, hepatitis A, B, C, D	HP	Powder, eaten fresh	Oral

Ricinus communis L. /Euphorbiaceae/**MG-10**	0.0833	79	0.285	**Arand/Hirnoli**	Tr /Cult.	Open agricultural land, home gardening	Leaves, seed	Wound, constipation, family planning, gas	DS, DS, RP, DS	Powder, decoction	Topical, oral
Calotropis procera (Aiton) Dryand. /Apocynaceae/**MG-11**	0.0952	81.3	0.437	**Aak**	Sh /Wild	Sand dunes, roadside	Flowers, roots, leaves	Wound, worm, hemorrhoids, blood, paralysis, leukorrhea, joints pain	DS, DS, CS, MS, SS	Paste, powder	Topical, oral
Punica granatum L. /Lythraceae/**MG-12**	0.0714	100	0.416	**Anar**	Sh /Cult.	Homegardens, open agricultural land	Fruit, bark	T.B, liver, cough, asthma, liver	RP, HP, RP, RP, HP	Eaten fresh, powder	Oral
Aloe vera (L.) Burm.f. /Asphodelaceae/**MG-13**	0.0714	75	0.416	**Kanwar boti/gandal**	Sh/ Wild/cult.	Water bodies, homegardens	Bark	Stomach digestion, asthma, cough, kidney stone, liver	DS, RP, RP, ES, HP	Paste, powder	Oral
Rosa chinensis Jacq. /Rosaceae/**MG-14**	0.0655	82	0.272	**Gulab**	Sh /Cult.	Homegardens, open agricultural land	Flowers	Heart, liver, abdomen	CS, HP, DP	Decoction	Oral
Salvadora oleoides Decne. /Salvadoraceae/**MG-15**	0.0774	77	0.153	**Jal-tree**	Tr /Wild	Hilly areas	Root, leaves	Teeth, abdomen pain	DS, DS, DS	Paste, infusion	Topical, oral
Daucus carota L. / Apiaceae/**MG-16**	0.0655	91	0.272	**Gajer**	He /Cult.	Open agricultural land	Root	Liver, eyes, heart	HP, VS, CS	Eaten fresh, juice	Oral
Leptadenia pyrotechnica (Forssk.) Decne. /Apolynaceae/**MG-17**	0.0655	82	0.909	**Khip**	Sh /Wild	Hilly areas	Stem, branches	Flu	SS, RP	Paste	Topical
Cucurbita pepo L./ Cucurbitaceae/**MG-18**	0.0595	100	0.4	**Kadoo**	He /Cult.	Open agricultural land	Seed	Stomach, heart, abdomen pain, brain	DS, CS, DS, NS	Powder	Oral
Zygophyllum creticum (L.) Christenh. & Byng /Zygophyllaceae/**MG-19**	0.0417	71.4	0.857	**Dhamasa**	He /Wild	Roadside, hilly areas	Stem	Allergy, fever, blood cleaning, stomach, kidney stone, asthma	DS, IS, DS, ES, RP	Powder, infusion	Oral
Dalbergia sissoo Roxb. ex DC. /Fabaceae/**MG-20**	0.0417	57	0.428	**Shisham**	Tr /Cult.	Among agricultural land	Leaves	Blood cleaning, cholesterol levels, allergy	BCS, BCS, DS	Decoction, juice	Oral
Tribulus terrestris L. /Zygophyllaceae/**MG-21**	0.0476	87.5	0.5	**Gokhroo /bakhra**	He /Wild	Hilly areas, waste land	Stem	Leukorrhea, jaryan, kidney	RP, RP, ES, ES	Paste	Oral

