Ethno-medicinal survey of weeds of Changa Manga forest, Pakistan

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Research

Abstract

Background: Keeping in mind the popularity of using local flora in the traditional health care system, the present study was designed to document the ethnomedicinal data on the common weeds of a well-known man-made forest at Changa Manga town, tehsil Chunia, district Kasur, Punjab, Pakistan. The study aimed to widen the status of weeds as a primary healthcare resource to renovate the pharmacopeia in Pakistan.

Methods: In this study a total of 49 ethnomedicinally important weed species belonging to 30 families were collected from Changa Manga forest. The study area was partitioned into four blocks. A shed colony region and the vicinity of Change Manga Lake were also included. In a survey, the data was collected through standardized questionnaires about traditional therapies of the collected weeds from 100 informants, among whom 40 were traditional practitioners and 60 were indigenous people.

Results: The collected data was quantitatively analyzed through indices like relative frequency of citation (RFC = 0.09-0.44), use value (UV = 0.02-0.18), fidelity level (FL = 38-100 %), and informant census factor (ICF = 0.72-0.3). Results showed that the Solanaceae family's weeds comparatively have the utmost use for different therapies in this area. Leaves are the highly used part of the plants for medicines. Mostly the medicines are formulated in the form of an extract and a paste. Gastrointestinal disorders are the most dominantly treated by ethnomedicines in the region.

Conclusion: It is concluded that people acknowledged the medicinal significance of weeds and have believed in traditional ethnomedicines even in this modern era. However, there is an un-availability of scientific information and guidelines regarding the safety and efficiency of herbal medicines. This fact hinders the large-scale promotion and development of herbal therapies. So, the merging of indigenous knowledge with modern therapeutic practices is a great need of this era. This lineal knowledge also needs scientific documentation and validation.

Keywords: Ethnomedicinal survey, Medicinal weeds, Changa Manga forest, Medicinal weeds, Pharmacopeia, Medical anthropology, Traditional use.

Background

Humans are increasing their efforts day by day to find medicines based on naturally rooted constituents. This is because they have experienced the harmful side effects of currently available pharmaceutical medicines (Abiodun & Tunji 2019). Ethno-medicine is a discipline of medical anthropology studying ideas and knowledge of various cultures about health, illness, and healing (Quinlan 2011). The information gathered by ethno-medicines surveys can be significant guidelines to enroot drugs discovery from medicinal plants (Bahadur *et al*. 2020). There is a great curative significance of medicinal weeds, and these are also very valuable sources of bio-dynamic compounds because of their antibacterial, antifungal, antioxidant, insecticidal, anti-carcinogenic, and analgesic properties. The weeds also have great economic significance (Ahmad *et al*. 2015). In Pakistan, there is a wealth of medicinal plants, including common native varieties reported from all over Pakistan. Within the Solanaceae family, three genera stand out as the most significant in Pakistani usage: Solanum with 09 species, Lycium with 07 species, and Datura with 05 species (Naseem *et al*. 2023). A total of 150 medicinal plants belonging to 98 genera and 60 families were documented from District Bagh, Azad Jammu and Kashmir (AJK), Pakistan (Amjad *et al*. 2020). Peshawar has the pretension of a diverse population that has brought with a wealth of traditional plant knowledge to this area, reflecting the varied backgrounds of its inhabitants. In Peshawar, a total of 71 plant species belonging to 59 genera and 31 families are being used for various ailment treatments (Bahadur *et al*. 2020). The people of the Cholistan desert (Southern Punjab, Pakistan) are the aborigines who keep migrant livestock and use plants and herbs as curative media for themselves and for the benefit of their livestock, which are easily obtained from the pasture (Khan 2009). A total of 69 medicinal plants belonging to 41 families were documented from Pind Dadan Khan (salt range), District Jehlum, Pakistan, where distinct beliefs and traditions exist in the society and a rich tradition of using medicinal plants for generations (Iqbal *et al*. 2011). A total of 82 medicinal plants belonging to 42 families were reported from Ladha sub-division, South Waziristan agency, Pakistan. The overall socioeconomic status of the indigenous communities in these areas is comparatively poor. However, these illiterate sects are more conversant with respect to traditional knowledge and uses of medicinal plants as compared to literate ones (Aziz *et al*. 2016). However, the traditional knowledge of medicinal plants is held by rural communities even in our era. The lack of scientific documentation, poor plant identification (there are few taxonomic consultants in the country), anthropogenic activities, Quack hakeem (herbal doctors), and pansars (herbal merchants) are posing serious threats to this field.

Some endangered medicinal weeds are also reported in Pakistan. For example*, Lithospermum erythrorhizon* (Family: Boraginaceae) is called “Murasaki” in Japan, and it is well known for its purple colored dye, which is derived from its roots. This plant was recorded in the oldest medicinal literature in China, about 2000 years ago. Wild *Lithospermum* grew throughout China, Korea, and Japan, but it is now almost extinct in Japan because of uncontrolled collection of the wild plants and the difficulty of cultivating it; therefore, all the raw material used industrially in Japan is imported from China and Korea. However, it appears that the wild plants have diminished in quantity in both these countries recently, and their quality has deteriorated year by year (Fujita 1988). It is fortunate that *L. erythrorhizon* is reported in District Malakand in the northern areas of the Khyber Pakhtunkhwa province of Pakistan, and categorized among the less abundant weed species (IVI = 1-100) based on its IVI index = 90.8317 (Iqbal *et al*. 2017). Botanic Gardens Conservation International (BGCI) is the world’s largest system for plant conservation. Efforts should be made to conserve this economically important medicinal plant. There are about 20 species of different endangered plants that have been under the conservation process in the Botanic Garden, GC University Lahore, Pakistan, among them 2-3 are under severe harvesting pressure. The root extract of *L. erythrorhizon* contained highly specific naphthoquinone pigments, i.e., shikonin and allantoin (Chrzanowska *et al*. 2024). The chemotaxonomy of shikonin and its derivatives is very narrow and found in Boraginaceous genera Lithospermum, Arnebia, Anchusa, Echium, Onosma, and Alkanna (Yazaki 2017). Traditionally, the roots (powder) of these weeds are used for the treatment of a wide range of ailments, such as wound healing, tumors, bronchitis, tonsillitis, and hemorrhoids, and especially shikonin (purified as a natural drug) is used against HIV and breast cancer (Bagheri *et al*. 2018; Yu *et al*. 2024). Shikonin is a representative secondary metabolite of *L. erythrorhizon* and was first produced industrially by dedifferentiated cell cultures in the 1980s (Yazaki 2017). By employing callus culture of hairy roots of *L. erythrorhizon,* the high productivity of shikonin was achieved solely in a bubble column fermenter compared to other bioreactor configurations used (Taek *et al*. 1992). In 2020, during the COVID-19 pandemic, a report was published in Nature that described the structure-based virtual and high-throughput screening results of 10,000 compounds used as inhibitors of the main protease (M^{pro}) enzyme of SARS-CoV-2. Among them, six compounds showed inhibition with a half-maximal inhibitory concentration (K_i) of 0.67-26.4 μM. One of these six compounds was shikonin, which is the only natural compound, while all the others were synthetic ones (Jin *et al*. 2020). This report greatly contributed to diverting biotechnologists' attention to conduct surveys to explore medicobotanical wealth, scientific documentation, and conservation of national resources in Pakistan. Additionally, tropical primary forest has been given priority for the traditional formulation of herbal medicines because of biodiversity and endemism. Weeds receive little consideration for making traditional medicine, so ethnomedicinal studies of weeds will have

