# Quantitative study on medicinal plants traded in selected herbal markets of Khyber Pakhtunkhwa, Pakistan

Sikandar Shah, Sheharyar Khan, Sulaiman, Murad Muhammad, Lal Badshah, Rainer W. Bussmann and Wahid Hussain

## Research


## Abstract

*Background*: This study is the first large-scale medicinal plant survey in the herbal markets of seven Districts of Khyber Pakhtunkhwa, Pakistan. The study provides the first significant catalogue on medicinal plants trade, price patterns, routes and utilization.

*Methods*: Based on semi structured questionnaires, interviews and group discussions with 210 informants (92.86% men and 7.14% women) and personal observations were conducted.

*Results*: A total of 161 plant species and three species of fungi were documented. Among the plants with highest Use Value, *Allium cepa* were used as anthelmintic and carminative, *Bergenia ciliata* for bladder stones and *Brassica campestris* for dandruff and angina. The reported data were analyzed using various ethnobotanical indices such as Use Value (UV), Use Report (UR), Relative Frequency of Citation (RFC) and Cultural Importance Values (CIV). The most cited used plant part was seeds (22.90%), followed by fruits (19.88%), leaves (15.67%) and root (10.24%). The UV ranged from 0.18 (*Seriphidium kurramnse*) to 0.86 (*Allium cepa, Bergenia ciliata*, *Brassica campestris, Carum carvi, Coriandurm sativum* and *Plantago major*). RFC ranged from 0.976 (*Allium cepa*, *Piper nigrum* and *Punica granatum*) to 0.076 (*Nymphaea alba and Seriphidium kurramnse*). The highest mean Cultural Importance (mCI) value was recorded for *Allium cepa* (0.842) and lowest for *Ferula assa-foetida*, *Terminalia chebula* and *Croton tiglium* having each (0.083).

*Conclusions*: The current research confirmed that Khyber Pakhtunkhwa province is an interesting area for traditional plant use that should be studied in more detail.


*Keywords*: Quantitative study, medicinal plants, herbal markets, Khyber Pakhtunkhwa, Pakistan


## Correspondence

**Sikandar Shah[1], Sheharyar Khan[1], Sulaiman[1], Murad Muhammad[1], Lal Badshah[1], Rainer W. Bussmann[2] and Wahid Hussain[3*]**

[1]Department of Botany, University of Peshawar, Peshawar 25000, KP, Pakistan
[2]Institute of Botany, Department of Ethnobotany, Ilia State University, Tbilisi 0105, Georgia
[3]Department of Botany, GPGC Parachinar, District Kurram 26000, KP, Pakistan

[*]Corresponding Author:
wahidhussainwahid@gmail.com


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## Background

Medicinal plants are popular among consumers worldwide, although plant use has been documented back to the Paleolithicum (Petrakou *et al*. 2019) and has been common for millennia (Astutik *et al*. 2019). In developing countries plant based natural medicines are widely used in basic health care systems (Shah *et al*. 2020). Medicinal plants remain

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of importance as main healthcare for approximately 85% of the world's population (Fitzgerald *et al*. 2019; Rasethe *et al*. 2019,). The World Health Organization (WHO) estimated that 65-80% of people from emerging countries depend on natural medications (Tariq *et al*. 2020). About 25% of all synthetic drugs are still based on plant compounds (Bauer and Brönstrup 2014), and plants can supply low-cost medicinal care to developing countries (Djordjevic 2017; Sharif *et al*. 2018), as well as developed nations. Often a large number of species are traded in herbal markets (Ahmad *et al*. 2018; Hoareau and DaSilva 1999), which in turn are influenced by ecological conditions, socio-economic features, development strategies and transportation systems (Botha *et al*. 2004). The herbal business is quickly increasing globally (Kanwal and Sherazi 2017; Cunningham and Long 2019). Europe alone imports about US$ 1 billion worth in medicinal and aromatic plants annually from Asia and Africa (Sher and Hussain 2009). Because of the growing acceptance of herbal medicines, such trade is thought to increase significantly by the year 2050 (Khan *et al*. 2011). Ethnobotanical documentation can have ecological and economic implications, guiding strategic decisions on the sustainable development of agriculture through the introduction of new species for cultivation, and facilitating the protection of wild species from overexploitation (Patsch 2019). Pakistan has a rich tradition in medicinal plant use (Salim *et al.* 2019), out of 600 species used as medicines, 300 species are accessible in markets (Shinwari *et al*. 2002; Sulaiman *et al.* 2020).

The current study was designed to document the traded plant species along with their traditional uses and prices in the herbal markets in seven districts of Khyber Pakhtunkhwa (Banu, Dir, Kurram, Mardan, Peshawar, Swabi and Swat).

## Materials and Methods

### Study Area and Topography

The primary data were gathered from the districts Banu, Dir, Kurram, Mardan, Peshawar, Swabi and Swat of Khyber Pakhtunkhwa, Pakistan, a province located in the North West region of the country. Geographically, the region stretches between 33° 6' 54.9684" N and 71° 5' 43.9260" E, incorporating an area of 101521 km$^2$ (Figure 1). The province is bordered on the north-east by Gilgit-Baltistan (Northern areas), on the north-west by Afghanistan, on the east by Azad Kashmir, on the west and south by the former Federally Administered Tribal Areas (FATA), now merged into the province, and the capital area of Islamabad and Punjab on the west (Rahman and Dawood 2018). Khyber Pakhtunkhwa has hilly and plain areas, distinct cultural differences, temperature variation, vegetation cover, seasonal variation, snow fall and rain patterns. Peshawar is the provincial center and business hub of the province (Sulaiman *et al*. 2020). Topographically the province comprises the Hindu Raj, eastern Hindu Kush, and a portion of the lesser Himalayas, with large steppes bordered by mountains (Khan 2015). The Northern areas (NA) are cold and snowy in wintertime and pleasant in summer, while the southern part is dry in summer and cold in winter (Ali *et al*. 2018). Temperatures of the province greatly fluctuate with altitude, with both temperature and elevation rising from south-north and fall from north-south respectively.

The highest peak is Tirich Mir located in the Hindu Kush range (7690m) (Dawood 2017). Bannu (1227 km²), Mardan (1632 km²), Peshawar (1257 km²) and Swabi (1543 km²) are located in the plains and are the most populated districts of the province covering almost half of the province population while Dir (5282 km²), Kurram (3380 km²), and Swat (5337 km²) are the districts with dense forests, and high altitudes.

### Study Design

Data on harvesting, therapeutic uses and trade of plants were assessed in the seven districts of Khyber Pakhtunkhwa province, Pakistan. These sites were selected because of their physical topographies like, altitude, climate, diversity of plants, geographical location, range of plateaus, herbal plants production, utilization and large markets with more than 80 species traded

### Markets survey and data collection

Ethnomedicinal data, trade and price patterns were collected from March 2018 to April 2020. The information was collected through a purposive sampling method using open ended questionnaires. Face to face interviews and group discussions with different respondents like, collectors, healers, local dealers and traders were conducted in each district. Each herbal market was visited 3-5 times. The information was collected from all those participants who contributed their prior informed consent (Bussmann *et al*. 2007). Data regarding local names, herbal plants production sites, export, import, sales, utilization, parts traded, trade name, market price, uses, demand and supply and diseases treated were documented. The demographics of participants are given in Supplementary Table 1.

### Plant identification

Plants traded in the markets were photographed and collected for identification. The taxa were identified available literature and flora of Pakistan (Ali and Nasir 1989-1992; Ali and Qaiser 1993-2015; Nasir and Ali 1970-1989) at the herbarium Department of

Botany, University of Peshawar. After identification each species name was verified from (http://www.theplantlist.org and www.tropicos.org) and vouchers were deposited in the herbarium Department of Botany, University of Peshawar Khyber Pakhtunkhwa Pakistan.

Figure 1. Map of the study area

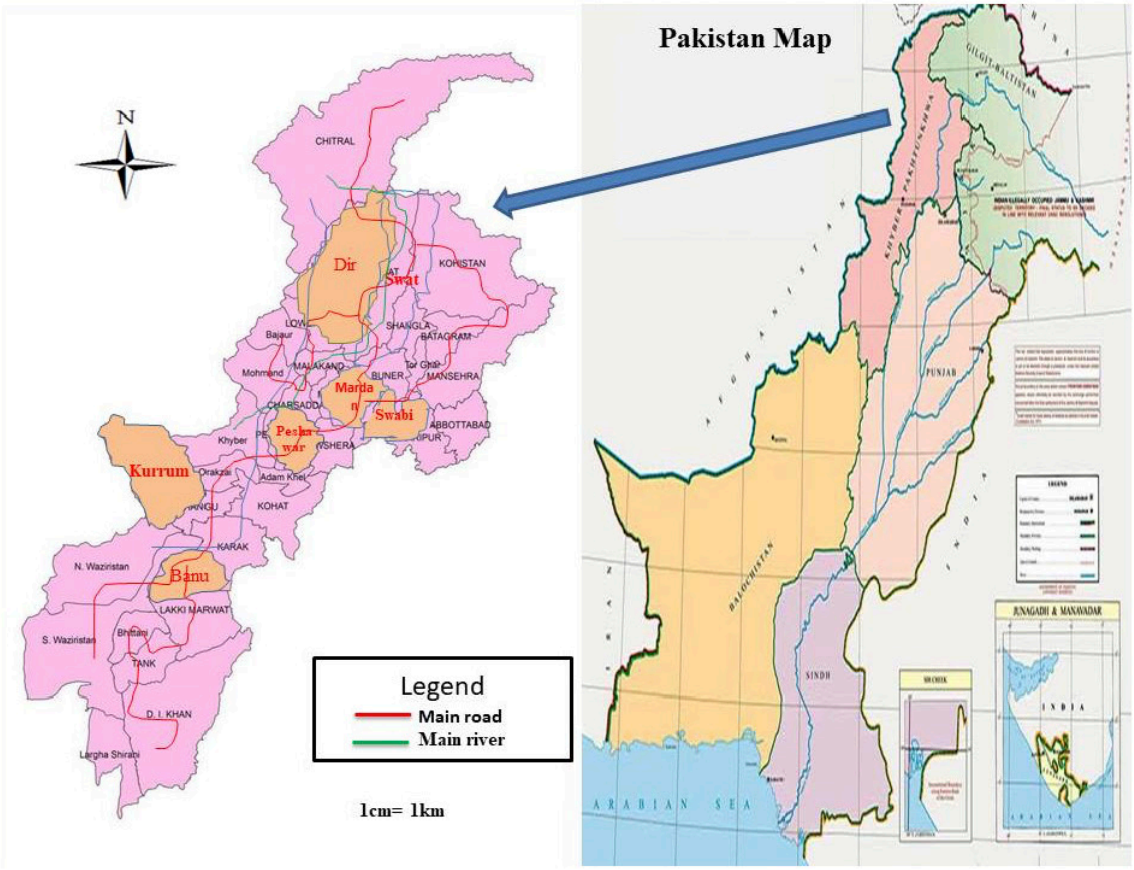


Table 1. Topographic details of selected Districts

| Districts | Population | Area (Km$^2$ ) | Tehsils | Latitude | Longitude | No of Interviewees |
|---|---|---|---|---|---|---|
| Banu | 1,167,892 | 1,227km$^2$ | 5 | 32°59'9.9906"N | 70°36'14.999'E | 30 |
| Dir Lower<br>Dir Upper | 1,435,917<br>946,421 | 1,582 km$^2$<br>3,699 km$^2$ | 2<br>6 | 34°50'9.9906"N<br>35°20'8.22"N | 71°54'16.43"E<br>72°2'48.54"E | 30 |
| Kurrum | 619,553 | 3,330 km$^2$ | 3 | 33°49'7"N | 70°10'24"E | 30 |
| Mardan | 2,373,961 | 1,632 km$^2$ | 5 | 34°11'56.01"N | 72°1'23.21"E | 30 |
| Peshawar | 4,269,079 | 1,257 km$^2$ | 4 | 34°0'54.49"N | 71°31'29.69"E | 30 |
| Swabi | 1,624,616 | 1,543 km$^2$ | 4 | 34°7'26.66"N | 72°27'40.75"E | 30 |
| Swat | 2,309,570 | 5,337 km$^2$ | 7 | 34°46'18.29"N | 72°21'36.54"E | 30 |

**Quantitative Statistical Analysis**

Data collected from markets survey were subjected for statistical analysis to evaluate their medicinal significance. Use Value (UV), Use Report (UR), Relative Frequency of Citation (RFC), Cultural Importance Index (CI).

**Use Value**

The relative importance of specific plant taxa can be determined by Use value. The use value is calculated by using its standard formula:

$$UV = \frac{UVi}{Ni},$$

Where *UVi* represent the sum of the uses documented for species and *Ni* reefers to the frequency of informants cited the species (Ferreira *et al*. 2009; Vitalini *et al*. 2013).

**Use Reports and Relative Frequency of Citation**
RFC highlights important taxa of an area used for many diseases (Idm'hand *et al.* 2020). The data collected from the markets were evaluated for Relative Frequency of Citation (*RFC*) to know the local importance of each species:

$$RFC = \frac{FC}{N} \ (0 < RFC < 1).$$

It is assumed by dividing number of informants mentioning the species (*FC*), by total number of informant's (*N*) participated in the study (Pardo-de-Santayana *et al*. 2007; Yaseen *et al*. 2015)

**Cultural importance Index**
The Cultural Importance of each taxon in every district was calculated by Cultural Importance Index (CI). It is calculated using the Cultural importance formula:

$$CI = URi/ Ni$$

Where UR is the Use Report in each district for each species and Ni is the number of respondents in every district. The mean cultural significance (mCI) for each species was calculated from cultural importance values (Abbasi *et al*. 2013; Kaur and Vashistha 2018; Najem *et al*. 2019).

**Jaccard Similarity Index**
The similarity and differences among the data obtained from seven districts were analyzed through Jaccard index (JI). It is calculated from Jaccard index formula:

$$J(A,B) = (A \cap B) / (A \cup B)$$

Which is the 'number in both districts' divided by the number in either district, and multiplied it with 100 (Abbas *et al*. 2020; Kayani *et al*. 2015;).

## Results and Discussion

**Demographic details of respondents**
In the current study[o] a total of 210 informants from various professions and cultural backgrounds participated in the survey. These included herbalists (34.29%), local people (18.09%), local dealers (16.67%), healers (15.72%), collectors (10%) and traders (5.23%). Among the total respondent's 92.86% were men and 7.14% women, due to the cultural restrictions that prohibit women from talking to strangers. The data as collected in various seasons of the year from informants of different age groups: 56.20% from 40-60 years, 27.14% from 20-40 years and 16.66% of the informants were older than 60 years (Table 2). The majority of the respondents (31.42%) possessed a school diploma (basic 4 years course). In the current study it was observed that the participation of men in the herbal plant trade was far higher than that of women, and thus, only few women (15) could be interviewed. Most participants had more than 15 years of trade experience (53.80%), 29.53% from 11-15 years, and 16.67% had less than 5 years of experience.

Table 2. Demographic information of respondents of selected Districts

| Parameter's | Classes | Frequency of respondents in each class | Percentage |
|---|---|---|---|
| Gender | Male | 195 | 92.86 |
| | Female | 15 | 7.14 |
| Age classes | 20-40 years | 57 | 27.14 |
| | 40-60 years | 118 | 56.20 |
| | Above 60 years | 35 | 16.66 |
| Educational background | Illiterate | 27 | 12.86 |
| | Matriculate | 15 | 7.14 |
| | Intermediate | 42 | 20 |
| | Diploma holder | 66 | 31.42 |
| | Graduate | 53 | 25.23 |
| | Post-graduate | 7 | 3.34 |
| Respondents profession | Collectors | 21 | 10 |
| | Healers | 33 | 15.72 |
| | Herbalists | 72 | 34.29 |
| | Local dealers | 35 | 16.67 |
| | Local people (Nonprofessional) | 38 | 18.09 |
| | Traders (Large scale) | 11 | 5.23 |
| Experience in relevant field | 5-10 years | 35 | 16.67 |
| | 11-15 years | 62 | 29.53 |
| | More than 15 years | 113 | 53.80 |

**Taxonomic classification of medicinal plants**

In the present survey, 164 medicinal taxa from 76 families that were traded and utilized as traditional herbal medicine against various ailments i were documented in herbal markets of the study area. This included 72 families of Angiosperms (159 species), two families of Gymnosperms (two species) and two families of fungi (three species) (Table **3**). The most important plant family was Fabaceae (14 species), followed by Apiaceae (12 species), Asteraceae and Lamiaceae each with 10 species, Zingiberaceae (5 species), Brassicaceae, Combretaceae, Lauraceae, Polygonaceae and Solanaceae with 4 species each (Figure 2). Each taxon was documented along with its market price (US dollars), status (local, imported), uses and trade number (CGP). The most common plant life form traded in the markets was herbs (52.44%), tailed by trees (28.04%), shrub (13.41%) and climber (6.10%).

**Plants parts traded**

The most traded plant parts were seeds (22.90%), followed by fruits (19.88%), leaves (15.67%), roots (10.24%), bark and rhizome (4.82%) as given in (Figure 3). The lesser used parts traded and utilized were corm, latex, pericarp, petals, sap and stigma (0.60%) respectively.

**Availability, trade and price patterns of medicinal plants**

During data collection, availability and average price of each taxon in each district was also documented. A total of 133 species were traded in markets of Peshawar, followed by 128 species in Mardan and Swat, 123 species in Swabi, 118 species in Dir, 109 species in Bannu and 85 species in Kurram. Due to far long location of district Kurram from the business hub (Peshawar), only 86 plants were found. Swat and Kurram are the areas located on maximum distance from the provincial hub.