								stone, urethral stone			
Ziziphus jujuba Mill. /Rhamnaceae/**MG-22**	0.0536	66.7	0.666	**Baer**	Tr / Wild/cult.	Homegardens, open agricultural land	Leaves, bark	Cough, asthma, old fever, jaundice, liver metabolism, stomach ulcer	RP, IS, DS, HP, DS	Powder, infusion	Oral
Momordica charantia L. /Cucurbitaceae/**MG-23**	0.0595	100	0.2	**Karela**	He /Cult.	Open agricultural land	Leaves	Jaundice, liver	HP, HP	Juice, infusion	Oral
Foeniculum vulgare Mill. /Apiaceae/**MG-24**	0.0476	87.5	0.375	**Soanp**	Sh /Cult.	Open agricultural land	Seed	Stomach, abdomen digestion, constipation	DS, DS, DS	Eaten fresh, infusion	Oral
Citrullus colocynthis (L.) Schrad. /Cucurbitaceae/**MG-25**	0.0536	100	0.333	**Bormba**	He /Wild	Hilly areas	Fruit	Stomach pain, haemorrhoids, jaundice, joints pain	DS, DS, HP	Powder	Oral
Ocimum basilicum L. /Lamiaceae/**MG-26**	0.0595	80	0.3	**Babri**	Sh /Cult.	Open agricultural land, homegardenig	Leaves	Stomach heat, intestine pain, liver	DS, DS, HP	Infusion	Oral
Psidium guajava L. /Myrtaceae/**MG-27**	0.0476	100	0.5	**Amrood**	Sh /Cult.	Open agricultural land, homegardens	Fruit, leaves	Heart, stomach, constipation, old fever	CS, DS, DS, IS	Eaten fresh, powder	Oral
Tamarix aphylla (L.) H. Karst. /Tamaricaceae/**MG-28**	0.0536	78	0.444	**Thola**	Tr /Wild	Roadside, hilly areas	Leaves	Haemorrhoids, constipation, skin, wound	DS, DS, DS, DS	Infusion, ash	Oral, topical
Cassia fistula L. /Fabaceae/**MG-29**	0.0357	100	0.5	**Amaltas**	Tr/ Wild/cult.	Open agricultural land	Seed	Cough, asthma, abdomen	RP, RP, DS	Infusion	Oral
Cichorium intybus L. /Asteraceae/**MG-30**	0.0417	86	0.428	**Kassni**	He /Wild	Open agricultural land	Leaves	Liver worm, old fever, jaundice	HP, IS, HP	Infusion	Oral
Ficus religiosa L. /Moraceae/**MG-31**	0.0476	75	0.375	**Peepal tree**	Tr/ Cult.	Homegardens	Bark, fruit	Vomiting, sugar, wound	DS, BCS, DS	Ash, eaten fresh	Oral
Mangifera indica L. /Anacardiaceae/**MG-32**	0.0536	78	0.555	**Aam**	Tr /Cult.	Open agricultural land	Seed, fruit	Stomach, kidney, constipation, liver, haemorrhoids	DS, ES, DS, HP DS	Powder	Oral
Ficus benghalensis L. /Moraceae/**MG-33**	0.0476	75	0.25	**Bohar**	Tr /Wild	Water bodies, waste land	Leaves	Wound, jaryan	DS, RP	Ash, paste	Topical