great scope now (MacIlwain 1998; Stepp & Moerman 2001). So, the main purpose of this study was to the weeds of Changa Manga forest comprehensively to explore the ethnomedicinal worth of the collected weeds.

Materials and Methods

Study Area

Changa Manga is the biggest forest of Pakistan, planted and managed by man. It is situated in Chunian, District Kasur of Punjab at 31.0833° North latitude and at 73.9667° East longitude. It is irrigated by Upper Bari Doab Canal and also from Vahn distributary channels. There is about 14 inches of annual rainfall in the Changa Manga region. On average the temperature remains about 24^{o}C (Ahmad *et al*. 2015). Weed specimens were collected via field trips of various regions of Changa Manga forest, i.e., shed colony, Block-1, Block-2, Block-3, and Block-4, and also the vicinity of Changa Manga Lake.

Collection of weeds

A random sampling method was followed to collect the weeds (Ahmad *et al*. 2015). The local community was approached to have some guidelines for mapping of the main areas with weed growth. The weeds were collected as a whole, including all parts like roots, flowers, fruit, stems, and leaves. They were wrapped in papers, carefully ensuring safety and conservation of their shape. On the paper, the local names (vernacular names) of weeds were written, which were informed by the indigenous community.

Preservation of weeds

A clean cloth was used to wipe the weeds. A tissue paper towel was applied to absorb the moisture. To keep them safe from fungal attack, the weeds were topped with glycerin. Then, they were spread on different papers having identification tags and covered with one more paper on the surface. To avoid wilting the weed specimens were sandwiched between layers of blotting paper twice. Then corrugated cardboards were kept on both sides of the specimens. At last, they were pressed by keeping a hard-wooden board on the top. After two days, the specimens were checked to evaluate the degree of dryness. Then the damp papers were removed and dry papers were kept in place of them. This practice was done for about three weeks until the weeds were completely dried out. The specimens were preserved on herbarium sheets by pasting with glue (Seshagirirao *et al*. 2016).

Identification of weeds

A key-out method was used to identify weeds based on morphological characters by using plant taxonomy in Flora of Punjab (Ahmad 1980), and Flora of Pakistan (http://www.efloras.org) (Nasir 1989). During identification, the special characteristics of specimens and their scientific names were noted down accordingly. An international plant name index (IPNI:http//www.ipni.org) and the plant list (theplantlist.org) were employed to further verify their botanical names (Bahadur *et al*. 2020). Then the specimens were deposited as herbarium sheets to Dr. Sultan Ahmad Herbarium, Department of Botany, GC University Lahore.

Demographic data of the informants from Changa Manga forest

The data was gathered from a total of 100 informants. These included 80 men and 20 women. While collecting data from informants, five variables were assessed: (i) informant category, (ii) age, (iii) gender, (iv) experience of traditional health practitioners, and (v) educational background (Table 1).

Data collection

The ethnomedicinal survey to examine the traditional remedial practice was conducted from June to December 2021. An already structured questionnaire (Asiimwe *et al*. 2021) and interviews were constructed to collect information from the local community about their herbal practices by standard ethnobotanical methods (Maroyi 2011; Cunningham 2014). The questionnaire had two segments, “A” and “B”. The socio-demographic background of informants was covered in Section “A” such as gender, age, occupation, region, and education. In section “B”, the general perception and familiarity of the consumers were examined in terms of open-ended questions. In this section, closed-ended questions about the knowledge, consumption frequency, and preferences of informants were also included. Overall, a total of four independent variables were included in data collection, which were (i) vernacular names of species, (ii) parts used to make medicines, (iii) modes of administration, and (iv) the illnesses treated.

Data analysis

To assess the indigenous knowledge, the data was analyzed by measuring different parameters as mentioned below:

Relative frequency citation (RFC)

RFC is an indication of the local significance of the plants, and it was calculated by employing Eq. 1 (Tardio & Pardo-De-Santayana 2008; Vitalini *et al*. 2013).

$$RFC = \frac{FC}{N} \quad (0 < \text{RFC} < 1) \ldots\ldots (1)$$

Where,

FC = stands for the number of informants who mentioned plant species usage.

N = stands for the total number of informants who participated in the survey.

Table 1. Demographic data of community membres from Changa Manga forest, Pakistan.

Variables	Categories	No. of Informants (%age) †
Informants' profession	Traditional practitioners*	40 (40)
	Indigenous people	60 (60)
Gender	Male	80 (80)
	Female	20 (20)
Age	>20 years	05 (05)
	20-30 years	15 (15)
	31-40 years	25 (25)
	41-50 years	35 (35)
	51-60 years	10 (10)
	<60 years	10 (10)
Education	Illiterate	32 (32)
	Completed 5 years education	15 (15)
	8 years education	10 (10)
	10 years education	15 (15)
	12 years education	15 (15)
	Graduate	10 (10)
	Post-Graduate	03 (03)
Experience of traditional health practitioners	>2 years	25 (62.5)
	2-5 years	24 (60)
	5-10 years	37 (92.5)
	10-20 years	10 (25)
	<20 years	04 (10)

*Hakeem (herbal doctors) and pansars (herbal merchants). †Percentage of prevalence for each category is shown in parenthesis.

Use value (UV)

The relative importance of the weeds was quantified by calculating an index UV, using Eq. 2.

$$UV = \frac{U}{n} \ldots\ldots (2)$$

In which,

U = stands for the total number of reports of particular species usage.