Among the seven districts, Swat and Kurram were the most important medicinal plant collection sites, i.e. the loications where most species for trade were collected. The species found with the highest trade price per kg (US$ 1400 in Kurram) was *Crocus sativus*, followed by *Ferula assa-foetida* (US$ 180; imported), *Morchella deliciosa* and *Morchella esculenta*, (US$ 11, both) and *Orchis mascula* (US$ 98.5). These species were not utilized locally as commonly as others, probably due to their high price and international export potential. The lowest price was recorded for *Seriphidium kurramense* (0.2$) in Kurram. Currentl, the trade and utilization of *Senna alexandrina* and *Artemisia absinthium* has increased due to their use throughout the country as anti-COVID-19 herbs. According to the informants most of their revenue came from the sale of *Allium cepa, Allium sativum, Brassica campestris, Carum carvi, Camellia sinensis, Coriandurm sativum, Cymbopogon citratus, Foeniculum vulgare, Helianthus annuus, Tamarindus indica, Trachyspermum ammi, Olea ferruginea* and *Zingiber officinale.* Because of their easy availability, low price, daily life uses and high medicinal values these plants were traded and utilized in vast quantity throughout the province. *Seriphidium kurramense* (Kurram), *Garcinia indica* (Peshawar), *Terminalia bellirica* (Swat), *Teucrium stocksianum* (Kurram), *Nymphaea alba* (Peshawar), *Aconitum violaceum* (Swat), *Murraya koenigii* (Peshawar) and *Calvatia gigantea* (Dir), were collected and traded only in one market respectively. The highest Jaccard Index values such as 78.26 between Mardan and Dir, 76.35 between Peshawar-Mardan and 76.05 between Peshawar-Dir indicated that a large number of plants traded were similar between two districts.

**Therapeutic plant uses**

The current research showed insights into the wide utilization of plants by the inhabitants of various districts of Khyber Pakhtunkhwa. The species with high UV and RFC values had everyday use, e.g. *Allium cepa* (bulb) was utilized as anthelmintic, carminative and for wasp bites (Swat). The oil of *Brassica campestris* was used for dandruff and angina (Mardan), and for chest pain (Kurram). The dry seeds of *Coriandurm sativum* were used as anti-cholesterol, flavouring agent and for indigestion (Banu and Swabi). *Camellia sinensis* (leaves) were used in high blood pressure, and to treat obesity (Peshawar and Mardan), *Ficus carica* (fruit) was used against diabetes, amnesia and infertility. The leaves of *Lawsonia inermis* were used against skin problems; *Mentha arvensis* leaves served as remedy for digestive disorders; *Plantago ovata* seeds for constipation and dysentery. *Carum carvi* was used for digestive disorders, *Cymbopogon citratus* for obesity, *Foeniculum vulgare* for stomach problems, *Helianthus annuus* for body weakness, *Tamarindus indica* for constipation, *Trachyspermum ammi* as carminative, *Olea ferruginea* against hair loss, *Zingiber officinale* to remedy fever, *Morchella esculenta* to treat infertility *Piper nigrum* for fever and *Astragalus tribulifolius was used for heat stroke*. *Artemisia absinthium, Senna alexandrina and Seriphidium kurramnse* were used against COVID-19, which was a novelty in dicating the quick reaction of local plant users to confront new health threats. *Seriphidium kurramnse* was locally collected and consumed only in Kurram.

Table 3. Medicinal plants and fungi traded in the selected Herbal Markets of Khyber Pakhtunkhwa, Pakistan.

| Family | Scientific name<br>Trade name<br>Trade sample number | Habit | Part(s) traded | Plant status | Price of each plant in US $/Kg | | | | | | | Medicinal uses | UV | UR | RFC | mCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Banu | Dir | Kurrum | Mardan | Peshawar | Swabi | Swat | | | | | |
| **Acanthaceae** | *Acanthus mollis* L.<br>Tukhme Utangan<br>SAL-1 | C | Leaves | L | 21.0 | - | 21.0 | 20.3 | 20.9 | 20 | - | Diarrhea, antiseptic[K] | 0.41 | 30 | 0.342 | 0.249 |
| **Acoraceae** | *Acorus calamus* L.<br>Sakhawaja<br>SAR-2 | H | Rhizome | L | - | 2.0 | - | 1.7 | 1.5 | 1.3 | 1.3 | Dyspepsia[SW, P], Flatulence | 0.46 | 51 | 0.523 | 0.424 |
| **Amaranthaceae** | *Dysphania botrys* (L.) Mosykin & Clemants<br>Kharwa<br>SDL-3 | H | Leaves | L | 1.2 | 1.2 | - | 1.2 | 1.0 | 1.2 | 1.0 | Diuretic | 0.59 | 69 | 0.552 | 0.382 |
| **Amaryllidaceae** | *Allium cepa* L.<br>Khushk Pyaaz<br>SAB-4 | H | Bulb | L | 1.2 | 1.2 | 1.0 | 1.2 | 1.2 | 1.2 | 1.2 | Anthelmintic, Arteriosclerosis[D], carminative, wasp biting[S] | 0.86 | 177 | 0.976 | 0.842 |
| | *Allium sativum* L.<br>Oaga<br>SAB-5 | H | Bulb | L | 16 | 16.7 | 14.1 | 16.5 | 16.5 | 16.0 | 15.0 | Fever[D], intestinal worms, Ear ache[D], hypertension[S] | 0.73 | 146 | 0.952 | 0.694 |
| **Anacardiaceae** | *Mangifera indica* L<br>Amchoor<br>SMF-6 | T | Powder | L | 1.0 | - | 0.8 | 1.6 | 1.3 | 1.3 | 1.0 | Candidiasis, digestive agent[K] | 0.74 | 126 | 0.809 | 0.699 |
| **Apiaceae** | *Anethum graveolens* L.<br>Soya<br>SAL-7 | H | Leaves | L | - | - | 0.4 | - | 0.6 | 0.5 | - | Bone fracture | 0.46 | 27 | 0.276 | 0.299 |
| | *Carum carvi* L.<br>Toora zera<br>SDS-8 | H | Seeds | L | 7.0 | 7.0 | 6.9 | 7.2 | 7.4 | 7.0 | 8.0 | Indigestion[S], colic[P], Carminative, flavoring agent[K] | 0.86 | 167 | 0.923 | 0.794 |
| | *Centella asiatica* (L.) Urb.<br>Brahmi booti<br>SCL-9 | H | Leaves | L | - | 3.6 | - | - | - | - | 3.0 | Anxiety, Burns[SW] | 0.46 | 20 | 0.204 | 0.333 |
| | *Corianrurm sativum* L.<br>Dhanya<br>SCF-10 | H | Fruit | L | 2.0 | 2.2 | 2.0 | 1.9 | 1.9 | 2.0 | 1.6 | High cholesterol, indigestion[B,SW], carminative | 0.86 | 175 | 0.79 | 0.833 |
| | *Cuminum cyminum* L.<br>Speena Zeera<br>SCS-11 | H | Seeds | L | 4.0 | 4.0 | 3.9 | 4.0 | 4.0 | 4.0 | 5.0 | Insufficient break milk, colic problems[K] | 0.72 | 135 | 0.642 | 0.642 |
| | *Daucus carota* L.<br>Tukhme gajar<br>SDS-12 | H | Seeds | L | 2.0 | 2.1 | - | 2.4 | - | 2.4 | 2.0 | Anemia, eye diseases[S] | 0.50 | 38 | 0.342 | 0.253 |
| | *Ferula assa-foetida* L.<br>Henja<br>SFR-13 | H | Latex | I | - | - | - | - | 180.0 | - | 173.0 | Hysteria[P], expectorant, | 0.16 | 5 | 0.142 | 0.083 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | laxative[P, S], pneumonia | | | | |
| | *Foeniculum vulgare* Mill.<br>Sonf/ Kaga<br>SFS-14 | H | Seeds | L | 2.0 | 1.9 | 2.0 | 1.6 | 1.4 | 2.0 | 1.5 | Colic, stomache[D], colic pain, carminative[K] | 0.71 | 136 | 0.9 | 0.6464 |
| | *Pastinaca sativa* L.<br>Saqaqal<br>SPR-15 | H | Root | L | 17.0 | 17.9 | - | 17.3 | 16.4 | - | - | Diuretic, arthritis | 0.44 | 31 | 0.333 | 0.258 |
| | *Petroselinum crispum* (Mill.) Fuss<br>Jafari<br>SPR-16 | H | Root | L | 39.0 | - | 39.0 | - | - | - | 41.9 | Anemia, ear diseases, body pain[K] | 0.30 | 14 | 0.219 | 0.466 |
| | *Pimpinella anisum* L.<br>Suwa<br>SPS-17 | H | Seeds | L | - | 1.7 | 1.4 | 1.4 | - | - | - | Lice, insecticidal | 0.45 | 25 | 0.261 | 0.277 |
| | *Trachyspermum ammi* (L.) Sprague<br>Ajwain<br>STS-18 | H | Seeds | L | 1.5 | 2.8 | 1.3 | 1.1 | 1.4 | 1.3 | 1.2 | Blocked nose[P], carminative, antiseptic | 0.78 | 117 | 0.714 | 0.556 |
| **Apocynaceae** | *Gymnema sylvestre* (Retz.) R. Br. ex. Sm.<br>Gurmaar booti<br>SGL-19 | C | Leaves | L | - | 6.0 | - | 6.0 | 6.0 | - | 5.0 | Diabetes | 0.54 | 19 | 0.166 | 0.158 |
| | *Rauvolfia serpentina* (L.) Benth ex Kurz<br>Aasrool<br>SRR-20 | S | Root | L | 7.0 | 7.8 | - | 7.1 | 9.6 | - | 6.0 | Heart attack[D], high blood pressure | 0.57 | 61 | 0.509 | 0.406 |
| | *Wrightia antidysenterica* (L.) R.Br.<br>Andar jotalkh<br>SBB-21 | S | Bark | i | 11.0 | 10.8 | - | 8.4 | 7.8 | 11.4 | 11.3 | Mouth sores inflammation[B] | 0.23 | 32 | 0.642 | 0.177 |
| **Arecaceae** | *Areca catechu* L.<br>Gul-e-separi<br>SAF-22 | T | Fruit | i | 5.7 | 5.0 | 5.7 | - | 5.4 | 5.0 | 6.0 | Amenorrhoea, Dysuria[M,D], body tonic[K] | 0.60 | 56 | 0.438 | 0.310 |
| **Ascelpiadaceae** | Calotropis *gigantea* (L.) Dryand.<br>Spalmay / Gule madar<br>SCB-23 | S | Bark | I | 4.0 | 4.8 | - | 3.0 | 3.4 | - | 3.4 | Eye diseases, malaria[M,P] | 0.46 | 30 | 0.309 | 0.199 |
| **Asparagaceae** | *Asparagus racemosus* Willd.<br>Satawar<br>SAR-24 | C | Roots | L | 8.0 | 10.0 | - | 9.6 | 9.6 | 9.4 | 8.3 | Vaginal rejuvenation, Cystitis[SW,D], constipation | 0.44 | 35 | 0.371 | 0.194 |
| **Asphodelaceae** | *Aloe vera* (L.) Burm. f.<br>Khushk aloe vera<br>SAS-25 | H | Sap | L | 4.0 | 4.1 | 3.8 | 3.0 | 4.0 | 4.0 | 4.0 | Skin[P,M], acne[D], smooth skin, antiseptic[K,S] | 0.76 | 119 | 0.738 | 0.566 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Asteraceae** | *Anacyclus pyrethrum* (L.) Lag.<br>Akarkara<br>SAR-26 | H | Root | L | - | 27.0 | - | 19.2 | 23.7 | - | - | Neuralgia, premature ejaculation | 0.39 | 16 | 0.195 | 0.177 |
| | *Artemisia absinthium* L.<br>Absinthen<br>SAL-27 | H | Leaves | L | - | 2.0 | 0.4 | - | 1.7 | - | 2.0 | Crohn's disease[P], Anti COVID-19, antimalarial[K] | 0.41 | 21 | 0.242 | 0.174 |
| | *Carthamus oxyacantha* M. Bieb.<br>Kariza<br>SCS-28 | H | Seeds | L | 5.0 | - | - | 5.2 | - | - | 5.0 | Wounds, worms[M] | 0.24 | 8 | 0.157 | 0.088 |
| | *Carthamus tinctorius* L.<br>Qurtum<br>SCS-29 | H | Seeds | L | - | - | - | 9.6 | 9.0 | - | - | Dysmenorrhea, joint pain | 0.44 | 12 | 0.128 | 0.199 |
| | *Centratherum anthelminticum* (L.) Gamble<br>Zangali Tora zeera<br>SCS-30 | H | Seeds | L | 3.9 | 4.1 | 3.5 | 3.9 | 5.4 | 5.0 | 3.5 | Digestion[P,M], Anemia, Immunity, anti-viral | 0.72 | 136 | 0.890 | 0.647 |
| | *Cichorium intybus* L.<br>Kasni<br>SCL-31 | H | Leaves | L | 2.0 | 2.3 | 2.5 | 1.9 | 1.7 | 2.3 | 1.4 | Kidney diseases, carminative[K] | 0.58 | 84 | 0.680 | 0.399 |
| | *Helianthus annuus* L.<br>Narparas<br>SHS-32 | H | Oil | L | 5.0 | 7.0 | 7.0 | 5.0 | 5.0 | 7.0 | 5.0 | Anti-Aging[D], body weakness[S], Ascaris | 0.73 | 150 | 0.976 | 0.618 |
| | *Matricaria chamomilla* L.<br>Kamilla<br>SMF-33 | H | Flower | L | 8.5 | - | 7.0 | - | 10.2 | 9.0 | - | Colic, teeth problems, anti-fungal[B] | 0.52 | 32 | 0.290 | 0.266 |
| | *Rudbeckia hirta* L.<br>Beekh-e-susan<br>SRR-34 | H | Root | L | 7.0 | 6.0 | 6.1 | 5.8 | 5.1 | 6.0 | 5.0 | Cold, earache, flu, common cold[K] | 0.43 | 32 | 0.347 | 0.152 |
| | *Seriphidium kurramnse* (Qazilb.) Y.R. Ling<br>Gul<br>SSW-35 | S | Whole plant | L | - | - | 0.2 | - | - | - | - | Anti-COVID-19, kill mosquitoes[K] | 0.18 | 3 | 0.076 | 0.1 |
| **Berberidaceae** | *Berberis lyceum* L.<br>Kawry/ Ziar largy<br>SBR-36 | S | Roots | L | 1.0 | 1.2 | 1.5 | 1.0 | 0.7 | 0.9 | 1.0 | Ear infections [D,M], antiseptic for internal wounds[K] | 0.71 | 128 | 0.852 | 0.609 |
| | *Berberis vulgaris* L.<br>Zirshak<br>SBR-37 | S | Root | L | 14.8 | 15.3 | - | 14.4 | 12.5 | 15.0 | 10.0 | Sore throat, nasal congestion, sinusitis[B] | 0.56 | 67 | 0.566 | 0.371 |
| **Boraginaceae** | *Borago officinalis L.*<br>*Gaozuban*<br>*SBL-38* | H | Seeds | I | - | - | - | 1.8 | 2.3 | - | - | Autoimmune diseases, lupus | 0.2 | 6 | 0.142 | 0.099 |
| | *Cordia myxa* L.<br>Lasoora<br>SCF-39 | T | Fruit | L | - | - | - | 4.0 | - | 4.2 | 4.2 | Acid reflux, asthma | 0.47 | 18 | 0.180 | 0.199 |
| | *Onosma echioides* L.<br>Ratan Jot | H | Root | L | - | 5.0 | - | 4.8 | 4.8 | - | 4.3 | Wounds, Bruises, hair loss | 0.20 | 13 | 0.3 | 0.108 |