Vitis vinifera L. /Vitaceae/**MG-34**	0.0357	100	0.5	**Angoor**	He /Cult.	Open agricultural land, homegardens	Fruit	Eye, heart, stomach	VS, CS, DS	Eaten fresh	Oral
Hordeum vulgare L. /Poaceae/**MG-35**	0.0417	71.4	0.142	**Jau**	He /Wild	Open agricultural land	Seed	Stomach heat, kidney, urethra stone	DS	Juice	Oral
Allium cepa L. /Amaryllidaceae/**MG-36**	0.0238	100	0.5	**Piaz/vassel**	He /Cult.	Open agricultural land	Bulb	Stomach, eye	DS, VS	Paste, infusion	Oral
Gossypium herbaceum L. /Malvaceae/**MG-37**	0.0298	60	0.6	**Kapas**	Sh /Cult.	Open agricultural land	Seed	Brain disorder, cough, asthma	NS, RP, RP	Decoction	Oral
Cenchrus americanus (L.) Morrone /Poaceae/**MG-38**	0.0357	100	0.333	**Bajraa**	Sh /Cult.	Open agricultural land	Seed	Constipation, stomach	DS, DS	Powder	Oral
Citrus limon (L.) Osbeck /Rutaceae/MG-39	0.0298	60	0.6	**Lemon**	Sh /Cult.	Homegardens, open agricultural land	Fruit	Stomach, liver, blood pressure	DS, HP, BCS	Juice	Oral
Sesamum indicum L. /Pedaliaceae/MG-40	0.0298	80	0.4	**Til**	/Sh Cult.	Open agricultural land	Seed	Cardiac muscle, stomach	CS, DS	Eaten dried, powder	Oral
Morus alba L. /Moraceae/MG-41	0.0417	71.4	0.428	**Shehtoot**	Tr /Cult.	Open agricultural land	Fruit, bark	Stomach ulcer, stomach heat, blood	DS, DS, BCS	Eaten fresh, infusion	Oral
Bauhinia variegata L. /Fabaceae/MG-42	0.0238	100	0.25	**Kachnar**	Tr /Cult.	Open agricultural land	Stem, leaves	Stomach liver	DS	Infusion	Oral
Brassica rapa L. /Brassicaceae/MG-43	0.0238	100	0.5	**Shaljum**	He /Cult.	Open agricultural land	Root	Stomach, abdomen	DS, DS	Eaten fresh	Oral
Raphanus raphanistrum subsp. *sativus* (L.) Domin /Brassicaceae/MG-44	0.0298	100	0.4	**Mooli**	He /Cult.	Open agricultural land	Root	Kidney stone, jaundice	ES, HP	Eaten fresh	Oral
Cassytha filiformis L. /Lauraceae**/MG-45**	0.0298	80	0.4	**Akass Bail**	He /Wild	Open agricultural land	Root	Worm, blood	DS, BCS	Powder	Oral
Fumaria parviflora Lam. /Papaveraceae/**MG-46**	0.0238	75	0.75	**Shahtra**	He /Wild	Open agricultural land	Leaves	Stomach heat, allergy, blood cleaning	DS, DS, BCS	Powder	Oral
Alhagi maurorum Medik. /Fabaceae/**MG-47**	0.0357	67	0.5	**Javansa /Kenda**	He /Wild	Roadside, hilly areas	Stem	Kidney stone, blood cleaning, haemorrhoids	ES, BCS, DS	Infusion	Oral
Datura stramonium L. /Solanaceae/**MG-48**	0.0179	67	1.333	**Datura**	Sh /Wild	Open agricultural land, waste land	Stem, leaves	Joints pain, asthma, cough, flu	ES, CS, DS	Powder	Oral
Albizia lebbeck (L.) Benth. /Fabaceae/**MG-49**	0.0238	75	0.25	**Serus/sharin**	Tr /Cult.	Open agricultural land	Bark	Wound	DS	Ash	Topical

Bombax ceiba L. /Malvaceae/**MG-50**	0.0238	75	0.5	**Sumbal**	Tr /Wild	Open agricultural land	Bark	Wound, asthma	DS, RP	Powder	Oral
Cordia myxa L. /Boraginaceae/**MG-51**	0.0238	75	0.5	**Lasura tree**	Tr /Cult.	Open agricultural land	Leaves	Heart, liver	CS, HP	Eaten fresh infusion	Oral
Melia azedarach L. /Meliaceae/**MG-52**	0.0298	100	0.6	**Baqain**	Tr /Cult.	Open agricultural land, homegardens	Seed, leaves	Haemorrhoids, sugar, constipation	DS, HP, DS	Powder	Oral
Chenopodium album L. /Amaranthaceae/**MG-53**	0.0238	75	1	**Bathoo**	He /Wild	Open agricultural land	Leaves	Abdomen pain, stomach, asthma, fever	DS, DS, RP, RP	Infusion	Oral
Triticum aestivum L. /Poaceae/**MG-54**	0.0179	100	0.666	**Ghandum**	Sh /Cult.	Open agricultural land	Seed	Stomach heat, haemorrhoids	DS, DS	Powder, juice	Oral
Citrus aurantium L. /Rutaceae/**MG-55**	0.0179	100	0.666	**Orange**	Sh /Cult.	Open agricultural land	Fruit	Liver, kidney stone	HP, ES	Eaten fresh	Oral
Cucumis melo L. /Cucurbitaceae/**MG-56**	0.0179	100	0.666	**Kherboza**	He /Cult.	Open agricultural land	Fruit	Jaundice, kidney stone	HP, ES	Eaten fresh	Oral
Allium sativum L. /Amaryllidaceae/**MG-57**	0.0179	100	0.666	**Lehsan**	He /Cult.	Open agricultural land	Bulb	Stomach pain, liver	DS, HP	Infusion	Oral
Convolvulus arvensis L. /Convolvulaceae/**MG-58**	0.0238	100	0.5	**Hiran khuri**	He /Wild	Open agricultural land	Root	Blood cleaning, allergy	BCS, DS	Infusion	Oral
Ficus carica L. /Moraceae/**MG-59**	0.0238	100	0.5	**Anjeer**	Tr /Cult.	Homegardens, open agricultural land	Leaves, fruit	Wound, heart	DS, CS	Powder	Oral, topical
Grewia asiatica L. /Malvaceae/**MG-60**	0.0119	100	0.5	**Phalsa or Falsa**	Tr /Cult.	Open agricultural land, homegardens	Fruit	Liver	HP	Eaten fresh, juice	Oral
Sesbania grandiflora sensu Miq. /Fabaceae/**MG-61**	0.0179	100	0.333	**Turi**	He /Cult.	Open agricultural land	Seed	Stomach	DS	Infusion	Oral
Jasminum officinale L. /Oleaceae/**MG-62**	0.0119	50	1.5	**Chumayli**	Sh /Cult.	Homegardens, open agricultural land	Flowers	Brain disorder**, e**ye, heart	NS, VS, CS	Decoction	Oral
Neltuma glandulosa (Torr.) Britton & Rose /Fabaceae/**MG-63**	0.006	100	1	**Vilayti kikkar**	Tr /Wild	Roadside, hilly areas	Bark	Asthma	RP	Powder, infusion	Oral
Melaleuca citrina (Curtis) Dum.Cours. /Myrtaceae/**MG-64**	0.0119	50	0.5	**Botttle brush**	Tr /Cult.	Home gardening, open agricultural land	Seed	Asthma	RP	Powder	Oral
Morus nigra L. /Moraceae/**MG-65**	0.0119	100	1	**Kala shehtoot**	Tr /Cult.	Open agricultural land	Seed	Sugar, liver	HP,	Paste	Oral