N = stands for the sum of the total number of informants that were inquired for that plant species, particularly (Phillips *et al*. 1994; Savikin *et al*. 2013).

Fidelity level (FL)

FL accounts for the species of a weed that are more perfect to treat specific ailments (Musa *et al*. 2011). It is the ratio of the informants who have recommended the use of a plant species for any ailment category independently, and the

number of total informants who declared the plants' usage for any category of disease. It was calculated by Eq. 3 (Friedman *et al*. 1986).

$$FL(\%) = \frac{Np}{N} \times 100 \qquad (3)$$

In this equation
Np = stands for the informant's number claiming the plant species' usage for a specific disease.
N = stands for the number of informants who mentioned the plant's usage for any disease treatments.

Informants census factor (ICF)

ICF is the sum of the total number of citations of use of a plant for a specific disease category "Nur" (number of people who mentioned a specific illness) deducted by the total number of plant's species employed (Nt) and divided by the number of total citations for use of plant for a particular category minus 1 (Trotter & Logan 1986; Tabuti *et al*. 2003; Teklehaymanot 2009). Normally, the range of ICF values lies between 0 to 1 (Eq. 4).

$$ICF = \frac{Nur - Nt}{Nur - 1} \qquad (4)$$

Results and Discussion

Weeds collection and identification

A much-enriched biodiversity of weed species was found along both sides of Changa Manga Lake. A total of 49 species of medicinal weeds belonging to 30 families were collected (Figure 1). The scientific names, vernacular names, and names of families have been tabulated (Table 2). The whole weed plants or their parts, like roots, flowers, fruit, stems, and leaves, have been used to formulate medicines. Medicines are made and employed in different ways, like infusion, juice, paste, decoction, extract, cooked, powder, or raw form (Table 3).

Some weeds of Changa Manga forest have already been reported for their ethnomedicinal uses i.e., *Achyranthes aspera, Cleome viscosa, Calotropis procera, Datura stramonium, Aerva javanica, Parthenium hysterophorus, Sonchus arvensis, Chenopodium ambrosioides, Malvastrum coromandelianum, Oxalis corniculate*, and *Cannabis sativa* (Ahmad *et al*. 2015). The plant *Withania somnifera* has been reported for its antimicrobial properties (Figure 1) (Adnan *et al*. 2014). The ethnomedicinal uses of *Mentha longifolia* are mostly reported to cure gastric issues (Tariq *et al*. 2015). The Lamiaceae and Asclepiadaceae (Figure 1) families have been mentioned for their properties used to cure Leishmaniasis disease (Tariq *et al*. 2016). *Azadirachta indica* and *Aloe barbadensis* weeds have been effective in curing diabetic patients (Aumeeruddy & Mahomoodally 2021). Many other reports are also found for these species for the treatment of many diseases (Table 3). *Atropa belladonna* is mentioned in this study for its use to heal menstrual problems. This is the novel use of this weed in Changa Manga and has been little investigated in Pakistan. A study of Europe is available on it, perhaps (Fatur 2020).

Attributes of medicinal weeds and their diversity at Changa Manga forest

Different attributes of use of collected medicinal weed were examined, i.e., percentage of (i) specific species used, (ii) ailments treated, (iii) part used, and (iv) mode of preparation (Figure 2 A-D).

(i) Among the whole collection of medicinal weeds from Changa Manga forest, the genera: *Solanum* (*miniatum* and *surattense*), *Datura* (*stramonium* and *metel*), and *Withania somnifera* belonging to the family Solanaceae were extravagantly available in the study area. The community was well experienced with the modes of usage of these weeds for different ailments (Figure 2A). Solanaceae has great ethnobotanical and pharmacological potential in Pakistan for traditional and commercial medications (Naseem *et al*. 2023). In another study, these weeds were also mentioned as the most widely used species in Tehsil Talagang of Punjab province, Pakistan (Rehman *et al*. 2017). The extent of usage of *Carthamus oxycantha*, *Eclipta prostrata, Parthenium hysterophorus, Cichorium intybus*, and *Sonchus asper*, belonging to the Asteraceae family, is represented as the second-highest family to which people were well aware (Table 3). The high traditional usage of Asteraceae was also reported in Nigeria (Abiodun & Tunji 2019).

(ii) Various disease categories are found to be treated ethnomedicinally in Changa Manga, i.e., cancer, fever, infection, pain, gastrointestinal, dermatological, nervous, sexual, respiratory, urinary disorders, and heart diseases, etc. The highest treatment has been given to gastrointestinal diseases with dermatological diseases taking second place (Figure 2B). Various studies in Pakistan have been reported for the gastrointestinal disorders, respiratory and hepatic issues widely treated ethnomedicinally (Singh *et al*. 2012; Aziz *et al*. 2016; Shah *et al*. 2016; Amjad *et al*. 2020; Bahadur *et al*. 2020) (Table 3). Various side effects are associated with the therapeutic drugs available for curing stomach issues, like cryoprotectants,

demulcents, anticholinergics, prostaglandin analogs, H2 receptors, and proton pump inhibitors. For example, proton pump inhibitors can cause constipation, diarrhea, nausea, and abdominal pain. H2 receptor antagonists are associated with gynecomastia and libido deficiency. Therefore, ethnomedicines are the better alternative options (Adnan *et al*. 2014).

(iii) Six different parts of weeds are widely employed in the study area for drug development. Leaves are the most prominent part used, followed by roots, seeds, fruit, stem, flower, and oil (Figure 2C). It depends on the habitat of the plant and the needs of users, which part of the plant body has to be employed. By using leaves, the preparations like paste and extract are easy to make. The collection of leaves is also quite simple. Leaves are also the most active plant part for the production of metabolites. Hence, most of the active compounds are located in this area (Rehman *et al*. 2017). Leaves are also mentioned as the most widely employed plant part in other studies conducted in Pakistan (Ahmed *et al*. 2015; Kumar *et al*. 2015; Roy *et al*. 2015; Aziz *et al*. 2016; Alamgeer *et al*. 2018; Amjad *et al*. 2020; Bahadur *et al*. 2020) (Table 3).


Chenopodium ambrosioides
Citrullus colocynthis
Cucumis melo
Momordica dioica
Cuscuta reflexa
Cyperus rotundus
Ephedra gerardiana
Euphorbia granulata
Euphorbia thymifolia
Euphorbia hirta
Ricinus communis
Melilotus indicus
Mentha longifolia
Salvia officinalis
Abutilion indicum
Malvastrum coromendelianum

Figure 1. Weed species collected from Changa Manga forest, Pakistan.