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| | SRR-40 | | | | | | | | | | | | | | | |
| **Brassicaceae** | *Brassica campestris* L.<br>Rai<br>SBS-41 | H | Oil | L | 2.1 | 2.4 | 0.9 | 1.0 | 1.5 | 1.5 | 1.5 | Dandruff, hair fall, angina[M], chest pain[K] | 0.86 | 174 | 0.961 | 0.828 |
| | *Brassica juncea* L.<br>Rai zard<br>SBS-42 | H | Oil | L | 2.1 | 2.4 | 0.8 | 1.0 | 1.5 | 1.5 | 1.5 | Tetanus, dandruff, hair fall[M], neuralgia[B] | 0.74 | 148 | 0.952 | 0.704 |
| | *Lepidium sativum* L.<br>Aalam<br>SLS-43 | H | Seeds | L | 1.7 | 1.9 | 1.1 | - | 0.9 | - | 2.3 | Anorexia, cough, carminative[K,S] | 0.65 | 89 | 0.647 | 0.593 |
| | *Sisymbrium irio* L.<br>Khub kalan<br>SSS-44 | H | Seeds | L | - | 4.5 | 3.5 | - | - | 4.3 | 4.5 | Ascaris, anthelmintic[K] | 0.26 | 29 | 0.519 | 0.241 |
| **Burseraceae** | *Canarium strictum* Roxb.<br>Dama<br>SCR-45 | T | Resin | L | - | - | - | 4.8 | - | - | 4.8 | Tumor, inflammation[S] | 0.42 | 8 | 0.090 | 0.133 |
| **Cactaceae** | *Opuntia dillenii* (Ker Gawl.) Haw.<br>Tohar<br>SOF-46 | S | Fruit | L | - | - | - | - | 0.3 | - | 0.3 | Liver injury, anemia[S] | 0.30 | 7 | 0.109 | 0.116 |
| **Caprifoliaceae** | *Nardostachys jatamansi* (D. Don) DC<br>Balchar<br>SCR-47 | S | Root | I | - | 14.9 | - | 14.4 | 13.7 | - | - | Alzheimer, epilepsy[D,M], headache | 0.28 | 17 | 0.280 | 0.188 |
| **Caricaceae** | *Carica papaya* L.<br>Papeeta<br>SCF-48 | H | Leaves | L | 1.2 | - | 1.3 | - | 0.6 | 1.3 | 1.0 | Dengue[P], skin peeling, antiviral[K] | 0.61 | 76 | 0.585 | 0.506 |
| **Casuarinaceae** | *Casuarina equisetifolia* L.<br>Mai khurd<br>SCF-49 | T | Fruit | L | 7.4 | - | - | 7.2 | 7.2 | 7.1 | 6.5 | Improve eye sight, immune system | 0.48 | 30 | 0.295 | 0.199 |
| **Clusiaceae** | *Garcinia indica* (Thouras) Choisy<br>Kokum<br>SGS-50 | T | Seeds | L | - | - | - | - | 12.0 | - | - | Obesity | 0.42 | 9 | 0.1 | 0.3 |
| **Colchicaceae** | *Colchicum luteum* Baker<br>Suranjan shirin<br>SCC-51 | H | Corm | L | 12.0 | 12.0 | 12.7 | 10.2 | 15.9 | 10. | 13.2 | Swelling, sexual disability[M], joint pain[K] | 0.60 | 62 | 0.490 | 0.295 |
| **Combretaceae** | *Anogeissus latifolia* (Roxb. ex DC.) Wall.<br>Gule dhao<br>SAF-52 | T | Flower | L | - | 7.8 | - | 8.4 | - | 7.0 | - | Blood disorders | 0.43 | 24 | 0.261 | 0.444 |
| | *Terminalia chebula* Retz.<br>Harid/Myrobalan<br>STS-53 | T | Seeds | L | 2.4 | 2.4 | - | 2.4 | 2.4 | 1.8 | 2.0 | Asthma, stomach problems | 0.20 | 15 | 0.342 | 0.083 |
| | *Terminalia bellirica* (Gaertn.) Roxb.<br>Bheda | T | Fruit | L | - | - | - | - | - | - | 3.2 | Gray hair, ascaris | 0.38 | 7 | 0.085 | 0.233 |

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| | STF-54 | | | | | | | | | | | | | | | |
| | *Terminalia arjuna* (Roxb.) Wight & Arn.<br>Arjun ki Chaal<br>STB-55 | T | Bark | L | 3.5 | - | - | - | 3.8 | 3.6 | - | Kidney stones, angina pectoris[B] | 0.42 | 16 | 0.180 | 0.177 |
| **Convovlulaceae** | *Cascuta reflexa* Roxb.<br>Aftiyon/Dooder<br>CHW-56 | H | Whole Plant | L | 2.5 | - | - | 2.8 | - | 1.8 | 2.0 | Emmenagogue, Eczema | 0.54 | 41 | 0.357 | 0.341 |
| | *Ipomoea nil* (L.) Roth.<br>Tukhm-e-neel<br>SIS-57 | C | Seed | L | 8.6 | 8.4 | - | - | 9.0 | 8.0 | 9.0 | Ascaris, asthma[SW] | 0.55 | 44 | 0.380 | 0.293 |
| **Cucurbitaceae** | *Cucumeropsis mannii* Naudin<br>Char maghz<br>SCF-58 | H | Fruit | L | 7.2 | 7.8 | - | 9.0 | 9.0 | 8.8 | 10.0 | Lotion | 0.27 | 27 | 0.476 | 0.149 |
| | *Momordica charantia* L.<br>Khushk kareela<br>SMF-59 | C | Fruit | L | 2.0 | 2.6 | - | 0.6 | 1.4 | 1.6 | 1.2 | Metabolic disorders | 0.57 | 63 | 0.527 | 0.349 |
| **Ebenaceae** | *Diospyros lotus* L.<br>Tour amlok<br>SDF-60 | T | Fruit | L | 0.5 | 0.5 | 0.2 | 0.5 | 0.5 | 0.4 | 0.7 | Sedative, fever, chest pain, cough[K] | 0.71 | 138 | 0.91 | 0.656 |
| **Euphorbiaceae** | *Croton tiglium* L.<br>Jamalkota<br>SCS-61 | T | Seeds | I | 3.0 | - | - | 3.0 | - | 3.0 | 3.4 | Constipation[S], stomach problems | 0.4 | 10 | 0.119 | 0.083 |
| | *Mallotus philippensis* (Lam.) Müll. Arg.<br>Kambela<br>SMF-62 | T | Fruit | L | - | - | - | - | - | 0.2 | 0.2 | Ascaris, stomach pain[S], alexeteric | 0.43 | 13 | 0.142 | 0.433 |
| | *Ricinus communis* L.<br>Tukhme arand<br>SRS-63 | S | Seeds | L | 5.0 | - | 5.7 | 5.4 | 6.0 | - | 2.4 | Liver diseases, melisma | 0.5 | 29 | 0.276 | 0.241 |
| **Fabaceae** | *Acacia modesta* Wall.<br>Cheer<br>SAG-64 | T | Gum | L | 12.8 | 12.0 | - | 14.4 | 12.0 | 12.0 | 6.3 | Relaxant, Fatigue, red eyes[SA,M] | 0.66 | 107 | 0.761 | 0.594 |
| | *Albizia lebbeck (L.) Benth.*<br>*Tukhm-e-saras*<br>*SAS-65* | T | Seeds | L | 5.0 | - | - | 7.2 | 6.0 | 4.0 | 5.4 | Urticaria, asthma[P] | 0.54 | 49 | 0.428 | 0.326 |
| | *Astragalus tribulifolius* Benth. ex Bunge<br>Gondkateera<br>SAR-116 | H | Gum | L | 8.0 | 8.3 | - | 4.4 | 3.0 | 5.8 | 2.4 | Cooling, heat stroke, adaptogenic | 0.78 | 136 | 0.823 | 0.755 |
| | *Butea monosperma (Lam.) Taub.*<br>*Kamar kas*<br>*SBRG-66* | T | Root, Gum | L | 5.2 | 6 | 7.0 | 4.8 | 4.8 | 6.4 | 5.0 | Back pain, Kidney diseases, postpartum[K] | 0.70 | 80 | 0.619 | 0.380 |
| | *Cassia fistula* L.<br>Amaltas<br>SCF-67 | T | Fruit | L | 0.9 | 1.6 | 0.5 | 0.8 | 0.7 | 1.8 | 2.0 | Constipation, abdominal disorders[K] | 0.70 | 131 | 0.880 | 0.623 |

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| | *Cullen corylifolium* (L.) Medik.<br>Babchi<br>SCS-68 | H | Seeds | i | - | 1.4 | - | 1.0 | 1.4 | - | - | Leprosy | 0.46 | 13 | 0.133 | 0.144 |
| | *Glycyrrhiza glabra L.*<br>Multhi/ Aslsoos<br>SGR-69 | H | Root | L | 1.2 | 3.6 | 2.5 | 1.2 | 1.2 | 1.2 | 1.0 | Cough[B], female body tonic after delivery | 0.23 | 23 | 0.47 | 0.109 |
| | *Medicago sativa* L.<br>Peshtary<br>SML-70 | H | Leaves | L | - | - | 1.1 | 0.6 | - | 1.0 | - | Anorexia, Laryngitis, tonic[K] | 0.24 | 16 | 0.314 | 0.177 |
| | *Mimosa pudica* L.<br>Lajwanti bareek<br>SSS-71 | H | Seeds | i | - | 1.0 | 1.9 | 2.7 | - | - | - | Dysentery, colic pain, chest pain[K] | 0.51 | 27 | 0.247 | 0.3 |
| | *Mucuna pruriens* (L.) DC.<br>Konche Sufaid<br>SMS-72 | C | Seeds | L | - | - | - | - | 6.0 | 6.0 | 6.0 | Parkinson's disease, erectile dysfunction[D] | 0.55 | 25 | 0.214 | 0.277 |
| | *Senna alexandrina* Mill.<br>Sana Mukhii<br>SSL-73 | S | Leaves | I | 14.2 | 14.9 | 16.3 | 14.0 | 14.0 | 15.0 | - | Enhance immunity, lungs infection, Anti COVID-19 | 0.75 | 159 | 0.966 | 0.883 |
| | *Senna tora* (L.) Roxb.<br>Tukhm-e-panawr<br>SSS-74 | H | Seeds | L | 4.5 | - | 4.2 | - | 4.0 | - | - | Eye infections, reduce weight | 0.45 | 14 | 0.147 | 0.155 |
| | *Tamarindus indica* L.<br>Imli<br>STF-75 | T | Fruit | L | 1.5 | 1.3 | 0.9 | 1.6 | 2.0 | 2.0 | 2.4 | Heat stroke, constipation[S], abscess, carminative[K] | 0.71 | 150 | 0.952 | 0.713 |
| | *Trigonella foenum-graecum* L.<br>Mulhuzay<br>STS-76 | H | Seed | L | 4.0 | 5.0 | 3.9 | 4.8 | 4.7 | 4.5 | 4.0 | Allergy, fever[S], child urination | 0.35 | 64 | 0.828 | 0.304 |
| | *Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.<br>Gul-e-babol<br>SVG-77 | T | Gum | L | 4.0 | 4.2 | 3.3 | 3.6 | 3.0 | 4.5 | 5.3 | Join pain, leucorrhea, chordae, constipation[K] | 0.60 | 50 | 0.390 | 0.237 |
| **Fagaceae** | *Quercus infectoria* G. Olivier<br>Mazu sabz<br>SQF-78 | T | Fruit | I | - | - | - | - | 12.0 | 12.0 | 10.0 | Astringent, chilblains, halitosis | 0.37 | 18 | 0.228 | 0.199 |
| **Geraniaceae** | *Geranium wallichianum* D. Don ex Sweet<br>Sraazeela<br>SGR-79 | H | Rhizome | L | - | - | - | - | - | 6.3 | 6.3 | Diarrhea, backache, oral ulcer | 0.42 | 8 | 0.090 | 0.037 |
| **Grossulariaceae** | *Ribes uva-crispa* L.<br>Aamla<br>RGL-80 | T | Powder | L | - | 1.8 | 1.6 | 2.0 | 1.8 | 1.6 | - | Hair growth, skin care | 0.46 | 29 | 0.3 | 0.193 |
| **Hypoxidaceae** | *Curculigo orchioides* Gaertn.<br>Siyah Musali<br>SCR-81 | H | Rhizome | L | - | 47.7 | - | 47.1 | 47.1 | - | - | Excessive masturbation, premature ejaculation | 0.22 | 8 | 0.166 | 0.122 |

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| **Iridaceae** | *Crocus sativus* L.<br>Zaafran<br>SCF-82 | H | Stigma | i | 1200.0 | 1200.0 | 1400.0 | 1200.0 | 1200.0 | 1200.0 | 1200.0 | Infertility, azoospermia[D], brain tonic K, good sense of smell[K] | 0.62 | 84 | 0.642 | 0.399 |
| **Juglandaceae** | *Juglans regia* L.<br>Ghuz<br>SJF-83 | T | Fruit | L | 6.0 | 6.0 | 5.2 | 8.0 | 8.0 | 6.0 | 5.4 | Heart diseases[D,P], atherosclerosis | 0.69 | 115 | 0.785 | 0.547 |
| **Lamiaceae** | *Gmelina philippensis Cham. Badhara*<br>*SGR-84* | S | Root | L | - | - | - | - | - | 13.0 | 13.8 | Asthma, bronchitis | 0.4 | 14 | 0.166 | 0.233 |
| | *Lallemantia royleana* (Benth.) Benth.<br>Tukhm-e-malanga<br>SLS-85 | H | Seeds | L | 3.6 | 3.1 | 2.5 | 2.4 | 2.4 | 3.2 | 4.7 | Respiratory problems, cooling effect, constipation | 0.69 | 144 | 0.980 | 0.685 |
| | *Mentha arvensis* L.<br>Khushk Podina<br>SML-86 | H | Leaves | L | 1.0 | 1.6 | 0.5 | 1.0 | 0.9 | 1.0 | 0.6 | Acid reflux, flatulence[S] | 0.67 | 138 | 0.966 | 0.656 |
| | *Mentha longifolia* L.<br>Wenaly<br>SML-87 | H | Leaves | L | 1.0 | 1.9 | 0.5 | 0.9 | 0.9 | 1.0 | 0.4 | Asthma, digestive disorders[S] | 0.71 | 133 | 0.885 | 0.633 |
| | *Ocimum basilicum* L.<br>Gul-e-rehan<br>SOS-88 | H | Seeds | L | 1.2 | 1.8 | 2.5 | 1.5 | 1.0 | 1.5 | 1.0 | Dental health, kidney problems, skin allergy[K] | 0.72 | 110 | 0.723 | 0.523 |
| | *Salvia hispanica* L.<br>Chia seeds<br>SSS-89 | H | Seeds | i | - | 5.5 | 5.5 | - | 5.3 | - | - | Help in digestion, hair growth[M], lose weight | 0.37 | 15 | 0.190 | 0.166 |
| | *Salvia officinalis* L.<br>Khardug<br>SSF-90 | H | Flowers | L | - | - | - | - | - | 4.2 | 4.8 | Candidiasis[D], Menstrual cycle disorders | 0.42 | 12 | 0.133 | 0.199 |
| | *Salvia pratensis* L.<br>Behmn surkh<br>SSR-91 | H | Root | i | - | 4.0 | - | 3.4 | 2.7 | 3.5 | 3.0 | Eye diseases | 0.36 | 17 | 0.219 | 0.113 |
| | *Teucrium stocksianum* Boiss.<br>Speer boti<br>STA-92 | S | Arial parts | L | - | - | 0.7 | - | - | - | - | Stomach problems, reduce obesity | 0.43 | 10 | 0.109 | 0.333 |
| | *Thymus serphyllum* L.<br>Barge uroosa<br>STL-93 | S | Leaves | L | - | - | - | 3.6 | 3.0 | 3.5 | - | Severe coughing, Cold | 0.48 | 22 | 0.214 | 0.244 |
| **Lauraceae** | *Cinnamomum camphora* (L.) J. Presl<br>Kamfoor<br>SCL-94 | T | Leaves | i | 9.0 | 8.6 | - | 8.9 | 8.9 | 8.9 | 10.0 | Rheumatism, eye diseases | 0.47 | 30 | 0.3 | 0.166 |
| | *Cinnamomum verum* J. Presl<br>Daar cheeni/Wars<br>SCB-95 | T | Bark | i | 5.0 | 4.6 | 5.3 | 4.2 | 5.9 | 4.8 | 5.3 | Anorexia, carminative, antiseptic[K] | 0.69 | 138 | 0.942 | 0.656 |
| | *Laurus nobilis* L.<br>Teez pat | T | Leaves | L | - | 2.3 | 3.0 | 2.8 | 3.0 | - | - | Flatulence, dandruff | 0.31 | 52 | 0.795 | 0.433 |

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| | SLLF-96 | | | | | | | | | | | | | | | |
| | *Litsea glutinosa* (Lour.) C.B. Rob.<br>Maida lakri<br>SLB-97 | T | Bark | i | - | - | - | 3.4 | - | 3.4 | 3.4 | Arthritis[P], external bleeding, bruises | 0.36 | 20 | 0.261 | 0.221 |
| **Linaceae** | *Linum usitatissimum* L.<br>Alsi<br>SLS-98 | H | Seed | L | 1.0 | 1.3 | - | 1.1 | 0.8 | 1.0 | 1.0 | Thyroid problems, constipation, blemishes[D] | 0.65 | 91 | 0.657 | 0.505 |
| **Lythraceae** | *Lawsonia inermis* L.<br>Nakreezy<br>SLL-99 | S | Powder | L | 0.8 | 1.0 | 2.0 | 0.8 | 0.8 | 1.0 | 1.3 | Baldness[D,M], Skin problems, coloring agent[S], skin cooling | 0.80 | 163 | 0.966 | 0.775 |
| **Malvaceae** | *Bombax ceiba* L.<br>Mochars<br>SBF-100 | T | Flower | L | 5.0 | 4.8 | - | 6.6 | 4.8 | 4.8 | 5.2 | Impotence, infertility | 0.51 | 69 | 0.63 | 0.383 |
| | *Helicteres isora* L.<br>Marror Phali<br>SHF-101 | S | Fruit | L | - | - | - | - | 6.0 | 6.0 | - | Diarrhea, abdominal disorders | 0.36 | 8 | 0.104 | 0.133 |
| **Meliaceae** | *Azadirachta indica* A. Juss.<br>Tukhm-e-neem<br>SALS-102 | T | Leaves, seeds | L | 1.6 | 3.0 | - | 1.2 | 1.0 | 1.2 | 0.7 | Acne, blackheads, hepatitis[S], body lice | 0.58 | 61 | 0.495 | 0.338 |
| **Menispermaceae** | *Tinospora cordifolia* (Willd.) Miers<br>Gelo<br>STB-103 | C | Bark | L | - | 2.0 | - | 2.7 | 3 | 3.5 | 3.6 | Fever, gout, dengue | 0.64 | 50 | 0.371 | 0.277 |
| **Moraceae** | *Ficus carica* L.<br>Inzar<br>SFF-104 | T | Fruit | L | 3.0 | 2.9 | 4.0 | 3.5 | 3.6 | 3.2 | 2.0 | Diabetes, amnesia, infertility, carminative[K] | 0.77 | 158 | 0.971 | 0.75 |
| | *Ficus palmata* Forsk.<br>Zangali Inzar<br>SFF-105 | T | Fruit | L | 9.6 | - | 8.0 | - | 14.3 | 10.0 | 10.5 | Constipation, gall bladder disease | 0.60 | 74 | 0.585 | 0.493 |
| **Moringaceae** | *Moringa oleifera* Lam.<br>Suhanjana<br>SML-106 | T | Leaves | L | 6.2 | 5.4 | - | 5.8 | 6.0 | 5.8 | 6.0 | Immune system, obesity, water retention | 0.68 | 102 | 0.704 | 0.566 |
| **Myristicaceae** | *Myristica fragrans* Houtt.<br>Jaifal<br>SMS-107 | T | Seeds | i | 10.0 | 10.8 | 6.9 | 7.8 | 6.6 | 6.2 | 8.3 | Drowsiness, dry mouth[P], carminative in children[K] | 0.48 | 35 | 0.342 | 0.166 |
| **Myrtaceae** | *Syzygium aromaticum* (L.) Merr. & L.M. Perry.<br>Lawang<br>SSF-108 | T | Fruit | L | 13.0 | 12.0 | 12.5 | 8.4 | 7.8 | 7.0 | 8.7 | Toothache[S], flavoring agent [K] | 0.65 | 130 | 0.952 | 0.618 |
| **Nymphaeaceae** | *Nymphaea alba* L.<br>Kanwal ka Phool<br>SNF-109 | H | Arial parts | L | - | - | - | 1.2 | - | - | - | Anxiety, acne | 0.5 | 8 | 0.076 | 0.266 |