Phyla nodiflora (L.) Greene /Verbenaceae/**MG-66**	0.006	100	1.5	**Buken buti**	He /Wild	water bodies	Leaves	Hemorrhoids, blood, noise	DS, BCS, RP	Powder	Oral
Salsola imbricata Forssk. /Amaranthaceae/***MG-67***	0.006	100	1.333	**Laran**	Sh /Wild	Open agricultural land, hilly areas	Leaves	Heart, skin diseases, cough, influenza	CS, DS, RP, RP	Powder	Oral
Zygophyllum paulayanum (J.Wagner & Vierh.) Christenh. & Byng /Zygophyllaceae/***MG-68***	0.0417	74.1	0.5	**Darmah**	Ah/Wild	Open agricultural lands	Stem, leaves	Stomach heat, blood purification	DS, CS, IS, RP	Paste/Juice	Oral

MoA** (mode of application), ***GI** (Gastrointestinal), ***CS** (Cardiac system), ***NS** (Nervous system), ***DS** (Dermal system), ***VS** (Visual system), ***DS** (Digestive system), ***HP** (Hepatic system), ***MS** (Muscular system), ***BCS** (Blood circulatory system), ***SS** (Skeletal system), ***RP** (Reproductive system), ***RS** (Respiratory system), ***Is** (Integumentary system), ***ES** (Excretory system), ***FL** (Fidelity level),UV** (Use value), ***RFCs** (Relative frequency of citations).