Table 2. Weed species collected from Changa Manga forest, Pakistan.

Botanical name	Family name	Vernacular name*	Voucher No.
Achyranthes aspera L.	Achyranthaceae	Puth Kanda	GC.Herb.Bot.4375
Abutilon indicum L.	Malvaceae	Bhtaka	GC.Herb.Bot.4376
Aloe barbadensis Milli.	Asphodelaceae	Qawar gandal	GC.Herb.Bot.4377
Amaranthus viridis L.	Amarantheace	Jungli cholai	GC.Herb.Bot.4378
Amaranthus retroflexus L.	Amarantheace	Pig weed/soarbooti	GC.Herb.Bot.4379
Atropa belladonna L.	Solanaceae	Katal	GC.Herb.Bot.4380
Aerva javanica (Burm. f.) Juss.	Amaranthaceae	Ispaghol grade B	GC.Herb.Bot.4381
Arundo donax L.	Poaceae	Nara	GC.Herb.Bot.4382
Cichorium intybus L.	Asteraceae	Kaasni	GC.Herb.Bot.4383
Cleome viscosa L.	Capparidaceae	Chaskoo	GC.Herb.Bot.4384
Calotropis procera (Aiton) R. Br.	Asclepiadaceae	Akk	GC.Herb.Bot.4385
Cannabis sativa L.	Cannabinaceae	Bhang	GC.Herb.Bot.4386
Chenopodium ambrosioides L.	Chenoppdiaceae	Bathu	GC.Herb.Bot.4387
Cuscuta reflexa Roxb	Cuscutaceae	Amar bail	GC.Herb.Bot.4388
Chenopodium murale L.	Amaranthaceae	Kurund	GC.Herb.Bot.4389
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Chota tumma/jungli tumma	GC.Herb.Bot.4390
Cucumis melo L.	Cucurbitaceae	Chibarh	GC.Herb.Bot.4391
Carthamus oxycantha M. Bieb.	Asteraceae	Pohli	GC.Herb.Bot.4392
Cyperus rotundus L.	Cyperaceae	Deela	GC.Herb.Bot.4393
Datura metel L.	Solanaceae	White tatura	GC.Herb.Bot.4394
Datura stramonium L.	Solanaceae	Black tatura	GC.Herb.Bot.4395
Ephedra gerardiana Wall. ex C.A. Mey.	Ephedraceae	Aasmani booti, sky	GC.Herb.Bot.4396
Eclipta alba (L.) Hassk.	Asteraceae	Yellow chili	GC.Herb.Bot.4397
Rumex spinosus L.	Polygonaceae	Tarkandi palak	GC.Herb.Bot.4398
Euphorbia granulata Forssk.	Euphorbiaceae	Hazar daani dodhak	GC.Herb.Bot.4399
Euphorbia thymifolia Michx.	Euphorbiaceae	Earth grass, Doodh booti	GC.Herb.Bot.4400
Euphorbia hirta L.	Euphorbiaceae	Laal dodhak, dodhiya	GC.Herb.Bot.4401
Malvastrum coromandelianum (L.) Garcke	Malvaceae	Patakha	GC.Herb.Bot.4402
Mentha longifolia (L.) Huds.	Lamiaceae	Jangli podina	GC.Herb.Bot.4403
Melilotus indicus (L.) All.	Fabaceae	Senji	GC.Herb.Bot.4404
Momordica dioica Roxb. ex Willd.	Cucurbitaceae	Jangli karela	GC.Herb.Bot.4405
Nerium oleander L.	Apocynaceaea	Kaner	GC.Herb.Bot.4406
Oxalis corniculata R. Knuth.	Oxalidaceae	Khati booti	GC.Herb.Bot.4407
Peganum harmala L.	Nitrariaceae	Harmal	GC.Herb.Bot.4408
Pteris vittata L.	Pteridaceae	Kangha	GC.Herb.Bot.4409
Parthenium hysterophorus L.	Asteraceae	Gajar booti	GC.Herb.Bot.4410
Plantago ovata Forssk.	Plantaginaceae	Ispaghol	GC.Herb.Bot.4411
Polygonum persicaria L.	Polygonaceae	Lady finger weed	GC.Herb.Bot.4412
Ricinus communis L.	Euphorbiaceae	Arand	GC.Herb.Bot.4413
Salvia officinalis L.	Lamiaceae	Chota podina	GC.Herb.Bot.4414
Solanum surattense Burm. f.	Solanaceae	Moraha, kandheri	GC.Herb.Bot.4415
Sonchus asper (L.) Vill.	Asteraceae	Kandyara	GC.Herb.Bot.4416
Solanum miniatum Bernh. ex Willd.	Solanaceae	Peelak	GC.Herb.Bot.4417
Tribulus terrestris L.	Zygophyllaceae	Pakhra	GC.Herb.Bot.4418
Trianthema portulacastrum L.	Aizoaceae	It sit(white)	GC.Herb.Bot.4419
Tinospora cordifolia (Willd.) Miers	Menispermaceae	Giloy bail	GC.Herb.Bot.4420
Withania somnifera (L.) Dunal	Solanaceae	Aaksan	GC.Herb.Bot.4421
Valeriana jatamansi Jones	Vahliaceae	Mushk bari	GC.Herb.Bot.4422
Verbascum thapsus L.	Scrophulariaceae	Forest tmbakoo	GC.Herb.Bot.4423

* Data was collected from community members of Changa Manga, Pakistan.