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| **Oleaceae** | *Olea ferruginea* Wall. ex Aitch<br>Zaitoon<br>SOO-110 | T | Oil | L | 2.0 | 1.5 | 3.9 | 1.4 | 1.2 | 1.5 | 0.8 | Hair fall, fever[S], back pain, carminative[K] | 0.50 | 68 | 0.638 | 0.323 |
| **Orchidaceae** | *Orchis mascula* (L.) L.<br>Salab Misri<br>SOR-111 | H | Root | i | 96.0 | 98.5 | - | 96.0 | 96.0 | - | - | Sexual diseases, libido male | 0.43 | 19 | 0.209 | 0.158 |
| | *Vanilla planifolia* Jacks. ex Andrews<br>Khushboodar<br>SVP-112 | C | Pods | i | 2.0 | - | - | 2.0 | - | 2.0 | - | Flavoring agent, Intestinal gas[M], fever | 0.45 | 14 | 0.147 | 0.155 |
| **Paeoniaceae** | *Paeonia emodi* Royle.<br>Mamaikh<br>SPL-113 | H | Leaves | L | - | 2.3 | - | 1.0 | 0.9 | 2.0 | 1.5 | Biliousness, convulsion | 0.48 | 25 | 0.247 | 0.166 |
| **Papaveraceae** | *Fumaria officinalis* L.<br>Shahtara<br>SFL-114 | H | Leaves | L | 3.7 | 3.6 | 3.9 | 4.5 | 1.9 | - | 2.8 | Skin diseases, blood purifier[K] | 0.48 | 28 | 0.276 | 0.155 |
| | *Papaver somniferum* L.<br>Afeem/ Dooda<br>SPFP-115 | H | Seeds, Pods | L | 2.0 | 1.9 | 1.2 | 1.9 | 1.3 | 1.8 | 2.3 | Coughing, sleep disorders, anodyne[K] | 0.70 | 145 | 0.976 | 0.690 |
| **Pedaliaceae** | *Sesamum indicum* L.<br>Sufaid Tal<br>SSS-117 | H | Seeds | L | 2.6 | 2.9 | - | 2.4 | 2.1 | 2.5 | 3.2 | Skin diseases, insufficient breast milk | 0.59 | 86 | 0.685 | 0.477 |
| **Phyllanthaceae** | *Phyllanthus emblica* L.<br>Khushk Aamla<br>SPF-118 | T | Fruit | L | 4.0 | 3.1 | - | 4.8 | 3.4 | 3.0 | 4.1 | Convalescence, asthenospermia, eye diseases | 0.50 | 47 | 0.333 | 0.260 |
| **Piperaceae** | *Piper cubeba* L. f.<br>Kabab cheeni<br>SPF119 | C | Fruit | i | 0.8 | - | - | 0.6 | 0.6 | 0.8 | - | Flavoring agent | 0.47 | 32 | 0.319 | 0.266 |
| | *Piper longum* L.<br>Falfaledaraz<br>SPF-120 | S | Fruit | L | 11.2 | 11.6 | - | 12.0 | 12.2 | - | - | Diabetes, Infertility | 0.45 | 32 | 0.314 | 0.266 |
| | *Piper nigrum* L.<br>Toor mirch<br>SPF-121 | S | Fruit | L | 12.0 | 12.0 | 6.1 | 4.8 | 3.3 | 3.2 | 3.7 | Fever, carminative, cough[K] | 0.78 | 160 | 0.976 | 0.771 |
| **Plantaginaceae** | *Plantago major* L.<br>Isphagol bareek<br>SPS-122 | H | Seeds | L | 3.0 | 2.2 | 3.0 | 10.8 | 2.0 | 3.0 | 3.8 | Healing of cuts, Constipation, anti-cholestrol | 0.86 | 171 | 0.942 | 0.813 |
| | *Plantago ovata* Forssk.<br>Ispaghol<br>SPS-123 | H | Seeds | L | 3.0 | 2.4 | 3.0 | 10.8 | 1.9 | 4.0 | 4.0 | Constipation, dysentery, anti-cholesterol | 0.66 | 135 | 0.966 | 0.642 |
| **Poaceae** | *Cymbopogon citratus* (DC.) Stapf<br>Lemongrass<br>SCL-124 | H | Leaves | L | 2.0 | 1.9 | 2.1 | 0.7 | 1.2 | 1.3 | 2.3 | Indigestion, loss weight[M,P], low back pain | 0.63 | 125 | 0.942 | 0.594 |
| | *Hordeum vulgare* L.<br>Varbashy<br>SHS-125 | H | Seeds | L | 2.4 | 2.4 | 1.8 | 2.4 | 2.4 | 2.4 | 2.4 | Sore throat, skin diseases[M] | 0.61 | 103 | 0.8 | 0.490 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polygonaceae** | *Rheum australe* D. Don<br>Asarah rewand<br>SRR-126 | H | Rhizome | L | - | 11.9 | - | - | 13.3 | - | - | Cancer, oral herpes, digestive disorders | 0.47 | 11 | 0.109 | 0.199 |
| | *Rumex dentatus* L.<br>Shalkhy<br>SRL-127 | H | Leaves | L | 0.5 | 0.5 | - | 0.3 | 0.5 | 0.3 | 0.2 | Dermatitis | 0.45 | 27 | 0.280 | 0.179 |
| | *Polygonum aviculare* L.<br>Anjabar<br>SPF-128 | H | Leaves | L | - | 2.7 | 3.0 | 2.3 | 2.1 | 2.1 | 2.5 | Colic[D,M], diarrhea, carminative[K] | 0.48 | 31 | 0.304 | 0.147 |
| **Punicaceae** | *Punica granatum* L.<br>Anarsawy<br>SPP-129 | T | Pericarp | L | 0.8 | 1.2 | 0.7 | 0.5 | 0.4 | 0.5 | 0.7 | Coughing, Heart diseases[K] | 0.64 | 132 | 0.976 | 0.628 |
| **Ranunculaceae** | *Aconitum heterophyllum* Wall. ex Royle<br>Zaharmora<br>SAR-130 | H | Rhizome | L | - | - | - | - | - | 4.3 | 4.3 | Headache, skin diseases, joint pain | 0.5 | 10 | 0.95 | 0.628 |
| | *Aconitum violaceum* Jacquem. ex Stapf<br>Zaharboty<br>SAR-131 | H | Root | L | - | - | - | - | - | - | 5.7 | Snake bite, arthritis[S], inflammation | 0.41 | 7 | 0.080 | 0.166 |
| | *Nigella sativa* L.<br>Kalvangi<br>SNS-132 | H | Seeds | L | 3.0 | 3.1 | 4.0 | 3.8 | 2.0 | 2.0 | 3.5 | Cardiovascular disease, chest pain[K] | 0.72 | 110 | 0.723 | 0.523 |
| **Rhamnaceae** | *Sageretia theezans* Brongn.<br>Mamana<br>SSL-133 | S | Leaves | L | - | - | - | - | - | 3.9 | 3.9 | Fever, joint pain[S] | 0.33 | 12 | 0.171 | 0.199 |
| | *Ziziphus jujuba* Mill.,<br>Beera<br>SZF-134 | T | Fruit | L | 1.4 | 2.0 | 0.8 | 1.8 | 4.0 | 1.0 | 1.0 | Insomnia, tonic[P], sex tonic[K] | 0.64 | 122 | 0.904 | 0.580 |
| | *Ziziphus nummularia* (Burm. f.) Wight & Arn.<br>Bera<br>SZF-135 | T | Fruit | L | 1.1 | 1.2 | 0.5 | 0.7 | 0.9 | 1.2 | 0.5 | Cold, diarrhea, inflammation of gums, sex tonic[K] | 0.72 | 132 | 0.871 | 0.628 |
| **Rosaceae** | *Prunus bokhariensis* Royle ex C.K. Schneid.<br>Aalo Bukhara<br>SPF-136 | T | Fruit | L | 2.6 | 2.9 | - | 2.4 | 2.4 | 2.7 | 3.2 | Digestive disorders, cooling effect, eye vision[P,SW], cooling agent[K] | 0.71 | 127 | 0.847 | 0.705 |
| | *Rosa indica* L.<br>gule gulab<br>SRR-137 | S | Petals | L | 0.3 | 0.6 | 0.3 | 0.7 | 1.0 | 0.3 | 0.3 | Dry lips, age spots, anti-constipation[K] | 0.70 | 125 | 0.842 | 0.594 |
| **Rutaceae** | *Aegle marmelos* L. Correa<br>Belgiri<br>SAF-138 | T | Fruit | i | 7.9 | 8.1 | - | 7.8 | 7.8 | 8.0 | - | Constipation, Scurvy, peptic ulcer | 0.45 | 55 | 0.580 | 0.3664 |
| | *Citrus limon* (L.) Osbeck<br>Khushk lemon<br>SCF-139 | H | Fruit | L | 1.0 | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | Smooth digestion, Kidney stones, skin care | 0.73 | 138 | 0.890 | 0.656 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Murraya koenigii* (L.) Spreng.<br>Barg-e-kari<br>SML-140 | T | Leaves | L | - | - | - | - | 8.4 | - | - | Digestive disorders, bruises | 0.43 | 7 | 0.76 | 0.656 |
| | *Zanthoxylum armatum* DC.<br>Dambara<br>SZS-141 | T | Seeds | L | 3.0 | 3.0 | - | 4.8 | 4.2 | 3.4 | 2.3 | Irregular menstrual bleeding[D], leucorrhoea | 0.59 | 98 | 0.78 | 0.544 |
| **Santalaceae** | *Santalum album* L.<br>Sandal<br>SSB-142 | S | Bark | L | - | 46.6 | - | 48.0 | 48.0 | 48.0 | - | Indigestion[P], peeling skin, melisma | 0.41 | 22 | 0.252 | 0.183 |
| **Saxifragaceae** | *Bergenia ciliata* (Haw.) Sternb<br>Zakhm-e-hayat<br>SBR-143 | H | Roots | L | - | 4.0 | - | 4.7 | 4.7 | 4.2 | 4.2 | Bladder stones, conjunctivitis, dysentery[K] | 0.86 | 50 | 0.419 | 0.333 |
| **Schisandraceae** | *Illicium verum* Hook. f.<br>Baadyan<br>SIF-144 | T | Fruit | L | 11.8 | 12.8 | 10.0 | 13.1 | 12.0 | 12.0 | 13.5 | Bloating, colic, stomachache, intestinal gases[K] | 0.53 | 34 | 0.304 | 0.161 |
| **Solanaceae** | *Capsicum annuum* L.<br>Khushk marchaky<br>SCF-145 | H | Fruit | L | 0.3 | 0.4 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | Increase immunity, pain reliever, taste purpose | 0.61 | 87 | 0.676 | 0.414 |
| | *Solanum nigrum* L.<br>Makwa Khushk<br>SSF-146 | H | Fruit | L | 4.2 | - | - | - | 4.2 | - | 4.2 | Acne, abdominal diseases | 0.46 | 13 | 0.133 | 0.414 |
| | *Solanum surrattense* Burm. f.<br>Marhaghon<br>SSF-147 | H | Fruit | L | 5.0 | - | - | - | - | - | 5.2 | Alterative, Asthma | 0.45 | 9 | 0.095 | 0.144 |
| | *Withania coagulans* (Stocks) Dunal<br>Ashwagand<br>SWS-148 | H | Seeds | L | 11.7 | 13.7 | 9.0 | 13.2 | 12.5 | 12.0 | 12.0 | Antidiabetic, liver diseases indigestion[K] | 0.58 | 53 | 0.433 | 0.252 |
| **Tamaricaceae** | *Tamarix aphylla* (L.) H.Karst.<br>Ghaz<br>STB-149 | T | Bark | L | 2.1 | 2.0 | - | 0.4 | 1.4 | - | 0.9 | Astringent | 0.57 | 40 | 0.328 | 0.286 |
| **Theaceae** | *Camellia sinensis* (L.) Kuntze.<br>Shana chai<br>SCL-150 | S | Leaves | i | 6.0 | 6.0 | 6.4 | 6.0 | 4.3 | 6.0 | 5.7 | High blood pressure, obesity[P,M], thermo genic[K] | 0.79 | 162 | 0.971 | 0.771 |
| **Violaceae** | *Viola serpens* Wall. ex Ging.<br>Banafsha<br>SVF-151 | H | Fruit | L | 7.2 | 8.3 | 11.0 | 7.2 | 7.8 | 7.2 | 6.4 | Cough, chest problems[K] | 0.62 | 85 | 0.642 | 0.404 |
| **Vitaceae** | *Vitis vinifera* L.<br>Waskay<br>SVF-152 | C | Fruit | i | 0.8 | 0.8 | 0.4 | 0.8 | 0.8 | 1.0 | 1.5 | Testosterone booster[M], acidosis, carminative[K] | 0.73 | 145 | 0.933 | 0.690 |
| **Zingiberaceae** | *Alpinia galanga* (L.) Willd.<br>Khulanjaan<br>SAR-154 | H | Rhizome | L | - | - | - | 2.4 | 2.0 | 2.0 | - | Impotence[SW], Menstrual cycle disorders | 0.48 | 12 | 0.119 | 0.133 |
| | *Amomum subulatum* Roxb<br>Toor Alaichi<br>SAS-155 | H | Seeds | i | 10.0 | 10.7 | 8.0 | 10.8 | 12.0 | 12.0 | 11.3 | Nervine, Anti-malarial, brain enhancer | 0.71 | 130 | 0.871 | 0.618 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Curcuma longa* L.<br>Korkaman<br>SCR-156 | H | Rhizome | L | 1.5 | 1.4 | 1.3 | 1.4 | 1.2 | 1.4 | 2.1 | High cholesterol[P,M], Alzhemier's, analgesic[K] | 0.63 | 110 | 0.819 | 0.523 |
| | *Elettaria cardamomum* (L.) Maton,<br>Sheen Alaichi<br>SES-157 | H | Seeds | i | 50.0 | 50.0 | 51.0 | 50.0 | 50.0 | 50.0 | 51.0 | Bad breath[M,P], Indigestion, heart burn, cooling effect[K] | 0.66 | 95 | 0.676 | 0.452 |
| | *Zingiber officinale* Roscoe Sonth<br>SZR-153 | H | Rhizome | L | 3.5 | 4.3 | 3.5 | 3.8 | 4.2 | 4.0 | 2.8 | Allergy, tendinitis[P,M], nausea, fever, vomiting[K] | 0.73 | 146 | 0.947 | 0.694 |
| **Zygophyllaceae** | *Fagonia cretica* L.<br>Dhamasa<br>SFL-158 | S | Leaves | L | - | 35.8 | - | 39.1 | 38.0 | - | 36.0 | Diabetes, allergy, liver tonic | 0.60 | 43 | 0.338 | 0.358 |
| | *Peganum harmala* L.<br>Spelany<br>SPS-159 | H | Seeds | L | 1.3 | 1.0 | 1.3 | 1.2 | 1.2 | 1.0 | 2.4 | Analgesic, Stimulate, menstrual flow | 0.60 | 42 | 0.328 | 0.199 |
| **Cycadaceae** | *Cycas revoluta* Thunb.<br>Sago dana<br>SCS-160 | T | Seeds | L | - | - | 3.0 | 1.2 | 1.1 | 1.0 | 1.0 | Burn, bone regeneration, anti-constipation[K] | 0.36 | 14 | 0.180 | 0.093 |
| **Pinaceae** | *Pinus roxburghii* Sarg.<br>Ganda beroza<br>SPR-161 | T | Resin | L | - | 4.7 | 2.9 | - | - | 4.0 | 4.2 | Urinary diseases, Antiseptic, antiseptic, anthelmintic[K] | 0.43 | 20 | 0.219 | 0.166 |
| **Agaricaceae** | *Calvatia gigantea* (Batsch ex pers) Lloyd<br>Kharerry<br>SCW-162 | H | Whole plant | L | - | 1.0 | - | - | - | - | - | Blood clotting | 0.31 | 5 | 0.076 | 0.166 |
| **Morchellaceae** | *Morchella deliciosa* Fr.<br>Husay/Ghusay<br>SMW-163 | H | Whole Plant | L | - | 119.0 | - | 119.0 | - | 119.0 | 119.0 | Infertility[B,M], purgative, emollient | 0.73 | 98 | 0.638 | 0.816 |
| | *Morchella esculenta* Fr.<br>Husay/ Ghusay<br>SMW-164 | H | Whole Plant | L | 100.0 | 119.0 | 99.0 | 119.0 | - | 119.0 | 119.0 | Infertility[B,M], tonic, carminative[K] | 0.78 | 134 | 0.809 | 0.799 |