Jaccard index

The results of the current study were compared to previously available ethnobotanical literature. Through the Jaccard index, a total of 31 research articles from nearly 20 years prior were examined and compared with recently reported data Table 8. When compared to aligned areas, the Jaccard index monitors reported indigenous medicinal flora and how it is used (Yaseen *et al.* 2015). In the current study, JI scores ranged from 13.48 to 0.00. JI's similarities and variations reveal the similarities and differences in the flora of the compared locations (Bibi *et al.* 2022). These similarities and differences' likely causes are related to the ecological (Ladio *et al.* 2007), historical (Moerman 1998), organoleptic (Aziz *et al.* 2017) and phytochemical differences (Leonti *et al.* 2003) throughout the region. The ethnobotanical data from southern Punjab showed the most significant degree of resemblance (Jabbar *et al.* 2006), District Kasur (Punjab), Pakistan (Arshad *et al.* 2020) and riverine area of Chenab, province Punjab, Pakistan (Umair *et al.* 2019), Hafiz Abad (Punjab), Pakistan (Umair *et al.* 2017) i.e. ≥ 11. Because of similar geographic or climatic conditions, the similarity in plant types between each place is reflected in the greater JI assessment (Farooq *et al.* 2019). However, some other studied ethnobotanical regions like Haroon Abad, District Bahawalnagar (Punjab) Pakistan (Anwer *et al.* 2020) have similar kinds of ecology but due to lack of ethnobotanical data lower JI value was observed. Additionally, zero resemblance to the ethnobotanical investigations were discovered of Northern Iran (Nejad *et al.* 2013). The current study also reviews the health of thirteen medicinal plants that have never been documented or their medicinal properties in ethnomedicinal literature i.e., *Salsola imbricata* Forssk. (Amaranthaceae), *Melaleuca citrina* (Curtis) Dum.Cours. (Myrtaceae) (Curtis) Skeels, *Sesbania grandiflora* sensu Miq. (Fabaceae), *Grewia asiatica* L. (Malvaceae), *Gossypium herbaceum* L. (Malvaceae), *Vitis vinifera* L. (Vitaceae), *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) (Forssk.) Decne, *Moringa oleifera* Lam. (Moringaceae), *Cenchrus americanus* (L.) Morrone (Poaceae), *Saccharum bengalense* Retz., *Dendrocalamus strictus*., *Alhagi maurorum* Medik. (Fabaceae), *Sesamum indicum* L. (Pedaliaceae). Although 59 medicinal plants have already been mentioned in the literature, the current study takes advantage of their novel therapeutic uses reported in this study. In addition to testing for bioactive chemicals the reported plants may be used for clinical trials.

Table 7. Informant consensus factor (ICF)

Categories of diseases	Number of use reports	Number of used plants	ICF
GIT diseases	38	20	0.486
Respiratory diseases	14	9	0.384
Muscle and skeletal disorder	8	6	0.285
Ear, noise, eye disorder	8	5	0.428
Urinary disorder	8	5	0.428
Sexual diseases	4	2	0.666
Dental disorder	3	1	1
Blood circulatory disorder	10	6	0.444
Skin and hair disorder	15	9	0.42
Cardiovascular disorder	7	5	0.333
Nervous disorder	10	6	0.444
Body energizes infectious disorder	3	1	1

***ICF** (informant consensus factor) and ***GIT** gastrointestinal (disorders)

Table 8. Jaccard index (JI) calculated for the reported plants.

Author's Name	Reported year	Study area	Total number of plants in current study = a	Total reported plant species=b	Total plants with similar uses	Total plants with dissimilar uses	Total species common in both areas=c	c*100	a+b	(a+b)-c	JI
(Katewa *et al.* 2004)	2004	Tribal area of Rajasthan	68	61	7	4	11	1100	133	122	9.016
(Shah & Khan 2006)	2006	Siran valley, Mansehra	68	44	4	3	7	700	116	109	6.422
(Hussain *et al.* 2006)	2006	Shawar valley, district swat,	68	121	2	5	7	700	193	186	3.763
(Jabbar *et al.* 2006)	2006	Southern Punjab (Pakistan)	68	29	0	12	12	1200	101	89	13.483
(Qureshi *et al.* 2007)	2007	Mianwali district Punjab Pakistan	68	26	4	3	7	700	98	91	7.692
(Qureshi & Bhatti 2008)	2008	Nara Desert, Pakistan	68	51	5	2	7	700	123	116	6.034
(Ali & Qaiser 2009)	2009	Chitral valley Pakistan	68	83	2	1	3	300	155	152	1.974
(Jalali *et al.* 2009)	2009	Northeast of Iran	68	56	4	3	7	700	128	121	5.785
(Zheng & Xing 2009)	2009	Mt. Yinggeling, Hainan island, China	68	385	3	3	6	600	457	451	1.330
(Ghorbani *et al.* 2011)	2010	Hani ethnicity in Naban River Watershed National Nature Reserve, Yunnan, China	68	199	1	1	2	200	271	269	0.743
(Ahmad *et al.* 2011)	2011	Tehsil Kabal, Swat District, KPK, Pakistan	68	140	7	2	9	900	212	203	4.433
(Jan *et al.* 2011)	2011	Dir Kohistan valley, KPK, PAKISTAN	68	65	2	8	10	1000	137	127	7.874016
(Shinwari *et al.* 2011)	2011	Kohat pass (PAKISTAN)	68	60	0	4	4	400	132	128	3.125