Table 3. The prevalence of the use of medicinal weeds as traditional medicine. *

Weed	Parts used	Ailments cured	Mode of Applications	Reference
Achyranthes aspera	Stem, fruit, leaves, roots	Asthma, rheumatism, cough, stomach ache, insect bite, dysentery, skin diseases.	Ash, paste, and juice of the plant. Decoction of roots and leaves.	Bahadur *et al*. (2020) Ahmad *et al*. (2015)
Trianthema portulacastrum	Whole plant	Fungal infections, poultice, cough, venereal discharge, wound dressing, gonorrhea.	Decoction, powder, paste of leaves and fruit. Juice of whole plant,	Iqbal *et al*. (2011)
Amaranthus viridis	Leaves	Labor pains, digestive problems, skin diseases, urinary tract infections.	Direct application of leaves or their extract is recommended.	Ahmad *et al*. (2011)
Amaranthus retroflexus	Leaves	Female reproductive system-related issues	Raw form eating of leaves.	Batsatsashvili *et al*. (2016)
Aerva javanica	Whole plant	An emollient for skin dryness and cracking. Diarrhea, calculi formation and urethral discharges. A helminthic.	Raw form usage of seeds as whole or the infructescence of complete plant.	Ahmad *et al*. (2015)
Chenopodiastrum murale	Flowers, leaves, stem	Digestive. Disorders of respiratory system.	Cooked	Bahadur *et al*. (2020)
Nerium oleander	Leaves, roots	Heart diseases, swellings, bacterial infections, scaly skin, snakebite, cancer, ulcers.	Leaves and roots are applied as extract or paste, decoction is also used.	Nisar *et al*. (2014) Akhtar *et al*. (2019)
Calotropis procera	Whole plant	Spleen, abdomen, liver disorders, piles, ulcer, tumors.	Paste of leaves, fruit, root powder, raw application, fruits ash.	Ahmad *et al*. (2015) Ahmad (2007)
Aloe barbadensis	Whole plant	Arthritis, dermal diseases, cholesterol issues, digestive problems.	Inner gel, Bitter exudate, dried latex.	Manvitha and Bidya (2014) Qureshi *et al*. (2010)
Carthamus oxycantha	Whole plant	Cancer and itching of the skin.	Roasted seeds or the raw application of whole plant.	Akhtar *et al*. (2019) Ahmad *et al*. (2011)
Cichorium intybus	Leaves	Wounds and diabetic issues.	Squashed fresh leaves, decoction, Ointment Tea, Infusion, Aqueous extract.	Akhtar *et al*. (2019)
Eclipta alba	Root, oil, leaves	Insomnia, hair growth, tooth aches, memory, sight, hearing, skin disorders, headache, labor pain.	Oil is externally applied while root and leave extracts are used orally.	Nisar *et al*. (2014) Khan *et al*. (2019)
Parthenium hysterophorus	Leaves	Dysentery, foot burn, constipation, diabetes mellitus, cancer.	Leave extract and decoction powder.	Ahmad *et al*. (2015) Rehman *et al*. (2017) Khan *et al*. (2019) Akhtar *et al*. (2019) Bahadur *et al*. (2020)

Sonchus arvensis	Stem, leaves, fruit	Cancer, menstrual problems, liver disorders, warts, kidney disorders, wounds, cancer, inflammation, fever, burn.	Paste, Decoction. Juice, extract, and poultice.	Nisar *et al*. (2014) Iqbal *et al*. (2011)
Cannabis sativa	Leaves, flowers	Malaria, gastric disorders, pain, male impotency, insomnia.	Decoction powder, paste, extract.	Ahmad *et al*. (2011)
Cleome viscosa	Leaves and seed	Wounds, ulcers, ringworms.	Leaves and seed extract and paste, leaves surface coated with sesame oil then warm and applied on inflamed areas.	Mali (2010)
Chenopodium ambrosioides	Stem	Malarial, fever, diabetic issues.	Juice and extract of stem.	Ahmad *et al*. (2011) Song *et al*. (2011)
Citrullus colocynthis	Whole plant	Epilepsy, gastric issues, urine problems, Jaundice, diabetes.	Extract, powder, juice.	Khan *et al*. (2019) Bahadur *et al*. (2020) Rehman *et al*. (2017)
Cucumis melo	Fruit, seeds	Stomach problems, constipation, obesity.	Raw form of seeds and fruits or infusion powder.	Rehman *et al*. (2017)
Momordica dioica	Fruit, leaves, root	Bleeding piles and infections of urinary tract.	Paste and extract of plant.	Bawara *et al*. (2010)
Cuscuta reflexa	Seeds, leaves	Jaundice, kidney disorders, urination disorders, liver disorders. Flatulence, constipation,	Extract, Juice, paste.	Saini *et a*l. (2017)
Cyperus rotundus	Root	Dysentery, vomiting, gastric problems, Intestinal disorders, diuretics, fevers, vulnerary ulcers, and sores.	Oil, mixture of root.	Khan *et al*. (2019) Amjad *et al*. (2020) Nisar *et al*. (2014)
Ephedra gerardiana	Whole plant	Bronchitis, asthma, heart stimulant, bronchial spasm, hepatic diseases.	Paste, juice, decoction, powder.	Hossain *et al*. (2014)
Euphorbia granulata	Leaves	Gastric disorders in children, hepatitis-c, intestinal worms, snake bites.	Leaves extract or latex.	Salehi *et al*. (2019)
Euphorbia thymifolia	Leaves, seed, root	Diabetes, dysentery, lactation issues of cows, breast problems, digestive issues.	Leaves extract, juice, latex.	Qureshi *et al*. (2010) Rahman and Akter (2014)
Euphorbia hirta	Stem, leaves, fruit	Cough, ulcer, skin diseases, wounds, diarrhea, burn.	Extract, juice, paste.	Bahadur *et al*. (2020) Nisar *et al*. (2014) Barkatullah *et al*. (2015)
Ricinus communis	Leaves, seed	Anti-conceptive, anti-diabetic, anti-inflammatory, anti-	Paste.	Rehman *et al*. (2017) Marwat *et al*. (2017) Bahadur *et al*. (2020)