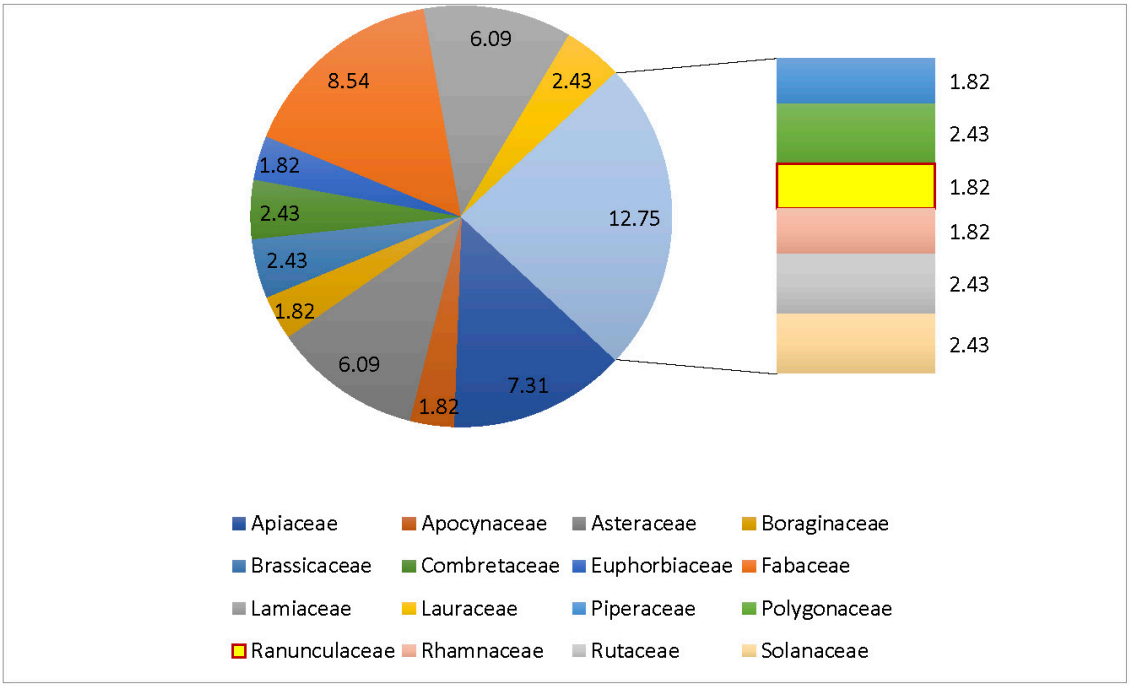


Figure 2. Families having highest percentage of species.

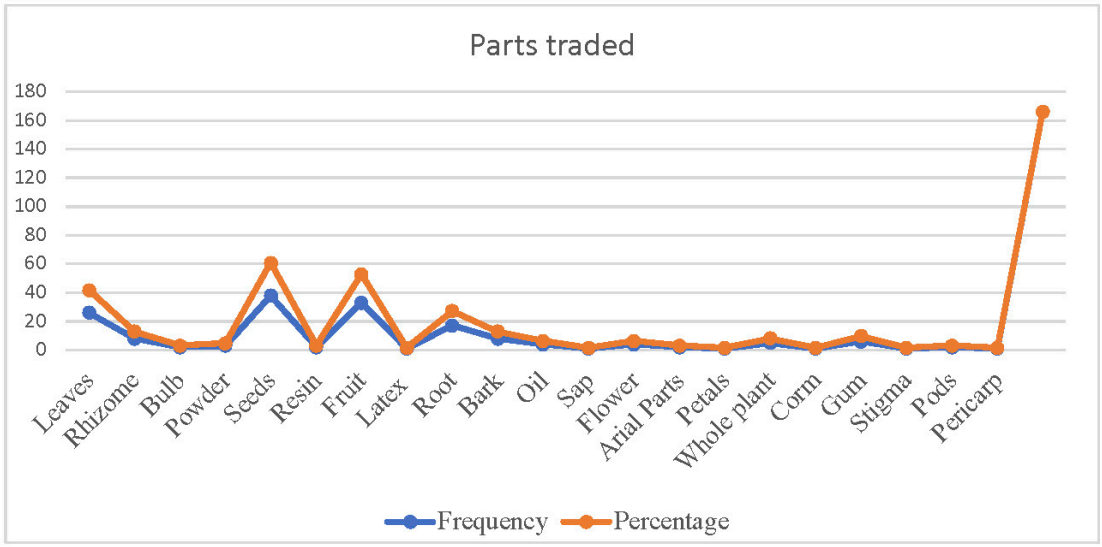


Figure 3. Parts traded having highest frequency

**Trade routes identified**

The marketing routes for trade and commercialization of medicinal plants were derived from the interviews with the informants. Figure 4 shows that the majority of the plant's parts traded in markets of selected districts of Khyber Pakhtunkhwa were collected locally (138 species) while the rest (26 species) were imported from the neighboring countries like China, Nepal, India.

Peshawar (Qissa Khawni bazar) is the central business hub regarding the import and export of medicinal in the Province and all over the country (Figure 5). Mingora (Swat) is the main collection hub for medicinal plants. All the plants collected from Northern areas were brought to Mingora from where they were exported to rest of the Province and all over the country. The herbal markets of Lahore turned out to be the primary trade center getting herbal Figure 5. Routes identified for medicinal plants Trade and Commercialization products and plants from India, China and Karachi. Karachi was the main hub for exporting natural products and plants to abroad

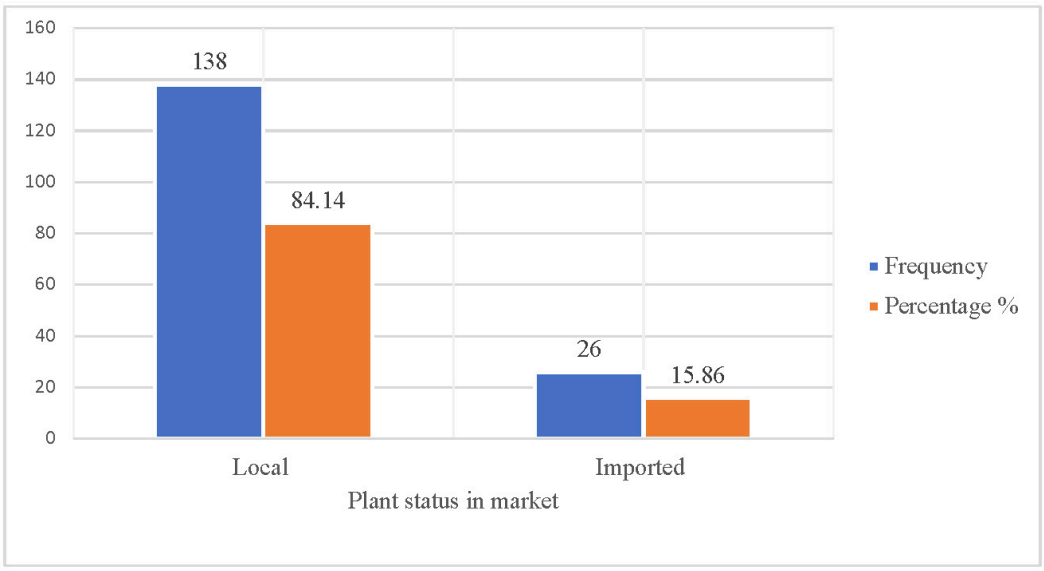


Figure 4. Status of plants traded in herbal markets

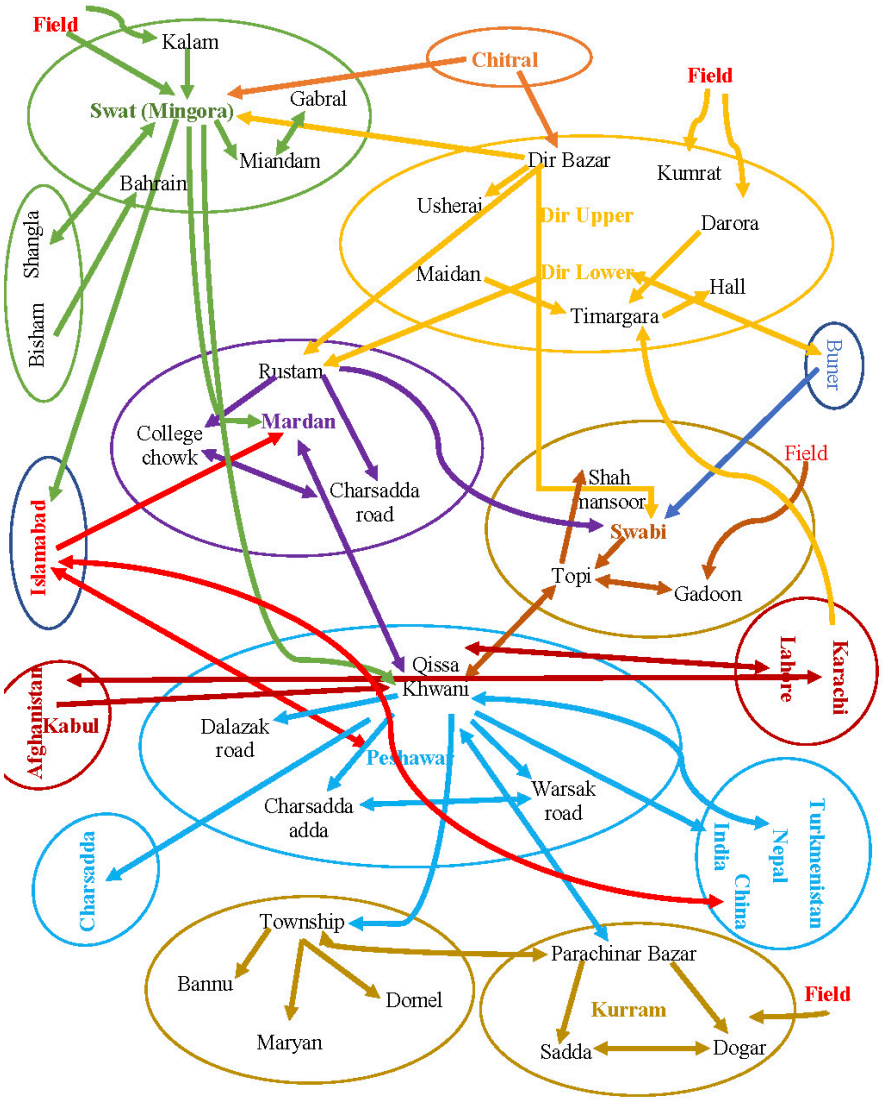


Figure 5. Routes identified for medicinal plants trade and commercialization

**Quantitative appraisal of medicinal plants**

The current study was the first to document medicinal taxa traded in herbal markets of the seven selected districts of Khyber Pakhtunkhwa. In order to quantify and cross check the importance and local uses of plants various analytical techniques were used, such as Use Value, Use Report, Relative Frequency of Citation and Cultural Importance Index.

**Use Value**

UV is used to highlight protuberant species in an area and to enumerate relative importance of medicinal plants (Zenderland *et al*. 2019). In the current study UV ranges from 0.18-0.86. The species with maximum UV were *Allium cepa, Bergenia ciliata*, *Brassica campestris, Carum carvi, Coriandurm sativum* and *Plantago major* each having (0.86) while minimum UV was recorded for *Seriphidium kurramnse* (0.18). Other species having high UV included *Lawsonia inermis* (0.80), *Camellia sinensis* (0.79), *Morchella esculenta, Piper nigrum, Astragalus tribulifolius, Trachyspermum ammi* each having (0.78), *Ficus carica* (0.77) and *Aloe vera* (0.76). The high UV values of the plants resulted from their high number of use reports, local collection, easy availability, ethnopharmacological knowledge and average price.

**Relative Frequency of Citation and Use Report**

RFC ranged from 0.08 to 0.98 The highest RFC value were recorded for *Allium cepa*, *Piper nigrum* and *Punica granatum* (0.976), followed by *Camellia sinensis and Ficus carica* (0.971), *Lawsonia inermis*, *Mentha arvensis*, *Plantago ovata* and *Senna alexandrina*, (0.966) and *Brassica campestris* (0.961). The lowest RFC values were recorded for *Nymphaea alba and Seriphidium kurramnse*. The highest RFC value means the plants and their uses are common among the local healers in the study area. The highest number of use reports were found for *Allium cepa* (177), followed by *Coriandurm sativum* (175), *Brassica campestris* and *Trigonella foenum-graecum* (174) each, *Astragalus tribulifolius (173), and Curcuma longa* (172). The species having least use report was *Seriphidium kurramnse* (3) (Supplementary Table 2 and 3).

**Cultural Importance index**

Cultural Importance index and mean CI index were calculated to quantify the importance values of traded plants. The CI value depends on the intensity of use and quality of use of a species for a disease. The Cultural Importance index highlights the range, worth and uses of a species in each locality (Kamalebo *et al.* 2018). In the current study Cultural importance (CI) and mean cultural importance (mCI) of medicinal plants traded in markets of Khyber Pakhtunkhwa were calculated. The highest mCI value was recorded for *Allium cepa* (0.842), followed by *Coriandurm sativum* (0.833), *Brassica campestris* (0.828) *Morchella deliciosa* (0.816), *Plantago major* (0.813), *Morchella esculenta* (0.799) and *Carum carvi* (0.794). Plants having lowest mCI values were *Ferula assa-foetida*, *Terminalia chebula* and *Croton tiglium* having each (0.083). Various plants are considered sacred because they are cited in holy books (*Allium cepa*, *Brassica campestris, Lawsonia inermis, Punica granatum* in the Quran), (*Coriandurm sativum* in the Bible). All plants having high cultural importance values were harvest and consumed locally. The highest Cultural values recorded for a single species in a single District was 1 for *Lawsonia inermis* (Mardan), *Piper nigrum* (Swabi), *Plantago major* (Peshawar) and *Senna alexandrina* (Peshawar).

**Cross districts assessment**

The similarity among the seven Districts was calculated using the Jaccard index (JI). Table 4 shows the similarity among the species present in seven districts. The highest similarity value recorded was 78.26 between Mardan and Dir, followed by Peshawar and Mardan (76.35), Peshawar and Dir (76.05), Swat and Swabi (74.64). The least Jaccard similarity value was between Peshawar and Kurram (50.30).

Table 4. Jaccard Index of similarity among the selected markets

| | | | | | | |
|---|---|---|---|---|---|---|
| x | | | | | | |
| Bannu | x | | | | | |
| Dir | 66.176 | x | | | | |
| Kurram | 53.658 | 52.30 | x | | | |
| Mardan | 69.784 | 78.26 | 45.833 | x | | |
| Peshawar | 70.714 | 76.05 | 50.704 | 76.35 | x | |
| Swabi | 66.911 | 66.206 | 53.03 | 74.1 | 68.666 | x |
| Swat | 69.064 | 67.808 | 48.591 | 67.32 | 67.741 | 74.64 |

The transfer of medicinal knowledge from one generation to the next is a time dependent process (Hussain *et al*. 2012; Kanwal and Sherazi 2017, Larsen and Smith 2004). Over harvesting is a major problem in the context of medicinal plant use and trade (Hamayun *et al.* 2003).

The number of medicinal plants traded and utilized in the herbal markets of Khyber Pakhtunkhwa was higher than comparative results in previous studies. A total of 133 species were traded in markets of Peshawar, followed by 128 species in Mardan and Swat, 123 species in Swabi, 118 species in Dir, 109 species in Bannu and 85 species in Kurram compared to the 92 plants reported from herbal markets of District Rawalpindi (Punjab Province) (Ahmad *et al*. 2016). Only 44 medicinal plants were traded in herbal markets of Makerwal and Gulla Khel (Zougagh *et al*. 2019), and 103 species were traded in herbal markets of Gilgit-Baltistan (Yebouk *et al*. 2020). Peshawar was however the central hub for medicinal plants trade. Majority of the revenue of herbal dealers were generated from the plants that have average price, easy and local availability, common uses, and traded in each District.
Men were generally more knowledgeable and active in medicinal plants trade and utilization than women, as also found in other studies (Malik *et al*. 2019, Zougagh *et al*. 2019). In our study seeds were the most traded plant part, in contrast to other studies (e.g. Panmei *et al*. 2019) who found leaves as more commonly traded.

**Novelty Profile and Future Research**

The current study is the first cross district study on plant resource utilization and trade in the herbal markets of Khyber Pakhtunkhwa. Plants and their uses such as *Acorus calamus* for flatulence from Mardan, Peshawar and Swabi, *Artemisia absinthium, Senna alexandrina* and *Seriphidium kurramnse* (Kurram) for COVID-19, *Berberis lyceum* and *Butea monosperma* for back pain were reported for the first time from the selected districts. It was also observed and documented that the price and medicinal uses of a plant may be varying from one district to another. Three species *Artemisia absinthium, Senna alexandrina and Seriphidium kurramense* (Kurram) was documented for the first time from Pakistan as anti-COVID-19. Of course the use of plants against COVID-19 has to be seen with a caveat, because the majority of the study occurred before the pandemic.