(Abbasi *et al.* 2013)	2013	Tribal communities of Lesser Himalayas-Pakistan	68	35	3	5	8	800	107	99	8.081
(Amir *et al.* 2013)	2013	Northern Iran	68	16	0	0	0	0	88	88	0.000
(Chellappandian *et al.* 2012)	2012	Radha Puram taluk of Tirunelveli District, Tamil Nadu, India	68	217	8	6	14	1400	289	275	5.091
(Bibi *et al.* 2014)	2014	District Mastung of Balochistan province-Pakistan	68	102	9	6	15	1500	174	159	9.434
(Shah *et al.* 2015)	2015	Basikhel tribe of district tor Ghar Khyber Pakhtunkhwa Pakistan	68	250	9	17	26	2600	322	296	8.784
(Samreen *et al.* 2016)	2016	Darazinda, Takht-e-Suleman range F.R D.I. Khan, Pakistan	68	198	5	20	25	2500	270	245	10.204
(Soelberg & Jäger 2016)	2016	Wakhi agropastoralist and the Kyrgyz nomads of Afghanistan	68	72	1	1	2	200	144	142	1.408
(Ali *et al.* 2018)	2018	Hindukush Range, District Swat, Pakistan	68	167	5	10	15	1500	239	224	6.696
(Umair *et al.* 2017)	2017	Hafizabad district, Punjab Pakistan	68	85	11	5	16	1600	157	141	11.348
(Umair *et al.*, 2019)	2019	Chenab riverine area, Punjab province, Pakistan	68	129	13	8	21	2100	201	180	11.667
(Muhammad *et al.* 2019)	2019	Kurram Agency, tribal area, Pakistan	68	150	6	9	15	1500	222	207	7.246

(Amjad *et al.* 2020)	2020	Harighal, Azad Jammu & Kashmir, Pakistan	68	150	10	6	16	1600	222	206	7.767
(Anwer *et al.* 2020)	2020	Haroon Abad, District Bahawalnagar, Punjab, Pakistan	68	81	2	4	6	600	153	147	4.082
(Mughal *et al.* 2020)	2020	District Dera Ghazi Khan, Province Punjab, Pakistan	68	185	1	3	4	400	257	253	1.581
(Arshad *et al.* 2020)	2020	District Kasur (Punjab), Pakistan	68	78	12	5	17	1700	150	133	12.782
(Iqbal *et al.* 2021)	2021	Head Maralla Punjab Pakistan	68	119	2	4	6	600	191	185	3.243
(Abidullah *et al.* 2021)	2021	Pak-Afghan border, near Bajaur, Pakistan	68	95	0	7	7	700	167	160	4.375
(Qureshi *et al.* 2009)	2009	Chakwal, Pakistan	68	29	7	2	9	900	101	92	9.783