		fertility, hepatoprotective, anti-microbial, anti-oxidant, insect killing, wound-healing.		
Melilotus indicus	Whole plant	Heart burn, snake bite, skin diseases.	Decoction, powder, juice, infusion.	Ahmad *et al*. (2015) Akhtar *et al*. (2019)
Mentha longifolia	Leaves, stem	Gastrointestinal disorders, pulmonary infection, menstrual disorders, wounds, fever, cough, infections of urinary tract.	Leaves extract, decoction.	Nisar *et al*. (2014) Ahmad *et al*. (2011) Bahadur *et al*. (2020)
Salvia officinalis	Whole plant	Ulcers, dizziness, gout, inflammation, diarrhea hyperglycemia, tremor.	Decoction, powder, juice, infusion.	Ahmad *et al*. (2011) Qureshi *et al*. (2010) Bahadur *et al*. (2020)
Abutilon indicum	Leaves, root, seed, flowers	Fevers, bladder inflammation, chest infections, ulcers, gonorrhea, urethritis, mend piles.	Paste, extract, decoction.	Nisar *et al*. (2014)
Malvastrum coromandelianum	Whole plant	Inflamed sores, dysentery, wounds, constipation, arthritis.	Paste, decoction, powder. Flowers of plant are used as sudorific.	Ahmad *et al*. (2015) Saxena *et al*. (2020)
Tinospora cordifolia	Root, stem	Urinary issues, gastric problems.	Juice, extract of root and stem.	Iqbal *et al*. (2011)
Peganum harmala	Stem, root, leaves, fruit	Asthama, laryngitis, jaundice, rheumatism, heart pain.	Paste, juice, decoction.	Iqbal *et al*. (2011) Aziz *et al*. (2016)
Oxalis corniculata	Fruit, seed	Snake bite, teeth problems, stomach disorders, dysentery, fever, bronchial disorders, headache.	Raw form, juice, infusion, paste, decoction.	Rehman *et al*. (2017) Ahmad *et al*. (2015)
Plantago ovate	Seeds	Constipation, bowel disease, colon cancer, diarrhea, bowel syndrome, hypercholesterolemia, skin irritations, diabetes.	Husk of the seeds.	Sarfraz *et al*. (2017)
Arundo donax	Stem, root, leaves and fruit	Skeletal problems, cancer.	Raw plant powder.	Bahadur *et al*. (2020) Akhtar *et al*. (2019)
Rumex spinosus	Leaves	Bacterial infection, cancer.	Leaves extract.	Donia *et al*. (2014)
Polygonum persicaria	Fruit, seed	Fungal infections, vaginal diseases, skin treatment	Paste, infusion of seeds and fruit.	Derita and Zacchino (2011)
Pteris vittata	Leaves, stem	Wounds.	Paste.	Amjad *et al*. (2020) Karthik *et al*. (2018)
Verbascum thapsus	Leaves, root, fruit	Pain, cough, migraine, gout, diarrhea.	Paste, decoction.	Ahmad *et al*. (2011) Khan *et al*. (2019) Ahmad (2007)

Atropa belladonna	Leaves, fruit, flowers	Respiratory issues, muscle spasm, dermatological disorders, sciatica, aches of head, tooth and ear.	Raw form, poultice and extract of entire plant for children.	Fatur (2020)
Datura metel	Leaves, seed	Respiratory issues, muscle spasm, dermatological disorders, sciatica, aches of head, tooth and ear	Raw form, poultice and extract of entire plant.	Khan *et al*. (2019) Monira and Munan (2012)
Datura stramonium	Whole plant	Respiratory issues, muscle spasm, dermatological disorders, sciatica, aches of head, tooth and ear	Raw form, poultice and extract of entire plant for children.	Ahmad *et al*. (2015) Bahadur *et al*. (2020) Khan *et al*. (2019)
Solanum surattense	Whole plant	Migraine, joint pains, bronchial asthma, fever, cough.	Paste, ash of plant.	Khan *et al*. (2019) Ahmad *et al*. (2015) Akhtar *et al*. (2019) Rehman *et al*. (2017)
Solanum miniatum	Whole plant	Insomnia, wounds, small pox, skin diseases, boils.	Decoction, sugar mixture, juice.	Khan *et al*. (2019) Iqbal *et al*. (2011) Akhtar *et al*. (2019)
Withania somnifera	Whole plant	Male sexual disorders, gynecological disorders, painful swelling, rheumatism, asthma, cough, bleeding wounds.	Powder.	Bahadur *et al*. (2020) Rehman *et al*. (2017)
Valeriana jatamansi	Whole plant	Epilepsy, intestinal pain, neurosis, inflammation, constipation.	Extract	Khan *et al*. (2019) Amjad *et al*. (2020)
Tribulus terrestris	Whole plant	Depression, gynecological problems, urinary disorders, hair fall.	Powder.	Nisar *et al*. (2014) Rehman *et al*. (2017)

* Data was collected from community members of Changa Manga, Pakistan.