## Conclusions

The present investigation of traded therapeutic taxa uncovers a rich assorted variety of herbal culture and socio-financial assets of collectors, herbalists, healers, traders and local people inhabited in the herbal markets of Khyber Pakhtunkhwa. During data collection it was also found that due to lack of proper attention and identification various herbal products and plants were unauthenticated, misidentified and not stored in suitable environment (temperature, light, humidity) due to which it may produce huge misunderstanding and hurdles in primary health care. The plants having high importance should be further investigated for their secondary metabolites in clinical scientific laboratories to regulate their potential in treatment of various human ailments in primary health care medical services. A balance is required between the value of plant trade and the environmental services provided by the local vegetation. The increasing supply needed in local markets is a problem mainly because most of the plants are harvested from the wild. As the trade has become international and market-oriented, the activities of a growing number of gatherers are outstripping natural plant populations. Conservation and better management of medicinal plant resources are urgently needed.

## Declarations

**List of abbreviation:** H: Herb; S, Shrub; T: Tree; C, Climber; L: Local; I: Imported; B: Use only in Banu; D: Use only in Dir; K: Use only in Kurram; M: Use only in Mardan; P: Use only in Peshawar; SW: Use only in Swabi; S: Use only in Swat; UR: Use Report; UV: Use Value; RFC: Relative Frequency of Citation; mCI: Mean Cultural Importance value; Kg: Kilogram (Mass unit); $: US dollar

**Ethics approval and consent to participate:** All participants were informed about the aim and objectives of the study and provided their prior informed consent.

**Consent for publication:** Not applicable

**Availability of data and materials:** The data was not deposited in any public sources**.** Data are available from the authors.

**Competing interests:** The author declares no conflict of interest.

**Funding**: This research work did not receive any specific grant from any public or private agency.

**Author contribution:** W. Hussain: Study design and monitor the whole project. Sulaiman and Murad: Conduct surveys and structure the methodology. Sikandar and Sheharyar: Analyze, interpret and write the manuscript. Lal Badshah: Review and proofread the manuscript. R.W. Bussmann: Critical revision of data and manuscript. All authors read, reviewed and approved the manuscript.

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Supplementary Table 1. Socio-demographics of the respondents

| Parameter | Classes | Distribution of frequency in each district | | | | | | | Frequency of respondents in each class | Percentage of respondents |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Banu | Dir | Kurrum | Mardan | Peshawar | Swabi | Swat | | |
| Gender | Male | 29 | 27 | 28 | 28 | 30 | 26 | 27 | 195 | 92.86 |
| | Female | 1 | 3 | 2 | 2 | 0 | 4 | 3 | 15 | 7.14 |
| Age classes | 20-40 years | 5 | 7 | 10 | 6 | 8 | 11 | 10 | 57 | 27.14 |
| | 40-60 years | 18 | 14 | 17 | 16 | 22 | 11 | 20 | 118 | 56.20 |
| | Above 60 years | 7 | 9 | 3 | 8 | 0 | 8 | 0 | 35 | 16.66 |
| Educational background | Illiterate | 4 | 7 | 10 | 0 | 0 | 3 | 3 | 27 | 12.86 |
| | Matriculate | 2 | 4 | 4 | 2 | 1 | 0 | 2 | 15 | 7.14 |
| | Intermediate | 7 | 5 | 5 | 6 | 5 | 8 | 6 | 42 | 20 |
| | Diploma holder | 11 | 9 | 9 | 10 | 9 | 10 | 8 | 66 | 31.42 |
| | Graduate | 6 | 4 | 2 | 9 | 12 | 9 | 11 | 53 | 25.23 |
| | Postgraduate | 0 | 1 | 0 | 3 | 3 | 0 | 0 | 7 | 3.34 |
| Respondents professions | Collectors | 1 | 4 | 6 | 1 | 0 | 2 | 7 | 21 | 10 |
| | Healers | 4 | 6 | 1 | 4 | 5 | 6 | 7 | 33 | 15.72 |
| | Herbalists | 9 | 8 | 7 | 10 | 15 | 14 | 9 | 72 | 34.29 |
| | Local dealers | 8 | 4 | 9 | 6 | 4 | 1 | 3 | 35 | 16.67 |
| | Local people (Nonprofessional) | 7 | 6 | 4 | 9 | 5 | 4 | 3 | 38 | 18.09 |
| | Traders (Wholesale) | 1 | 2 | 3 | 0 | 1 | 3 | 1 | 11 | 5.23 |
| Experience in relevant professions | 5-10 years | 4 | 5 | 7 | 6 | 6 | 4 | 3 | 35 | 16.67 |
| | 11-15 years | 10 | 8 | 9 | 7 | 11 | 7 | 10 | 62 | 29.53 |
| | More than 15 years | 16 | 17 | 14 | 17 | 13 | 19 | 17 | 113 | 53.80 |

*Supplementary* Table 2. Use reports of each medicinal plant traded in selected districts of Khyber Pakhtunkhwa

| Scientific name | UR | Banu | Dir | Kurrum | Mardan | Peshawar | Swabi | Swat |
|---|---|---|---|---|---|---|---|---|
| Angiosperms | | | | | | | | |
| *Acacia modesta* Wall. | 107 | *15* | *18* | - | *21* | *13* | *17* | *23* |
| *Acanthus mollis* L. | 30 | 9 | - | 8 | 4 | 8 | 5 | - |
| *Aconitum heterophyllum* Wall. ex Royle | 10 | - | - | - | - | - | 3 | 7 |
| *Aconitum violaceum* Jacquem. ex Stapf | 7 | - | - | - | - | - | - | 7 |
| *Acorus calamus* L. | 51 | - | 9 | - | 7 | 10 | 14 | 11 |
| *Aegle marmelos* (L.) Correa | 55 | 12 | 9 | - | 16 | 10 | 8 | - |
| *Albizia lebbeck* (L.) Benth. | 49 | 5 | - | - | 18 | 9 | 11 | 6 |
| *Allium cepa* L. | 177 | 27 | 26 | 27 | 22 | 27 | 22 | 26 |
| *Allium sativum* L. | 146 | 20 | 24 | 21 | 11 | 25 | 20 | 25 |
| *Aloe vera* (L.) Burm. f. | 119 | 18 | 18 | 15 | 14 | 16 | 17 | 21 |
| *Alpinia galanga* (L.) Willd. | 12 | - | - | - | 4 | 3 | 5 | - |
| *Amomum subulatum* Roxb | 130 | 21 | 19 | 22 | 14 | 16 | 18 | 20 |
| *Anacyclus pyrethrum* (L.) Lag. | 16 | - | 4 | - | 5 | 7 | - | - |
| *Anethum graveolens* L. | 27 | - | - | 7 | - | 11 | 9 | - |
| *Anogeissus latifolia* (Roxb. ex DC.) Wall. | 24 | - | 8 | - | 7 | - | 9 | - |
| *Areca catechu* L. | 56 | 8 | 7 | 10 | - | 11 | 11 | 9 |
| *Artemisia absinthium* L. | 21 | - | 5 | 7 | - | 4 | - | 5 |
| *Asparagus racemosus* Willd. | 35 | 7 | 5 | - | 5 | 6 | 7 | 5 |
| *Astragalus tribulifolius Benth.* ex Bunge | 136 | *19* | *28* | - | *23* | *19* | *20* | *27* |
| *Azadirachta indica* A.Juss. | 61 | 14 | 11 | - | 9 | 10 | 13 | 4 |
| *Berberis lyceum* L. | 128 | 16 | 14 | 17 | 21 | 17 | 20 | 23 |
| *Berberis vulgaris* L. | 67 | 11 | 8 | - | 9 | 12 | 14 | 13 |
| *Bergenia ciliata* (Haw.) Sternb | 50 | - | 6 | - | 4 | 12 | 16 | 12 |
| *Bombax ceiba* L. | 69 | 13 | 12 | - | 9 | 13 | 12 | 10 |
| *Borago officinalis* L. | 6 | - | - | - | 2 | 4 | - | - |
| *Brassica campestris* L. | 174 | 26 | 24 | 23 | 27 | 25 | 24 | 25 |
| *Brassica juncea* (L.) | 148 | 23 | 19 | 23 | 18 | 20 | 21 | 24 |
| *Butea monosperma* (Lam.) Taub. | 80 | 10 | 6 | 9 | 11 | 13 | 19 | 12 |
| *Calotropis gigantea (*L.) Dryand. | 30 | 6 | 5 | - | 6 | 7 | - | 5 |
| *Camellia sinensis* (L.) Kuntze. | 162 | 29 | 23 | 27 | 19 | 18 | 22 | 24 |
| *Canarium strictum* Roxb. | 8 | - | - | - | 3 | - | - | 5 |
| *Capsicum annuum* L. | 87 | 13 | 10 | 14 | 18 | 6 | 14 | 12 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Carica papaya* L. | 76 | 14 | - | 13 | - | 15 | 16 | 18 |
| *Carthamus tinctorius* L. | 12 | - | - | - | 4 | 8 | - | - |
| *Carthamus oxyacantha* M. Bieb. | 8 | 3 | - | - | 3 | - | - | 2 |
| *Carum carvi* L. | 167 | 24 | 28 | 22 | 25 | 20 | 22 | 26 |
| *Cascuta reflexa* Roxb. | 41 | 9 | - | - | 11 | - | 12 | 9 |
| *Cassia fistula* L. | 131 | 13 | 16 | 20 | 22 | 19 | 20 | 21 |
| *Casuarina equisetifolia* L. | 30 | 6 | - | - | 7 | 4 | 6 | 7 |
| *Centella asiatica* (L.) Urb. | 20 | - | 8 | - | - | - | - | 12 |
| *Centratherum anthelminticum* (L.) Gamble | 136 | 17 | 16 | 19 | 18 | 24 | 23 | 19 |
| *Cichorium intybus* L. | 84 | 13 | 10 | 12 | 14 | 11 | 13 | 11 |
| *Cinnamomum camphora* (L.) J. Presl | 30 | 5 | 6 | - | 3 | 7 | 4 | 5 |
| *Cinnamomum verum* J. Presl | 138 | 23 | 14 | 19 | 21 | 14 | 19 | 28 |
| *Citrus limon* (L.) Osbeck | 138 | 17 | 19 | 23 | 28 | 26 | 15 | 10 |
| *Colchicum luteum* Baker | 62 | 9 | 8 | 6 | 10 | 10 | 7 | 12 |
| *Cordia myxa* L. | 18 | - | - | - | 7 | - | 4 | 7 |
| *Coriandrum sativum* L. | 175 | 24 | 22 | 25 | 27 | 26 | 27 | 24 |
| *Crocus sativus* L. | 84 | 12 | 16 | 13 | 19 | 10 | 9 | 5 |
| *Croton tiglium* L. | 10 | 2 | - | - | 3 | - | 3 | 2 |
| *Cucumeropsis mannii* Naudin | 27 | 6 | 3 | - | 5 | 7 | 2 | 4 |
| *Cullen corylifolium* (L.) Medik. | 13 | - | 5 | - | 6 | 2 | - | - |
| *Cuminum cyminum* L. | 135 | 24 | 13 | 21 | 20 | 22 | 16 | 19 |
| *Curculigo orchioides* Gaertn. | 8 | - | 3 | - | 3 | 2 | - | - |
| *Curcuma longa* L. | 110 | 17 | 16 | 19 | 17 | 15 | 13 | 13 |
| *Cymbopogon citratus* (DC.) Stapf | 125 | 23 | 19 | 12 | 11 | 17 | 25 | 18 |
| *Daucus carota* L. | 38 | 6 | 7 | - | 8 | - | 7 | 10 |
| *Diospyros lotus* L. | 138 | 23 | 19 | 24 | 18 | 11 | 22 | 21 |
| *Dysphania botrys* (L.) Mosykin & Clemants | 69 | 11 | 10 | - | 8 | 17 | 12 | 11 |
| *Elettaria cardamomum* (L.) Maton,- | 95 | 15 | 10 | 14 | 11 | 17 | 15 | 13 |
| *Fagonia cretica* L. | 43 | - | 13 | - | 15 | 9 | - | 6 |
| *Ferula assa-foetida* L | 5 | - | - | - | - | 2 | - | 3 |
| *Ficus carica* L. | 158 | 23 | 19 | 28 | 23 | 27 | 20 | 18 |
| *Ficus palmata* Forsk. | 74 | 23 | - | - | 14 | 18 | 13 | 6 |
| *Foeniculum vulgare* Mill. | 136 | 24 | 20 | 19 | 20 | 18 | 16 | 19 |
| *Fumaria officinalis* L. | 28 | 5 | 3 | 7 | 4 | 3 | - | 6 |
| *Garcinia indica* (Thouras) Choisy | 9 | - | - | - | - | 9 | - | - |
| *Geranium wallichianum* D.Don ex Sweet | 8 | | | | | | 3 | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Glycyrrhiza glabra* L. | 23 | 5 | 3 | 4 | 2 | 3 | 2 | 4 |
| *Gmelina philippensis Cham.* | 14 | - | - | - | - | - | *8* | *6* |
| *Gymnema sylvestre* (Retz.) R.Br. ex. Sm. | 19 | - | 6 | - | 4 | 5 | - | 4 |
| *Helianthus annuus* L. | 150 | 18 | 22 | 21 | 22 | 24 | 19 | 24 |
| *Helicteres isora* L. | 8 | - | - | - | - | 3 | 5 | - |
| *Hordeum vulgare* L. | 103 | 12 | 19 | 17 | 20 | 12 | 13 | 10 |
| *Illicium verum* Hook. f. | 34 | 3 | 4 | 5 | 2 | 7 | 5 | 8 |
| *Ipomoea nil* (L.) Roth. | 44 | 9 | - | - | 11 | 8 | 7 | 6 |
| *Juglans regia* L. | 115 | 23 | 25 | 29 | 13 | 12 | 6 | 7 |
| *Lallemantia royleana (*Benth.) Benth. | 144 | *16* | *13* | *25* | *20* | *14* | *27* | *29* |
| *Laurus nobilis* L. | 52 | - | 16 | 12 | 10 | 14 | - | - |
| *Lawsonia inermis* L. | 163 | 23 | 15 | 22 | 29 | 30 | 19 | 25 |
| *Lepidium sativum* L. | 89 | 17 | 17 | 15 | - | 19 | - | 21 |
| *Linum usitatissimum* L. | 91 | 13 | 19 | | 15 | 11 | 15 | 18 |
| *Litsea glutinosa* (Lour.) C.B. Rob. | 20 | - | - | - | 11 | - | 5 | 4 |
| *Mallotus philippensis* (Lam.) Müll.-Arg. | 13 | - | - | - | - | - | 7 | 6 |
| *Mangifera indica* L | 126 | 24 | - | 18 | 22 | 17 | 20 | 25 |
| *Matricaria chamomilla* L. | 32 | 7 | - | 8 | - | 9 | 8 | - |
| *Medicago sativa* L. | 16 | - | - | 4 | 5 | - | 7 | - |
| *Mentha arvensis* L. | 138 | 13 | 22 | 20 | 14 | 29 | 12 | 28 |
| *Mentha longifolia* L. | 133 | 23 | 15 | 18 | 25 | 29 | 13 | 10 |
| *Mimosa pudica* L. | 27 | - | 9 | 12 | 6 | - | - | - |
| *Momordica charantia* L. | 63 | 10 | 13 | - | 17 | 9 | 7 | 7 |
| *Moringa oleifera* Lam. | 102 | 16 | 25 | - | 19 | 14 | 15 | 13 |
| *Mucuna pruriens* (L.) DC. | 25 | - | - | - | - | 8 | 10 | 7 |
| *Murraya koenigii* (L.) Spreng. | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Myristica fragrans* Houtt. | 35 | 6 | 2 | 7 | 8 | 4 | 2 | 6 |
| *Nardostachys jatamansi* (D. Don) DC | 17 | - | 6 | - | 5 | 6 | - | - |
| *Nigella sativa* L. | 110 | 17 | 12 | 15 | 16 | 14 | 18 | 18 |
| *Nymphaea alba* L. | 8 | - | - | - | 8 | - | - | - |
| *Ocimum basilicum* L. | 110 | 20 | 16 | 12 | 20 | 17 | 15 | 10 |
| *Olea ferruginea* Wall. ex Aitch | 68 | 12 | 9 | 10 | 7 | 8 | 9 | 13 |
| *Onosma echioides* L. | 13 | - | 4 | - | 3 | 3 | - | 3 |
| *Opuntia dillenii* (Ker Gawl.) Haw. | 7 | - | - | - | - | 5 | - | 2 |
| *Orchis mascula* (L.) L. | 19 | 3 | 5 | - | 6 | 5 | - | - |
| *Paeonia emodi* Royle. | 25 | - | 5 | - | 4 | 6 | 3 | 7 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Papaver somniferum* L. | 145 | 23 | 19 | 18 | 20 | 18 | 19 | 28 |
| *Pastinaca sativa* L. | 31 | 9 | 7 | - | 6 | 8 | - | - |
| *Peganum harmala* L. | 42 | 4 | 8 | 6 | 4 | 9 | 5 | 6 |
| *Petroselinum crispum* (Mill.) Fuss | 42 | 15 | - | 11 | - | - | - | 16 |
| *Phyllanthus emblica* L. | 47 | 5 | 12 | - | 8 | 7 | 9 | 6 |
| *Pimpinella anisum* L. | 25 | - | 9 | 8 | 8 | - | - | - |
| *Piper cubeba* L. f. | 32 | 7 | - | - | 8 | 9 | 8 | - |
| *Piper longum* L. | 32 | 8 | 8 | - | 7 | 9 | - | - |
| *Piper nigrum* L. | 160 | 24 | 20 | 29 | 32 | 16 | 30 | 29 |
| *Plantago major* L. | 171 | 22 | 20 | 24 | 29 | 30 | 23 | 23 |
| *Plantago ovata* Forssk. | 135 | 18 | 21 | 24 | 20 | 15 | 22 | 15 |
| *Polygonum aviculare* L. | 31 | 3 | 8 | 5 | 2 | 5 | 4 | 4 |
| *Prunus bokhariensis* Royle ex C.K. Schneid. | 127 | 16 | 13 | - | 23 | 24 | 26 | 25 |
| *Punica granatum* L. | 132 | 19 | 17 | 21 | 20 | 13 | 20 | 22 |
| *Quercus infectoria* G. Olivier | 18 | - | - | - | - | 6 | 8 | 4 |
| *Rauvolfia serpentina* (L.) Benth. ex Kurz | 61 | - | 15 | 14 | 12 | 11 | - | 9 |
| *Rheum australe* D. Don | 11 | - | 5 | - | - | 7 | - | - |
| *Ribes uva-crispa* L. | 29 | - | 6 | 4 | 5 | 9 | 5 | - |
| *Ricinus communis* L. | 29 | - | 7 | - | 8 | 10 | - | 4 |
| *Rosa indica* L. | 125 | 23 | 22 | 16 | 25 | 17 | 10 | 12 |
| *Rudbeckia hirta* L. | 32 | 6 | 4 | 5 | 6 | 4 | 4 | 3 |
| *Rumex dentatus* L. | 27 | 5 | - | - | 4 | 6 | 7 | 5 |
| *Sageretia theezans* Brongn. | 12 | - | - | - | - | - | 7 | 5 |
| *Salvia hispanica* L. | 15 | - | 4 | 7 | - | 4 | - | - |
| *Salvia officinalis* L. | 12 | - | - | - | - | - | 5 | 7 |
| *Salvia pratensis* L. | 17 | - | 4 | - | 3 | 2 | 6 | 2 |
| *Santalum album* L. | 22 | - | 5 | - | 7 | 4 | 6 | - |
| *Senna alexandrina* Mill. | 159 | 23 | 28 | 27 | 25 | 30 | 26 | - |
| *Senna tora* (L.) Roxb. | 14 | 5 | - | 4 | - | 5 | - | - |
| *Seriphidium kurramnse* (Qazilb.) Y.R. Ling | 3 | - | - | 3 | - | - | - | - |
| *Sesamum indicum* L. | 86 | 21 | 16 | - | 18 | 19 | 7 | 5 |
| *Sisymbrium irio* L. | 29 | - | 6 | 8 | - | - | 9 | 6 |
| *Solanum nigrum* L. | 13 | - | - | - | 6 | - | 4 | 3 |
| *Solanum surrattense* Burm. f. | 9 | - | 1 | 2 | 1 | 2 | - | 3 |
| *Syzygium aromaticum* (L.) Merr. & L.M.Perry. | 130 | 19 | 13 | 16 | 14 | 20 | 23 | 25 |
| *Tamarindus indica* L. | 150 | 23 | 26 | 19 | 25 | 20 | 19 | 18 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Tamarix aphylla* (L.) H.Karst. | 40 | 5 | 6 | - | 13 | 12 | - | 4 |
| *Terminalia arjuna* (Roxb. DC.) Wight & Arn. | 16 | 5 | - | - | - | 7 | 4 | - |
| *Terminalia bellirica* (Gaertn .) Roxb. | 7 | - | - | - | - | - | - | 7 |
| *Terminalia chebula* Retz. | 15 | 3 | 2 | - | 4 | 3 | 1 | 2 |
| *Teucrium stocksianum* Boiss. | 10 | - | - | 10 | - | - | - | - |
| *Thymus serphyllum* L. | 22 | - | - | - | 11 | 5 | 6 | - |
| *Tinospora cordifolia (*Willd.) Meirs | 50 | 10 | 7 | - | 6 | 4 | 11 | 12 |
| *Trachyspermum ammi* (L.) Sprague | 117 | 18 | 17 | 15 | 20 | 15 | 18 | 14 |
| *Trigonella* foenum-graecum L. | 64 | 14 | 9 | 12 | 5 | 8 | 6 | 10 |
| *Vachellia nilotica* (L.) P.J.H. Hurter & Mabb. | 50 | 3 | 6 | 5 | 12 | 7 | 9 | 8 |
| *Vanilla planifolia* Jacks.ex Andrews | 14 | 6 | - | - | 5 | - | 3 | - |
| *Viola serpens* Wall. ex Ging. | 85 | 9 | 11 | 6 | 10 | 7 | 18 | 24 |
| *Vitis vinifera* L. | 145 | 19 | 18 | 15 | 23 | 21 | 27 | 22 |
| *Withania coagulans* (Stocks) Dunal | 53 | 7 | 9 | 12 | 6 | 3 | 10 | 6 |
| *Wrightia antudysenterica* (L.) R.Br. | 32 | 6 | 4 | - | 4 | 5 | 6 | 7 |
| *Zanthoxylum armatum* DC. | 98 | 19 | 15 | - | 20 | 12 | 13 | 19 |
| *Zingiber officinale* Roscoe | 146 | 15 | 23 | 24 | 22 | 18 | 23 | 19 |
| *Ziziphus jujuba* Mill. | 122 | 23 | 19 | 16 | 13 | 10 | 22 | 19 |
| *Ziziphus nummularia* (Burm.f.) Wight & Arn. | 132 | 15 | 16 | 20 | 23 | 17 | 22 | 19 |
| Gymnosperms | | | | | | | | |
| *Cycas Revoluta* Thunb. | 14 | - | - | 3 | 4 | 2 | 4 | 1 |
| *Pinus roxburghii* Sarg. | 20 | - | 6 | 4 | - | - | 7 | 3 |
| **Fungi** | | | | | | | | |
| *Calvatia gigantea* (Batsch ex Pers.) Lloyd | 5 | - | 5 | - | - | - | - | - |
| *Morchella deliciosa* Fr. | 98 | - | 23 | - | 25 | - | 29 | 21 |
| *Morchella esculenta* Fr. | 144 | 23 | 28 | 25 | 19 | - | 21 | 28 |