***JI** (Jaccard index)

Discussion

Ethnobotany is the interaction of traditional knowledge of the human community related to plants. It also underpins the management and conservation of the native flora of any region based on their rate of utilization. The present work is an attempt to explore the indigenous knowledge of Muzaffargarh district, located in the southern region of the province of Punjab, Pakistan. The study area is home for the rural dominant population with ample knowledge about medicinal plant-based population knowledge. However, speedy modernization and easy entry to allopathic drug treatments are probably the principal reasons which diminish the conventional expertise of the local people. Young people's indigenous knowledge was low compared to old, aged people, but ruler people have some indigenous knowledge compared to urban people. Moreover, the daily life profession also accounts for the potential and quantity of traditional knowledge. For instance, people engaged with agro pastoral activities hold more indigenous knowledge. Interviews discovered that intentionally and unintentionally, indigenous knowledge is transferred at young ages, but with the passage of time, the pervading modern trends in society contribute to eroding local people's cultural and indigenous knowledge. Their willingness to switch expertise early in lifestyles may be very low because of modernization and little attention to indigenous expertise. They have established vernacular names for plants used for different purposes. Sometimes, the local plant's name changes with cultures, languages and even different area of same language. For instance, the local name of a plant species is Gokhroo. Another name is **Bakhraa**. The legume family represents a number of medicinally valued species in the region. Habit-wise, trees were dominant as medicinal plants utilized by the local people compared to herbs and shrubs. This finding maybe attributed the geoecological settings of the area. The study area is located in the lowland and sandwiched between two rivers (River Indus & River Chenab). Arboreal species are also used for other purposes such as fuel, building logs etc. In addition, urbanization, industry, power plants, colonization, waterlogging and salinity conditions are also threating for the tree region (Hasan *et al.* 1992). These species were used for different purposes in the area. For instance, medicinal importance of *Solanum nigrum* L. (Solanaceae) in the present study is to treat liver worms, and different types of hepatitis. Simlarliy that (Chauhan *et al.* 2012) presented that *Solanum nigrum* L. (Solanaceae) has been used traditionally to deal with diverse illnesses together with irritation fever, pain, and enteric diseases. It is also used in opposition to sexually transmitted illnesses. Our study reported that the seeds and fruits of *Syzygium cumini* (L.) Skeels (Myrtaceae) were reported to treat sugar, liver, diarrhea, and heart diseases. It is the best blood purifier *but* (Ayyanar & Subash-Babu 2012) reported that *Syzygium cumini* (L.) Skeels (Myrtaceae) of fruit is acrid, candy, cooling and gets rid of horrific odour from the mouth, astringent, stomachic and diuretic. *The Syzygium cumini* (L.) Skeels (Myrtaceae) of seed is good and desirable for diabetes. The ash from the leaves is used to strengthen teeth and gums. In this study *Azadirachta indica* A.Juss. (Meliaceae) leaves to treat many diseases wound, allergy, sugar, blood cleaning but (Bhowmik *et al.* 2010) reported that *Azadirachta indica* A.Juss. (Meliaceae) extract which has Nimbinin, nimbandiol as lively ingredients and alcoholic extract of the leaves was located to own a huge blood sugar decreasing effect, which is very beneficial against diabetes. *Azadirachta indica* A.Juss. (Meliaceae) is being used to treat fungal infections, bacterial infections, and skin infections in dermatitis. It has been proven to be an efficient antibiotic. *Azadirachta indica* A.Juss. (Meliaceae) additionally has proven antiviral, anti-fungal, and anti-bacterial properties. It allows the support of a wealthy immune system and is used in instances of inflammatory pores and skin situations. Traditionally *Azadirachta indica* A.Juss. (Meliaceae) has been used for skin and blood purifying situations. (Zia-Ul-Haq *et al.* 2011) reported that *Capparis decidua* is one of the most widely used herbal remedies in Pakistan. This theory provides for the formation of adjacent formulas, tocopherols, phenolic, fatty acids and their antidiabetic and antioxidant activity. All tested extracts are very rich in phenolics and gluconate and have strong antidiabetic and antihemolytic activity. The existing look may be useful in growing medicinal arrangements for the treatment of diabetes and associated symptoms.While our study carried out *Capparis decidua* of leaves to treatment of toothache. *Calotropis procera* (Aiton) Dryand. (Apocynaceae) flowers, roots and leaves are of high therapeutic importance to treat wounds, worms, hemorrhoids, blood purification, paralysis, leukorrhea and joint pain diseases. (Meena *et al.* 2010) reported that *Calotropis procera* (Aiton) Dryand. (Apocynaceae) had been extensively used within the Unani, Sudanese and Arabic, conventional medical products for a long time. They use these medicines in the treatment of various disorders, particularly piles, ulcers, spleen and liver diseases. bronchial allergies, leprosy and pores and skin problems. (Hassan *et al.* 2017) presented that *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) is manipulated for the treatment of diarrhoea and the twigs are utilized to make toothbrushes (Miswak). The current research carried out Vachellia *nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) gum is used for removal of abdominal worms and flowers for cough. *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (Fabaceae) of bark, leaves and flowers are used to deal with vintage fever, vomiting, allergy, cough, leukorrhea, and jaryan .The present study of the results represents the *Moringa oleifera* Lam. (Moringaceae) of leaves to treat Joints pain, blood pressure, stomach, liver, back pain, sugar, and flu diseases. *Wihle* (Fatima *et al.* 2014) has been reported that *Moringa oleifera* Lam. (Moringaceae) for its unique uses in the same area; commonly used to combat anemia, acne, psoriasis anxiety, allergies, blackheads, blood pressure, bronchitis, diarrhea, cough, diarrhea, eye and ear infections, fever, headache and high blood pressure unusual, joint pain, respiratory problems. The present study carried out the *Ziziphus jujuba* Mill. (Rhamnaceae) leaves and bark to