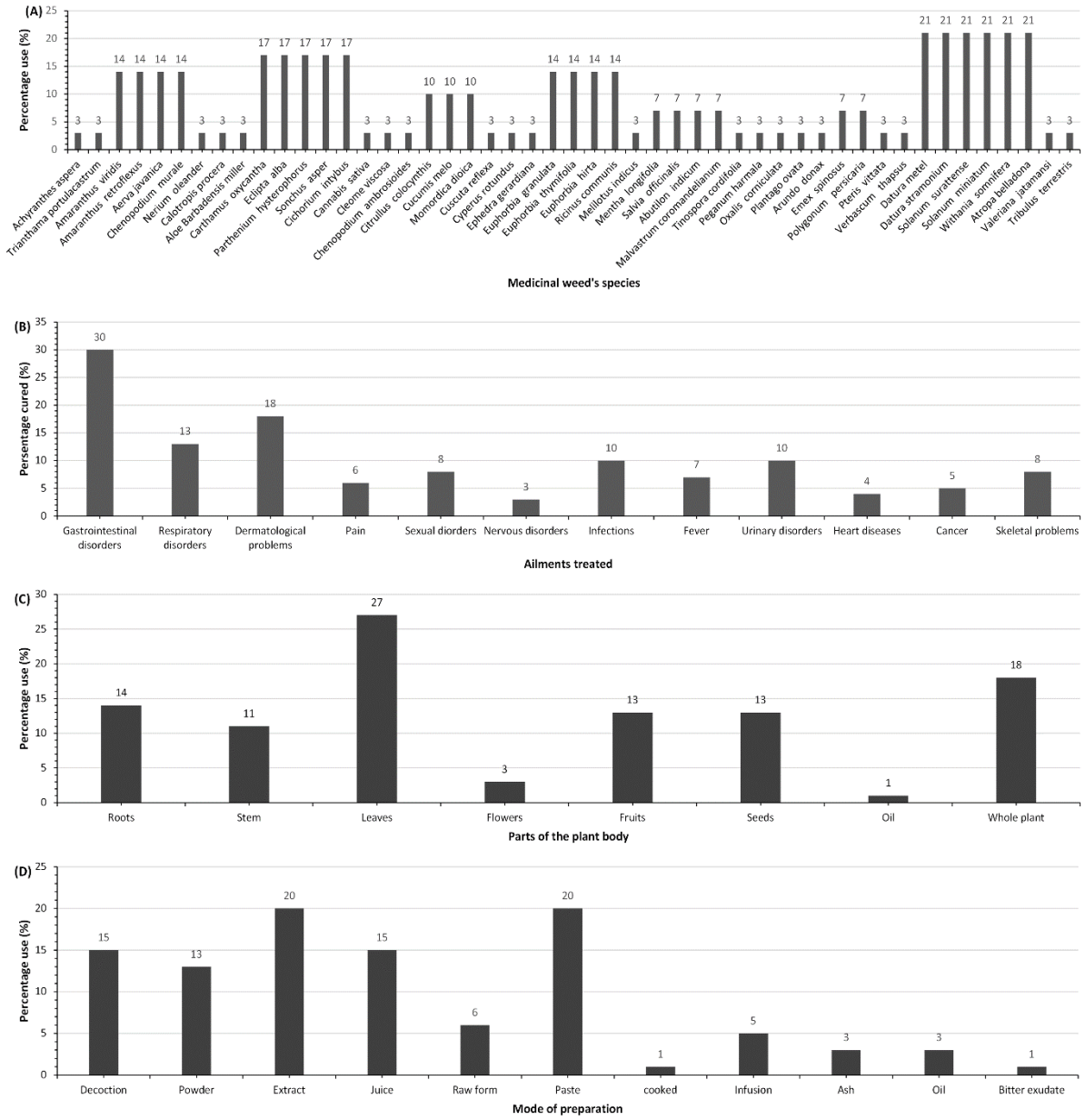

Figure 2. (A) Percentage (%) used of a specific weed's species by Changa Manga community. (B) Percentage (%) of ailment's cured by collected weed's species. (C) Percentage (%) of part of the plant used by Changa Manga community. (D) Percentage (%) mode of preparation used by Changa Manga community.

(iv) About 60 % of ethno-medicines are used internally, and 40 % are applied externally. External administration is performed in various forms, including paste, decoction, juice, powder, extract, infusion, bitter exudate, ash, oil, and cooked (Table 3). Raw form usage of plants is little mentioned in studies. Among the modes of preparation, the extract and paste lie first, followed by decoction and juice (Figure 2D). Because extract and paste are easy to formulate and use. Paste formulation has also been reported as the most common formulation applied (Singh *et al*. 2017).

Relative frequency of citation (RFC)

The RFC values were lied in the range of 0.09 - 0.44 (Table 4). *Tribulus terrestris, Mentha Longifolia, Solanum miniatum, Momordica dioica, Datura metel, Calotropis procera*, and *Trianthema portulacastrum* are the species with the highest RFC = 0.44. This is because these plants are abundantly available in the study area. The community has also found significant medicinal effects of these plants.

Table 4. Quantitative data analysis of ethnomedicinal survey.

Weed	FI (%)	RFC	UV
Achyranthes aspera (Puth Kanda)	92	0.28	0.11
Abutilon indicum (Bhtaka)	100	0.31	0.15
Aloe barbadensis (Qawar gandal)	100	0.36	0.16
Amaranthus viridis (Jungli cholai)	94	0.31	0.15
Amaranthus retroflexus (Pig weed/soarbooti)	38	0.09	0.02
Atropa belladonna (Katal)	38	0.09	0.02
Aerva javanica (Ispaghol grade B)	100	0.31	0.15
Arundo donax (Nara)	38	0.09	0.02
Cichorium intybus (Kaasni)	100	0.36	0.16
Cleome viscosa (Chaskoo)	100	0.36	0.16
Calotropis procera (Akk)	100	0.44	0.18
Cannabis sativa (Bhang)	100	0.36	0.16
Chenopodium ambrosioides (Bathu)	84	0.29	0.1
Cuscuta reflexa (Amar bail)	100	0.36	0.16
Chenopodium murale (Kurund)	38	0.09	0.02
Citrullus colocynthis (Chota tumma/jungli tumma)	67	0.3	0.13
Cucumis melo (Chibarh)	92	0.28	0.12
Carthamus oxycantha (Pohli)	38	0.09	0.02
Cyperus rotundus (Deela)	94	0.3	0.15
Datura metel (White tatura)	100	0.44	0.18
Datura stramonium (Black tatura)	92	0.28	0.15
Ephedra gerardiana (Aasmani booti, sky)	92	0.24	0.12
Eclipta alba (Yellow chili)	38	0.09	0.02
Rumex spinosus (Tarkandi palak)	92	0.24	0.11
Euphorbia granulata (Hazar daani dodhak)	56	0.18	0.09
Euphorbia thymifolia (Earth grass, Doodh booti)	44	0.16	0.08
Euphorbia hirta (Laal dodhak, dodhiya)	84	0.26	0.14
Malvastrum coromandelianum (Patakha)	94	0.31	0.15
Mentha longifolia (Jangli podina)	100	0.44	0.18
Melilotus indicus (Senji)	94	0.31	0.15
Momordica dioica (Jangli karela)	100	0.44	0.18
Nerium oleander (Kaner)	84	0.26	0.13
Oxalis corniculata (Khati booti)	94	0.3	0.15
Peganum harmala (Harmal)	38	0.09	0.02
Pteris vittata (Kangha)	44	0.16	0.09
Parthenium hysterophorus (Gajar booti)	92	0.28	0.12
Plantago ovata (Ispaghol)	100	0.31	0.15
Polygonum persicaria (Lady finger weed)	84	0.24	0.12
Ricinus communis (Arand)	84	0.24	0.12
Salvia officinalis (Chota podina)	84	0.24	0.12
Solanum surattense (Moraha, kandheri)	84	0.24	0.12
Sonchus asper (Kandyara)	94	0.3	0.15
Solanum miniatum (Peelak)	100	0.44	0.18
Tribulus terrestris (Pakhra)	100	0.44	0.18
Trianthema portulacastrum (It sit(white))	100	0.44	0.18
Tinospora cordifolia (Giloy bail)	84	0.24	0.12
Withania somnifera (Aaksan)	84	0.26	0.14
Valeriana jatamansi (Mushk bari)	56	0.18	0.09
Verbascum thapsus (Forest tmbakoo)	100	0.36	0.16

***** Vernacular names are given in parenthesis.

The weed species like *Cleome viscosa, Boerhavia diffusa, Verbascum thapsus, Aloe barbadensis, Cuscuta reflexa,* and *Cannabis sativa* have RFC = 0.36. The least RFC = 0.09 was found for species *Amaranthus retroflexus, Eclipta alba, Carthamus oxycantha, Arundo donax, Chenopodium murale*, and *Peganum harmala*. The highest RFC value indicates the plant species with dominant uses. If a plant species has 1 RFC value, it can be mentioned as most useful among informants. A zero RFC value means no citations or reports by informants (Medeiros *et al*. 2011). The RFC values range reported by other workers are 0.04-0.93 (Amjad *et al*. 2020), 0.05-0.24 (Bahadur *et al*. 2020), 0.556-0.956 (Malik *et al*. 2019), 0.15-0.36 (Rehman *et al*. 2017), 0.1-0.385 (Shah *et al*. 2016), 0.1-1 (Roy *et al*. 2015).