*Supplementary* Table 3. RFC, CI and mCI of each medicinal plant traded in selected districts of Khyber Pakhtunkhwa

| Scientific name | RFC Banu | RFC Dir | RFC Kurrum | RFC Mardan | RFC Peshawar | RFC Swabi | RFC Swat | Σ of all CI | Plant present in districts | mCI |
|---|---|---|---|---|---|---|---|---|---|---|
| **Angiosperms** | | | | | | | | | | |
| *Acacia modesta* Wall. | 0.5 | 0.6 | - | 0.7 | 0.433 | 0.566 | 0.766 | 3.565 | *6* | 0.594 |
| *Acanthus mollis* L. | 0.3 | - | 0.266 | 0.133 | 0.133 | 0.166 | - | 0.998 | 4 | 0.249 |
| *Aconitum heterophyllum* Wall. ex Royle | 0.633 | 0.566 | 0.7 | 0.666 | 0.433 | 0.666 | 0.733 | 4.397 | 7 | 0.628 |
| *Aconitum violaceum* Jacquem. ex Stapf | - | - | - | - | - | 0.1 | 0.233 | 0.333 | 2 | 0.166 |
| *Acorus calamus* L. | - | 0.3 | - | 0.233 | 0.333 | 0.466 | 0.366 | 1.698 | 4 | 0.424 |
| *Aegle marmelos* (L.) Correa | 0.4 | 0.3 | - | 0.533 | 0.333 | 0.266 | - | 1.832 | 5 | 0.3664 |
| *Albizia lebbeck* (L.) Benth. | 0.166 | - | - | 0.6 | 0.3 | 0.366 | 0.2 | 1.632 | 5 | 0.326 |
| *Allium cepa* L. | 0.9 | 0.866 | 0.9 | 0.733 | 0.9 | 0.733 | 0.866 | 5.898 | 7 | 0.842 |
| *Allium sativum* L. | 0.666 | 0.8 | 0.7 | 0.366 | 0.833 | 0.666 | 0.833 | 4.864 | 7 | 0.694 |
| *Aloe vera* (L.) Burm. f. | 0.6 | 0.6 | 0.5 | 0.466 | 0.533 | 0.566 | 0.7 | 3.965 | 7 | 0.566 |
| *Alpinia galanga* (L.) Willd. | - | - | - | 0.133 | 0.1 | 0.166 | - | 0.399 | 3 | 0.133 |
| *Amomum subulatum* Roxb | 0.7 | 0.633 | 0.733 | 0.466 | 0.533 | 0.6 | 0.666 | 4.331 | 7 | 0.618 |
| *Anacyclus pyrethrum* (L.) Lag. | - | 0.133 | - | 0.166 | 0.233 | - | - | 0.532 | 3 | 0.177 |
| *Anethum graveolens* L. | - | - | 0.233 | - | 0.366 | 0.3 | - | 0.899 | 3 | 0.299 |
| *Anogeissus latifolia* (Roxb. ex DC.) Wall. | - | 0.8 | - | 0.233 | - | 0.3 | - | 1.333 | 3 | 0.444 |
| *Areca catechu* L. | 0.266 | 0.233 | 0.333 | - | 0.366 | 0.366 | 0.3 | 1.864 | 6 | 0.310 |
| *Artemisia absinthium* L. | - | 0.166 | 0.233 | - | 0.133 | - | 0.166 | 0.698 | 4 | 0.174 |
| *Asparagus racemosus* Willd. | 0.233 | 0.166 | - | 0.166 | 0.2 | 0.233 | 0.166 | 1.164 | 6 | 0.194 |
| *Astragalus tribulifolius* Benth. ex Bunge | 0.633 | 0.933 | - | 0.766 | 0.633 | 0.666 | 0.9 | 4.531 | *6* | 0.755 |
| *Azadirachta indica* A.Juss. | 0.466 | 0.366 | - | 0.3 | 0.333 | 0.433 | 0.133 | 2.031 | 6 | 0.338 |
| *Berberis lyceum* L. | 0.533 | 0.466 | 0.566 | 0.7 | 0.566 | 0.666 | 0.766 | 4.263 | 7 | 0.609 |
| *Berberis vulgaris* L. | 0.366 | 0.266 | - | 0.3 | 0.4 | 0.466 | 0.433 | 2.231 | 6 | 0.371 |
| *Bergenia ciliata* (Haw.) Sternb | - | 0.2 | - | 0.133 | 0.4 | 0.533 | 0.4 | 1.666 | 5 | 0.333 |
| *Bombax ceiba* L. | 0.433 | 0.4 | - | 0.3 | 0.433 | 0.4 | 0.333 | 2.299 | 6 | 0.383 |
| *Borago officinalis* L. | - | - | - | 0.066 | 0.133 | - | - | 0.199 | 2 | 0.099 |
| *Brassica campestris* L. | 0.866 | 0.8 | 0.766 | 0.9 | 0.833 | 0.8 | 0.833 | 5.798 | 7 | 0.828 |
| *Brassica juncea* (L.) | 0.766 | 0.633 | 0.766 | 0.6 | 0.666 | 0.7 | 0.8 | 4.931 | 7 | 0.704 |
| *Butea monosperma* (Lam.) Taub. | 0.333 | 0.2 | 0.3 | 0.366 | 0.433 | 0.633 | 0.4 | 2.665 | 7 | 0.380 |
| *Calotropis gigantea* (L.) Dryand. | 0.233 | 0.166 | - | 0.2 | 0.233 | - | 0.166 | 0.998 | 5 | 0.199 |
| *Camellia sinensis* (L.) Kuntze. | 0.966 | 0.766 | 0.9 | 0.633 | 0.6 | 0.733 | 0.8 | 5.398 | 7 | 0.771 |
| *Canarium strictum* Roxb. | - | - | - | 0.1 | - | - | 0.166 | 0.266 | 2 | 0.133 |
| *Capsicum annuum* L. | 0.433 | 0.333 | 0.466 | 0.6 | 0.2 | 0.466 | 0.4 | 2.898 | 7 | 0.414 |
| *Carica papaya* L. | 0.466 | - | 0.433 | - | 0.5 | 0.533 | 0.6 | 2.532 | 5 | 0.506 |
| *Carthamus oxyacantha* M. Bieb. | 0.1 | - | - | 0.1 | - | - | 0.066 | 0.266 | 3 | 0.088 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Carthamus tinctorius* L. | - | - | - | 0.133 | 0.266 | - | - | 0.399 | 2 | 0.199 |
| *Carum carvi* L. | 0.8 | 0.933 | 0.733 | 0.833 | 0.666 | 0.733 | 0.866 | 5.564 | 7 | 0.794 |
| *Cascuta reflexa* Roxb. | 0.3 | - | - | 0.366 | - | 0.4 | 0.3 | 1.366 | 4 | 0.341 |
| *Cassia fistula* L. | 0.433 | 0.533 | 0.666 | 0.733 | 0.633 | 0.666 | 0.7 | 4.364 | 7 | 0.623 |
| *Casuarina equisetifolia* L. | 0.2 | - | - | 0.233 | 0.133 | 0.2 | 0.233 | 0.999 | 5 | 0.199 |
| *Centella asiatica* (L.) Urb. | - | 0.266 | - | - | - | - | 0.4 | 0.666 | 2 | 0.333 |
| *Centratherum anthelminticum* (L.) Gamble | 0.566 | 0.533 | 0.633 | 0.6 | 0.8 | 0.766 | 0.633 | 4.531 | 7 | 0.647 |
| *Cichorium intybus* L. | 0.433 | 0.333 | 0.4 | 0.466 | 0.366 | 0.433 | 0.366 | 2.797 | 7 | 0.399 |
| *Cinnamomum camphora* (L.) J.Presl | 0.166 | 0.2 | - | 0.1 | 0.233 | 0.133 | 0.166 | 0.998 | 6 | 0.166 |
| *Cinnamomum verum* J. Presl | 0.766 | 0.466 | 0.633 | 0.7 | 0.466 | 0.633 | 0.933 | 4.597 | 7 | 0.656 |
| *Citrus limon* (L.) Osbeck | 0.566 | 0.633 | 0.766 | 0.933 | 0.866 | 0.5 | 0.333 | 4.597 | 7 | 0.656 |
| *Colchicum luteum* Baker | 0.3 | 0.266 | 0.2 | 0.333 | 0.333 | 0.233 | 0.4 | 2.065 | 7 | 0.295 |
| *Cordia myxa* L. | - | - | - | 0.233 | - | 0.133 | 0.233 | 0.599 | 3 | 0.199 |
| *Coriandrum sativum* L. | 0.8 | 0.733 | 0.833 | 0.9 | 0.866 | 0.9 | 0.8 | 5.832 | 7 | 0.833 |
| *Crocus sativus* L. | 0.4 | 0.533 | 0.433 | 0.633 | 0.333 | 0.3 | 0.166 | 2.798 | 7 | 0.399 |
| *Croton tiglium* L. | 0.066 | - | - | 0.1 | - | 0.1 | 0.066 | 0.332 | 4 | 0.083 |
| *Cucumeropsis mannii* Naudin | 0.2 | 0.1 | - | 0.166 | 0.233 | 0.066 | 0.133 | 0.898 | 6 | 0.149 |
| *Cullen corylifolium* (L.) Medik. | - | 0.166 | - | 0.2 | 0.066 | - | - | 0.432 | 3 | 0.144 |
| *Cuminum cyminum* L. | 0.8 | 0.433 | 0.7 | 0.666 | 0.733 | 0.533 | 0.633 | 4.498 | 7 | 0.642 |
| *Curculigo orchioides* Gaertn. | - | 0.2 | - | 0.1 | 0.066 | - | - | 0.366 | 3 | 0.122 |
| *Curcuma longa* L. | 0.566 | 0.533 | 0.633 | 0.566 | 0.5 | 0.433 | 0.433 | 3.664 | 7 | 0.523 |
| *Cymbopogon citratus* (DC.) Stapf | 0.766 | 0.633 | 0.4 | 0.366 | 0.566 | 0.833 | 0.6 | 4.164 | 7 | 0.594 |
| *Daucus carota* L. | 0.2 | 0.233 | - | 0.266 | - | 0.233 | 0.333 | 1.265 | 5 | 0.253 |
| *Diospyros lotus* L. | 0.766 | 0.633 | 0.8 | 0.6 | 0.366 | 0.733 | 0.7 | 4.598 | 7 | 0.656 |
| *Dysphania botrys* (L.) Mosykin & Clemants | 0.366 | 0.333 | - | 0.266 | 0.566 | 0.4 | 0.366 | 2.297 | 6 | 0.382 |
| *Elettaria cardamomum* (L.) Maton | 0.5 | 0.333 | 0.466 | 0.366 | 0.566 | 0.5 | 0.433 | 3.*164* | 7 | 0.452 |
| *Fagonia cretica* L. | - | 0.433 | - | 0.5 | 0.3 | - | 0.2 | 1.433 | 4 | 0.358 |
| *Ferula assa-foetida* L | - | - | - | - | 0.066 | - | 0.1 | 0.166 | 2 | 0.083 |
| *Ficus carica* L. | 0.766 | 0.633 | 0.933 | 0.766 | 0.9 | 0.666 | 0.6 | 5.264 | 7 | 0.75 |
| *Ficus palmata* Forsk. | 0.766 | - | 0.466 | - | 0.6 | 0.433 | 0.2 | 2.465 | 5 | 0.493 |
| *Foeniculum vulgare* Mill. | 0.8 | 0.66 | 0.633 | 0.666 | 0.6 | 0.533 | 0.633 | 4.525 | 7 | 0.6464 |
| *Fumaria officinalis* L. | 0.166 | 0.1 | 0.233 | 0.133 | 0.1 | - | 0.2 | 0.932 | 6 | 0.155 |
| *Garcinia indica* (Thouras) Choisy | - | - | - | - | 0.3 | - | - | 0.3 | 1 | 0.3 |
| *Geranium wallichianum* D. Don ex Sweet | - | - | - | - | - | 0.1 | 0.166 | 0.266 | 2 | 0.133 |
| *Glycyrrhiza glabra* L. | 0.166 | 0.1 | 0.133 | 0.066 | 0.1 | 0.066 | 0.133 | 0.764 | 7 | 0.109 |
| *Gmelina philippensis Cham.* | - | - | - | - | - | 0.266 | 0.2 | 0.466 | *2* | 0.233 |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Gymnema sylvestre* (Retz.) R.Br. ex. Sm. | - | 0.2 | - | 0.133 | 0.166 | - | 0.133 | 0.632 | 4 | 0.158 |
| *Helianthus annuus* L. | 0.6 | 0.066 | 0.7 | 0.733 | 0.8 | 0.633 | 0.8 | 4.332 | 7 | 0.618 |
| *Helicteres isora* L. | - | - | - | - | 0.1 | 0.166 | - | 0.266 | 2 | 0.133 |
| *Hordeum vulgare* L. | 0.4 | 0.633 | 0.566 | 0.666 | 0.4 | 0.433 | 0.333 | 3.431 | 7 | 0.490 |
| *Illicium verum* Hook.f. | 0.1 | 0.133 | 0.166 | 0.066 | 0.233 | 0.166 | 0.266 | 1.13 | 7 | 0.161 |
| *Ipomoea nil* (L.) Roth. | 0.4 | - | - | 0.366 | 0.266 | 0.233 | 0.2 | 1.465 | 5 | 0.293 |
| *Juglans regia* L. | 0.766 | 0.833 | 0.966 | 0.433 | 0.4 | 0.2 | 0.233 | 3.831 | 7 | 0.547 |
| *Lallemantia royleana (*Benth.) Benth. | 0.533 | 0.433 | 0.833 | 0.666 | 0.466 | 0.9 | 0.966 | 4.797 | 7 | 0.685 |
| *Laurus nobilis* L. | - | 0.533 | 0.4 | 0.333 | 0.466 | - | - | 1.732 | 4 | 0.433 |
| *Lawsonia inermis* L. | 0.766 | 0.5 | 0.733 | 0.966 | 1 | 0.633 | 0.833 | 5.431 | 7 | 0.775 |
| *Lepidium sativum* L. | 0.566 | 0.566 | 0.5 | - | 0.633 | - | 0.7 | 2.965 | 5 | 0.593 |
| *Linum usitatissimum* L. | 0.433 | 0.633 | - | 0.5 | 0.366 | 0.5 | 0.6 | 3.032 | 6 | 0.505 |
| *Litsea glutinosa* (Lour.) C.B.Rob. | - | - | - | 0.366 | - | 0.166 | 0.133 | 0.665 | 3 | 0.221 |
| *Mallotus philippensis* (Lam.) Müll. Arg. | - | - | - | - | - | 0.233 | 0.2 | 0.433 | 1 | 0.433 |
| *Mangifera indica* L | 0.8 | - | 0.6 | 0.733 | 0.566 | 0.666 | 0.833 | 4.198 | 6 | 0.699 |
| *Matricaria chamomilla* L. | 0.233 | - | 0.266 | - | 0.3 | 0.266 | - | 1.065 | 4 | 0.266 |