treat Cough, asthma, old fever, jaundice, liver metabolism and stomach ulcer. *Ziziphus jujuba* Mill. (Rhamnaceae) was reported (Ghobadi *et al.* 2019) as a blood purifier, vicious temperament stimulant, cough suppressant, anti-asthmatic, constipation, antiseptics, aphrodisiac, blood and bile refrigerant, anti-pruritus, and hematopoiesis helper. The novelty of this study was presented this plants *Salsola imbricata* Forssk. (Amaranthaceae), *Melaleuca citrina* (Curtis) Dum.Cours. (Myrtaceae), *Sesbania grandiflora* sensu Miq. (Fabaceae)*, Grewia asiatica* L. (Malvaceae)*, Gossypium herbaceum* L. (Malvaceae), *Vitis vinifera* L. (Vitaceae), *Leptadenia pyrotechnica* (Forssk.) Decne. (Apolynaceae) , *Moringa oleifera* Lam. (Moringaceae), *Cenchrus americanus* (L.) Morrone (Poaceae),*Saccharum bengalense* , *Dendrocalamus strictus*., *Alhagi maurorum* Medik. (Fabaceae), *Sesamum indicum* L. (Pedaliaceae). The wealth of endemic and indigenous plant information human community residing in extraordinarily remoted and Muzaffargarh district Punjab Pakistan is said for the first time. The present looks at for the first time documented at indigenous knowledge of plants at high risk, repaid urbanization, flora deplete at high level and medicinal plant depilation. This looks at provided ethno-vegetation and conventional expertise of the neighborhood population of the vicinity. The cultural plants and wild edible plants are not mostly present in our study. Therefore, traditional knowledge of plant workshop and seminar poster publication could be at school, college, and university level. Medicinal plants and cultural plants are established for botanical gardens. Micro and macro marketing could be established for conservation of plants. Furthermore, tremendous ethnomedicinal studies may want to find out the hidden expertise and may provide certain types of plants for chemical testing, which could lead to the development of new drugs.

Conclusion

The indigenous people of Muzaffargarh district possess ample information regarding the utilization of their local plant biota. The substantial diversity of ethnobotanical taxa advocates their significance in shaping the human culture of the study area. There is a dire need to take prompt steps to safeguard ethnobotanical plant species along with their related Indigenous knowledge. It addressed the present status and trend of ethnobotanical uses by different ethnic groups. It was also a fruitful contribution to the national ethnobiological literature and baseline information for researchers dedicated to ethnobotany and ethnobiology, medical anthropology, biodiversity, and conservation. The research work strived to fill the ethnobotanical research gap in the study area. The reported data may also figure out research venues for phytochemistry, nutraceutical chemistry, and cultural and medical anthropology. The current study concentrated on ethnomedicinal applications of commonly used medicinal plants in rural Muzaffargarh areas. The present study highlighted the important plant species, these important localities, important medicinal uses, and their cultural practices among ethnic communities.

Declarations

List of abbreviations: GI: Gastrointestinal; CS: Cardiac system; NS: Nervous system; DS: Dermal system; VS: Visual system; DS: Digestive system; HP: Hepatic system; MS: Muscular system; BCS: Blood circulatory system; SS: Skeletal system; RP: Reproductive system; RS: Respiratory system; Is: Integumentary system; ES: Excretory system; RFCs: Relative frequency of citations; FL: Fidelity Level; UV: Use value; ICF: Informant consensus factor; %: Percentage; JI: Jaccard index; MZG: Muzaffargarh; MoA : Mode of application; SSC: Secondary school certificate; HSSC: Higher Secondary school certificate

Ethics approval and consent to participate*:* Consent was obtained from all participants before conducting interviews. No further ethics approval was required.

Consent for publication*:* Oral permission was taken from all the authors. All people shown in images provided theior oral consent to have their images published.

Availability of data and materials*:* The manuscript contains all the data.

Competing interests*:* All authors declare that there is no conflict of interest.

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