Use value (UV)

The UV values were ranged between 0.02 to 0.18 (Table 4). Maximum UV = 0.18 was found for *Tribulus terrestris, Mentha longifolia, Solanum miniatum, Momordica dioica, Calotropis procera,* and *Datura metel*. It depicts the plant's abundance and significance in the community. These results can in turn give the roots for further pharmacological and phytochemical research of the plants (Ahmad *et al*. 2015). After these, the species *Cleome viscosa, Cuscuta reflexa, Boerhavia diffusa, Aloe barbadensis,* and *Cannabis sativa* got second highest UV = 0.16. Minimum UV was found for *Amaranthus retroflexus, Atropa belladonna, Arundo donax, Chenopodium murale, Carthamus oxycantha, Eclipta alba,* and *Peganum harmala* (UV = 0.02). In other studies, the range of UV was reported as 0.08-1.05 (Amjad *et al*. 2020), 0.03-0.35 (Bahadur *et al*. 2020), 0.006-0.094 (Malik *et al*. 2019), 0.04-0.16 (Rehman *et al*. 2017), 0.80-0.93 (Aziz *et al*. 2016), 0.13 maximum (Shah *et al*. 2016), 0.74-2.45 (Kumar *et al*. 2015), and 0.10-0.90 (Ahmed *et al*. 2015).

Fidelity level (FL)

The range of FL values was between 38 to 100 % (Table 4). There were 16 plant species that had the maximum FL value. These are *Abutilon indicum, Cuscuta reflexa, Aloe barbadensis miller, Cichorium intybus, Cleome viscosa, Calotropis procera, Aerva javanica, Cannabis sativa, Datura metel, Plantago ovata, Mentha longifolia, Momordica dioica, Trianthema portulacastrum, Solanum miniatum, Tribulus terrestris*, and *Verbascum thapsus*. This indicated that these plant species are prioritized by the users to treat particular diseases (Ahmad *et al*. 2015). It is also indicated that the community prioritized ethnomedicines over pharmaceutical drugs, although they have enough access to modern medicines (Rehman *et al*. 2017). The FL values range reported by other workers are 18.2-100 % (Amjad *et al*. 2020), 54.55-100 % (Bahadur *et al*. 2020), 50-99 % (Malik *et al*. 2019), 45-100 % (Rehman *et al*. 2017), 14-70 % (Shah *et al*. 2016), 19.2-100 % (Kumar *et al*. 2015).

Informant consensus factor (ICF)

There 12 major categories of diseases are mentioned here and for every category ICF value was calculated. The range of ICF values was lied between 0.3 to 0.72 (Table 5). Gastrointestinal disorders had the highest ICF value that was 0.72. The main reason is that mostly the youngsters and children intake less-quality food like fast and junk food. The second highest value was found for dermatological disorders, ICF = 0.61. Heart diseases and cancer had the lowest ICF values, that was 0.3. The main reason for this is that the people are not familiar with these issues, hence are more threatened too; they give less importance to ethnomedicines to treat these disorders in traditional manners. The high ICF values also give the clue that many people in the community are well aware of the use of herbal medicines. Low ICF indicates the lack of knowledge of informants about the use of that plant species. It also indicated that those species were randomly employed by the community for the treatment of a few ailments (Kloutsos *et al*. 2001; Abu-Irmaileh & Afifi 2003). The ICF value range reported by other workers was 0.25-0.35 (Amjad *et al*. 2020), 0.91-0.99 (Singh *et al*. 2017), 0.05-0.4 (Rehman *et al*. 2017), 0.65-0.93 (Shah *et al*. 2016), 0.76-0.93 (Kumar *et al*. 2015), 0-1 (Singh *et al*. 2012).

Table 5. Informants censes factor for ailment categories.

Disease categories	ICF
Gastrointestinal disorders	0.72
Respiratory disorders	0.53
Dermatological problems	0.66
Pains	0.11
Sexual disorders	0.49
Nervous disorders	0.24
Infections	0.59
Fever	0.61
Urinary disorders	0.32
Heart diseases	0.3
Cancer	0.3
Skeletal problems	1.3

Conclusion

It is concluded that the ultimate best solution for curing aggressive diseases in the natural ways is the use of medicinal plants. There is a rich flora of commercially and medicinally useful species in Changa Manga forest. Quantitative studies (ICF, RFC, UV, FL) of the collected data also portrayed the traditional medicinal practices by native people of Changa Manga with high prevalence. Gastrointestinal disorders had the highest ICF = 0.75. *Calotropis procera*, *Datura metel*, *Mentha longifolia*, *Momordica dioica*, and *Tribulus terrestris* have the highest RFC = 0.44, UV = 0.18, and FL values. Their medicinal value was also signified by comparative analysis and giving some pharmacological evidences too. *Calotropis procera* is used for spleen, abdomen, liver disorders, piles, ulcer, and tumors in the form of the paste of leaves, fruit, root, or powder. The extract of the entire plant *Datura metel* is very effective in respiratory issues, muscle spasm, dermatological disorders, sciatica, and aches of the head, tooth, and ear. Decoction and leave extract of *Mentha longifolia* is used to relieve gastrointestinal disorders, pulmonary infection, menstrual disorders, wounds, fever, cough, and infections of the urinary tract. *Momordica dioica* is used in the form of a paste for bleeding piles and infections of the urinary tract. Powder of the whole plant *Tribulus terrestris* is recommended for gynecological and urinary disorders. The plant species that had maximum values of quantitative indices in this study can enroot the further biochemical and biotechnological studies because these plants have great potential for drugs development in biopharma industries.

Declarations

List of abbreviations: IVI-Important Value Index, BGCI-Botanic Gardens Conservation International, COVID-19-Coronavirus disease 2019, M^{pro}-main protease, SARS-CoV-2-Severe Acute Respiratory Syndrome Coronavirus-2, K_i-inhibitory concentration, RFC-Relative Frequency Citation, UV-Use Value, FI-Fidelity Level, ICF-Informants Census Factor.

Ethics approval and consent to participate: Before commencement of interviews, prior informed consent was obtained individually from all the informants.

Consent for publication: Not applicable as no personal data is included in the paper.

Availability of data and materials: Not applicable, as all the data obtained from informants during the study are included in the manuscript.

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