| *Medicago sativa* L. | - | - | 0.133 | 0.166 | - | 0.233 | - | 0.532 | 3 | 0.177 |
| *Mentha arvensis* L. | 0.433 | 0.733 | 0.666 | 0.466 | 0.966 | 0.4 | 0.933 | 4.597 | 7 | 0.656 |
| *Mentha longifolia* L. | 0.766 | 0.5 | 0.6 | 0.833 | 0.966 | 0.433 | 0.333 | 4.431 | 7 | 0.633 |
| *Mimosa pudica* L. | - | 0.3 | 0.4 | 0.2 | - | - | - | 0.9 | 3 | 0.3 |
| *Momordica charantia* L. | 0.333 | 0.433 | - | 0.566 | 0.3 | 0.233 | 0.233 | 2.098 | 6 | 0.349 |
| *Moringa oleifera* Lam. | 0.533 | 0.833 | - | 0.633 | 0.466 | 0.5 | 0.433 | 3.398 | 6 | 0.566 |
| *Mucuna pruriens* (L.) DC. | - | - | - | - | 0.266 | 0.333 | 0.233 | 0.832 | 3 | 0.277 |
| *Murraya koenigii* (L.) Spreng. | 0.566 | 0.633 | 0.766 | 0.933 | 0.866 | 0.5 | 0.333 | 4.597 | 7 | 0.656 |
| *Myristica fragrans* Houtt. | 0.2 | 0.066 | 0.233 | 0.266 | 0.133 | 0.066 | 0.2 | 1.164 | 7 | 0.166 |
| *Nardostachys jatamansi* (D. Don) DC | - | 0.2 | - | 0.166 | 0.2 | - | - | 0.566 | 3 | 0.188 |
| *Nigella sativa* L. | 0.566 | 0.4 | 0.5 | 0.533 | 0.466 | 0.6 | 0.6 | 3.665 | 7 | 0.523 |
| *Nymphaea alba* L. | - | - | - | 0.266 | - | - | - | 0.266 | 1 | 0.266 |
| *Ocimum basilicum* L. | 0.666 | 0.53 | 0.4 | 0.666 | 0.566 | 0.5 | 0.333 | 3.661 | 7 | 0.523 |
| *Olea ferruginea* Wall. ex Aitch | 0.4 | 0.3 | 0.333 | 0.233 | 0.266 | 0.3 | 0.433 | 2.265 | 7 | 0.323 |
| *Onosma echioides* L. | - | 0.133 | - | 0.1 | 0.1 | - | 0.1 | 0.433 | 4 | 0.108 |
| *Opuntia dillenii* (Ker-Gawl.) Haw. | - | - | - | - | 0.166 | - | 0.066 | 0.232 | 2 | 0.116 |
| *Orchis mascula* (L.) L. | 0.1 | 0.166 | - | 0.2 | 0.166 | - | - | 0.632 | 4 | 0.158 |
| *Paeonia emodi* Royle. | - | 0.166 | - | 0.133 | 0.2 | 0.1 | 0.233 | 0.832 | 5 | 0.166 |
| *Papaver somniferum* L. | 0.766 | 0.633 | 0.6 | 0.666 | 0.6 | 0.633 | 0.933 | 4.831 | 7 | 0.690 |
| *Pastinaca sativa* L. | 0.333 | 0.233 | - | 0.2 | 0.266 | - | - | 1.032 | 4 | 0.258 |
| *Peganum harmala* L. | 0.133 | 0.266 | 0.2 | 0.133 | 0.3 | 0.166 | 0.2 | 1.398 | 7 | 0.199 |
| *Petroselinum crispum* (Mill.) Fuss | 0.5 | - | 0.366 | - | - | - | 0.533 | 1.399 | 3 | 0.466 |
| *Phyllanthus emblica* L. | 0.166 | 0.4 | - | 0.2666 | 0.233 | 0.3 | 0.2 | 1.5656 | 6 | 0.260 |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Pimpinella anisum* L. | - | 0.3 | 0.266 | 0.266 | - | - | - | 0.832 | 3 | 0.277 |
| *Piper cubeba* L.f. | 0.233 | - | - | 0.266 | 0.3 | 0.266 | - | 1.065 | 4 | 0.266 |
| *Piper longum* L. | 0.266 | 0.266 | - | 0.233 | 0.3 | - | - | 1.065 | 4 | 0.266 |
| *Piper nigrum* L. | 0.8 | 0.066 | 0.966 | 1.066 | 0.533 | 1 | 0.966 | 5.397 | 7 | 0.771 |
| *Plantago major* L. | 0.733 | 0.666 | 0.8 | 0.966 | 1 | 0.766 | 0.766 | 5.697 | 7 | 0.813 |
| *Plantago ovata* Forssk. | 0.6 | 0.7 | 0.8 | 0.666 | 0.5 | 0.733 | 0.5 | 4.499 | 7 | 0.642 |
| *Polygonum aviculare* L. | 0.1 | 0.266 | 0.166 | 0.066 | 0.1666 | 0.133 | 0.133 | 1.0306 | 7 | 0.147 |
| *Prunus bokhariensis* Royle ex C.K. Schneid. | 0.533 | 0.433 | - | 0.766 | 0.8 | 0.866 | 0.833 | 4.231 | 6 | 0.705 |
| *Punica granatum* L. | 0.633 | 0.566 | 0.7 | 0.666 | 0.433 | 0.666 | 0.733 | 4.397 | 7 | 0.628 |
| *Quercus infectoria* G. Olivier | - | - | - | - | 0.2 | 0.266 | 0.133 | 0.599 | 3 | 0.199 |
| *Rauvolfia serpentina* (L.) Benth. ex Kurz | - | 0.5 | 0.466 | 0.4 | 0.366 | - | 0.3 | 2.032 | 5 | 0.406 |
| *Rheum australe* D. Don | - | 0.166 | - | - | 0.233 | - | - | 0.399 | 2 | 0.199 |
| *Ribes uva-crispa* L. | - | 0.2 | 0.133 | 0.166 | 0.3 | 0.166 | - | 0.965 | 5 | 0.193 |
| *Ricinus communis* L. | - | 0.233 | - | 0.266 | 0.333 | - | 0.133 | 0.965 | 4 | 0.241 |
| *Rosa indica* L. | 0.766 | 0.733 | 0.533 | 0.833 | 0.566 | 0.333 | 0.4 | 4.164 | 7 | 0.594 |
| *Rudbeckia hirta* L. | 0.2 | 0.133 | 0.166 | 0.2 | 0.133 | 0.133 | 0.1 | 1.065 | 7 | 0.152 |
| *Rumex dentatus* L. | 0.166 | - | - | 0.133 | 0.2 | 0.233 | 0.166 | 0.898 | 5 | 0.179 |
| *Sageretia theezans* Brongn. | - | - | - | - | - | 0.233 | 0.166 | 0.399 | 2 | 0.199 |
| *Salvia hispanica* L. | - | 0.133 | 0.233 | - | 0.133 | - | - | 0.499 | 3 | 0.166 |
| *Salvia officinalis* L. | - | - | - | - | - | 0.166 | 0.233 | 0.399 | 2 | 0.199 |
| *Salvia pratensis* L. | - | 0.133 | - | 0.1 | 0.066 | 0.2 | 0.066 | 0.565 | 5 | 0.113 |
| *Santalum album* L. | - | 0.166 | - | 0.233 | 0.133 | 0.2 | - | 0.732 | 4 | 0.183 |
| *Senna alexandrina*-Mill. | 0.766 | 0.933 | 0.9 | 0.833 | 1 | 0.866 | - | 5.298 | 6 | 0.883 |
| *Senna tora* (L.) Roxb. | 0.166 | - | 0.133 | - | 0.166 | - | - | 0.465 | 3 | 0.155 |
| *Seriphidium kurramnse* (Qazilb.) Y.R. Ling | - | - | 0.1 | - | - | - | - | 0.1 | 1 | 0.1 |
| *Sesamum indicum* L. | 0.7 | 0.533 | - | 0.6 | 0.633 | 0.233 | 0.166 | 2.865 | 6 | 0.477 |
| *Sisymbrium irio* L. | - | 0.2 | 0.266 | - | - | 0.3 | 0.2 | 0.966 | 4 | 0.241 |
| *Solanum nigrum* L. | 0.433 | 0.333 | 0.466 | 0.6 | 0.2 | 0.466 | 0.4 | 2.898 | 7 | 0.414 |
| *Solanum surrattense* Burm. f. | 0.2 | - | 0.133 | - | 0.1 | - | - | 0.433 | 3 | 0.144 |
| *Syzygium aromaticum* (L.) Merr. & L.M.Perry. | 0.633 | 0.433 | 0.533 | 0.466 | 0.666 | 0.766 | 0.833 | 4.33 | 7 | 0.618 |
| *Tamarindus indica* L. | 0.766 | 0.866 | 0.633 | 0.833 | 0.666 | 0.633 | 0.6 | 4.997 | 7 | 0.713 |
| *Tamarix aphylla* -(L.) H.Karst. | 0.166 | 0.3 | - | 0.433 | 0.4 | - | 0.133 | 1.432 | 5 | 0.286 |
| *Terminalia arjuna* (Roxb. DC.) Wight &Arn. | 0.166 | - | - | - | 0.233 | 0.133 | - | 0.532 | 3 | 0.177 |
| *Terminalia bellirica* (Gaertn ) Roxb. | - | - | - | - | - | - | 0.233 | 0.233 | 1 | 0.233 |
| *Terminalia chebula* Retz. | 0.1 | 0.066 | - | 0.133 | 0.1 | 0.033 | 0.066 | 0.498 | 6 | 0.083 |
| *Teucrium stocksianum* Boiss. | - | - | 0.333 | - | - | - | - | 0.333 | 1 | 0.333 |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Thymus serphyllum* L. | - | - | - | 0.366 | 0.166 | 0.2 | - | 0.732 | 3 | 0.244 |
| *Tinospora cordifolia* (Willd.) Meirs | 0.333 | 0.233 | - | 0.2 | 0.133 | 0.366 | 0.4 | 1.665 | 6 | 0.277 |
| *Trachyspermum ammi* (L.) Sprague | 0.6 | 0.566 | 0.5 | 0.666 | 0.5 | 0.6 | 0.466 | 3.898 | 7 | 0.556 |
| *Trigonella foenum-graecum* L. | 0.466 | 0.3 | 0.4 | 0.166 | 0.266 | 0.2 | 0.333 | 2.131 | 7 | 0.304 |
| *Vachellia nilotica* (L.) P.J.H. Hurter & Mabb. | 0.1 | 0.2 | 0.166 | 0.4 | 0.233 | 0.3 | 0.266 | 1.665 | 7 | 0.237 |
| *Vanilla planifolia* Jacks.ex Andrews | 0.2 | - | - | 0.166 | - | 0.1 | - | 0.466 | 3 | 0.155 |
| *Viola serpens* Wall. ex Ging. | 0.3 | 0.366 | 0.2 | 0.333 | 0.233 | 0.6 | 0.8 | 2.832 | 7 | 0.404 |
| *Vitis vinifera* L.- | 0.633 | 0.6 | 0.5 | 0.766 | 0.7 | 0.9 | 0.733 | 4.832 | 7 | 0.690 |
| *Withania coagulans* (Stocks) Dunal | 0.233 | 0.3 | 0.4 | 0.2 | 0.1 | 0.333 | 0.2 | 1.766 | 7 | 0.252 |
| *Wrightia aniudysenterica* (L.) R. Br. | 0.2 | 0.133 | - | 0.133 | 0.166 | 0.2 | 0.233 | 1.065 | 6 | 0.177 |
| *Zanthoxylum armatum* DC. | 0.633 | 0.5 | - | 0.666 | 0.4 | 0.433 | 0.633 | 3.265 | 6 | 0.544 |
| *Zingiber officinale* Roscoe | 0.566 | 0.766 | 0.8 | 0.733 | 0.6 | 0.766 | 0.633 | 4.864 | 7 | 0.694 |
| *Ziziphus jujuba* Mill. | 0.766 | 0.633 | 0.533 | 0.433 | 0.333 | 0.733 | 0.633 | 4.064 | 7 | 0.580 |
| *Ziziphus nummularia* (Burm. f.) Wight & Arn. | 0.5 | 0.533 | 0.666 | 0.766 | 0.566 | 0.733 | 0.6333 | 4.3973 | 7 | 0.628 |
| **Gymnosperms** | | | | | | | | | | |
| *Cycas revoluta* Thunb. | - | - | 0.1 | 0.133 | 0.066 | 0.133 | 0.033 | 0.465 | 5 | 0.093 |
| *Pinus roxburghii* Sarg. | - | 0.2 | 0.133 | - | - | 0.233 | 0.1 | 0.666 | 4 | 0.166 |
| **Fungi** | | | | | | | | | | |
| *Calvatia gigantea* (Batsch ex Pers.) Lloyd | - | 0.166 | - | - | - | - | - | 0.166 | 1 | 0.166 |
| *Morchella deliciosa* Fr. | - | 0.766 | - | 0.833 | - | 0.966 | 0.7 | 3.265 | 4 | 0.816 |
| *Morchella esculenta* Fr. | 0.766 | 0.933 | 0.833 | 0.633 | - | 0.7 | 0.933 | 4.798 | 6 | 0.799 |

**"Questionnaire for Collecting Data from Herbal Markets of Khyber Pakhtunkhwa"**

1. **Market name** ……
2. **Respondent Name** ……
3. **Age** …….
4. **Gender** …….
5. **Respondents Profession** ……...
6. **Experience** ……
7. **Education**

a) Illiterate b) Matriculate c) Intermediate d) Diplomats

e) Graduate f) Post Graduate

8. Income per month of the respondent……

9. List of Plants sold/ used in the specific market

a) ……
b) ……
c)…….....
d)…….
e) …….

10) Part of the specific plant used

| **Plant Name** | **Parts used** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Leaves** | **Stems** | **Roots** | **Flowers** | **Rhizome** | **Bark** | **Bulb** | **Seed** | **Whole plant** |
| | | | | | | | | | |
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| | | | | | | | | | |

11) Price of each plant in local unit

a) …….
b) …….
c)…….....
d)…….
e) …….

12) Plant Availability

a) Local b) Imported

13) If Imported then from which city……

14) Medicinal use of the plant

a) ……
b) ……

c)…….....
d)…….
e) ……

15) Nature of each Plant (Habit)
a) …….
b) ……..
c)…….....
d)…….
e) ……..