

## Medicinal plants used for the treatment of liver diseases in Jammu province (Jammu and Kashmir, India)

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Liver is a vital organ in the human body. Almost all the drugs, foods, and water constituents are metabolized and detoxified in the liver. Liver diseases such as hepatitis, jaundice, cirrhosis, and liver cancer are continuously on the rise in recent years. Limited options are available for the treatment of liver diseases in the allopathic system of medicines. A study was conducted to document the plants used for the treatment of liver diseases in Jammu division of Jammu & Kashmir (J&K), India. Two districts (Doda and Samba) of Jammu province were selected for the study. One hundred twenty respondents were selected for the study, based on random sampling. Face to face interviews were conducted. Forty medicinal plants belonging to 39 genera and 25 families used for the treatment of liver diseases were recorded. Majority of plants were herbs (55%). Most commonly used plant part was root (27%) followed by fruit (22%), leaf (20%), whole plant (12%), seed (10%), stem (3%) and flower, rhizome and bark (2%). The most common mode of consumption was decoction (45.97%). RFC values for species used in treating liver disorders were between 0.02 and 0.30, respectively. FIV was highest for Lamiaceae (3.3) as 10% of the species reported belonged to this family. The study has documented the list of species used against liver disease that may be subjected to pharmacological and phytochemical studies that may be critical for the discovery of novel hepatoprotective drugs.

**Keywords:** Ethnobotany, Liver diseases, Medicinal plants, Western Himalayas

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Health care in India has been dependent on the use of plants as a source of medicine since ages. Plants are primarily used for the preparation of drugs because they are a rich source of secondary metabolites/bioactive compounds that have medicinal properties. There are various Indian Systems of Medicines (ISM) established in the course of many centuries such as Ayurveda, Unani and Siddha<sup>1</sup>. More than 70% of India's population still uses non-allopathic systems of medicines for treating common as well as severe health conditions since these are easily available and affordable<sup>2</sup>. Another reason for people's dependence on herbal medicines may be due to weak healthcare system in the rural areas<sup>3</sup>. Recently, urban population in India and across the globe has revived interest in herbal medicines owing to lesser side effects and lesser risk of contraindications<sup>4</sup>. The use of plants as a source of medicine varies from region to region depending upon their culture and traditions<sup>5</sup>. Ethnobotanical

approaches are significant in highlighting locally important medicinal plant species that can be helpful to ecologists, pharmacologists and taxonomists<sup>6</sup>.

Liver disease is a major health concern for humans as it encompasses a wide range of potential issues that can cause the liver to fail in performing its essential functions. Liver is the largest gland and metabolic engine-room of the body, liver plays a crucial role in detoxifying and metabolizing drugs, food, and water constituents. However, liver can be affected by various factors such as chemicals, infections (bacterial, viral, fungal, or parasitic), and foods, resulting in liver diseases like hepatitis, jaundice, cirrhosis, liver cancer, among others<sup>7</sup>. Liver disease in India is on the rise during the last 3-4 decades<sup>8,9</sup>. In 2015, India has reported 18.3% of the overall worldwide mortality reported as a result of liver diseases<sup>10</sup>. Unfortunately, there are limited options for treating liver diseases within the allopathic system of medicine. A study was therefore planned to document the plants used for the treatment of liver diseases in Jammu province of Jammu and Kashmir, India.

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## Methodology

### Study area

Union territory of Jammu and Kashmir (JKUT) is predominantly a Himalayan region lying between  $32^{\circ} 17'$  and  $36^{\circ} 58'$  North latitude and  $73^{\circ} 26'$  and  $80^{\circ} 30'$  East longitude with an area of 222236 sq. km. The geographical area of J&K is more than the collective neighboring Himalayan countries of Bhutan and Nepal. J&K is mainly mountainous, except for a short belt adjoining the Punjab plains and the valley of Kashmir. Jammu province has three different climatic zones like tropical to sub-tropical, temperate, alpine and cold desert. It has a plethora of natural resources that includes plentiful important medicinal and aromatic plants. In Jammu, two districts *viz.*, Doda and Samba were selected for the present study (Fig. 1). Doda district lies in the outer Himalayan range between  $32^{\circ} 53'$  and  $34^{\circ} 21'$  North latitude and  $75^{\circ} 01'$  and  $76^{\circ} 47'$  East longitude and has an average elevation of 1107 metres. It has an area of 8912 sq. km. Samba district is situated on the foothills of

Himalayas and lies between latitude of  $32^{\circ} 34'$  North and  $75^{\circ} 07'$  East and longitude of  $32^{\circ} 57'$  North and  $75^{\circ} 12'$  East and has an average elevation of 384 m. The key tribes of Jammu and Kashmir include the Dogras, Gujjars, Bakerwal and Gaddi. Gaddi shepherds shuffle between plains of Jammu during winters and upper reaches of Kishtwar, Udhampur and Dodaduring summers<sup>11</sup>.

### Sampling plan

There are 10 districts in Jammu region, out of these, Doda and Samba districts were selected purposively for the present study as they represent two contrasting agroclimatic zones, wherein Doda being temperate to sub-temperate and Samba being predominantly subtropical. There are 8 blocks in Doda district and 4 blocks in Samba district. From each district, half of the blocks were selected purposively, so that no adjacent blocks get selected and the whole of the district is represented. By this way, 6 blocks namely Assar, Bhaderwah, Gundna and Thatri from district Doda and 2 blocks namely

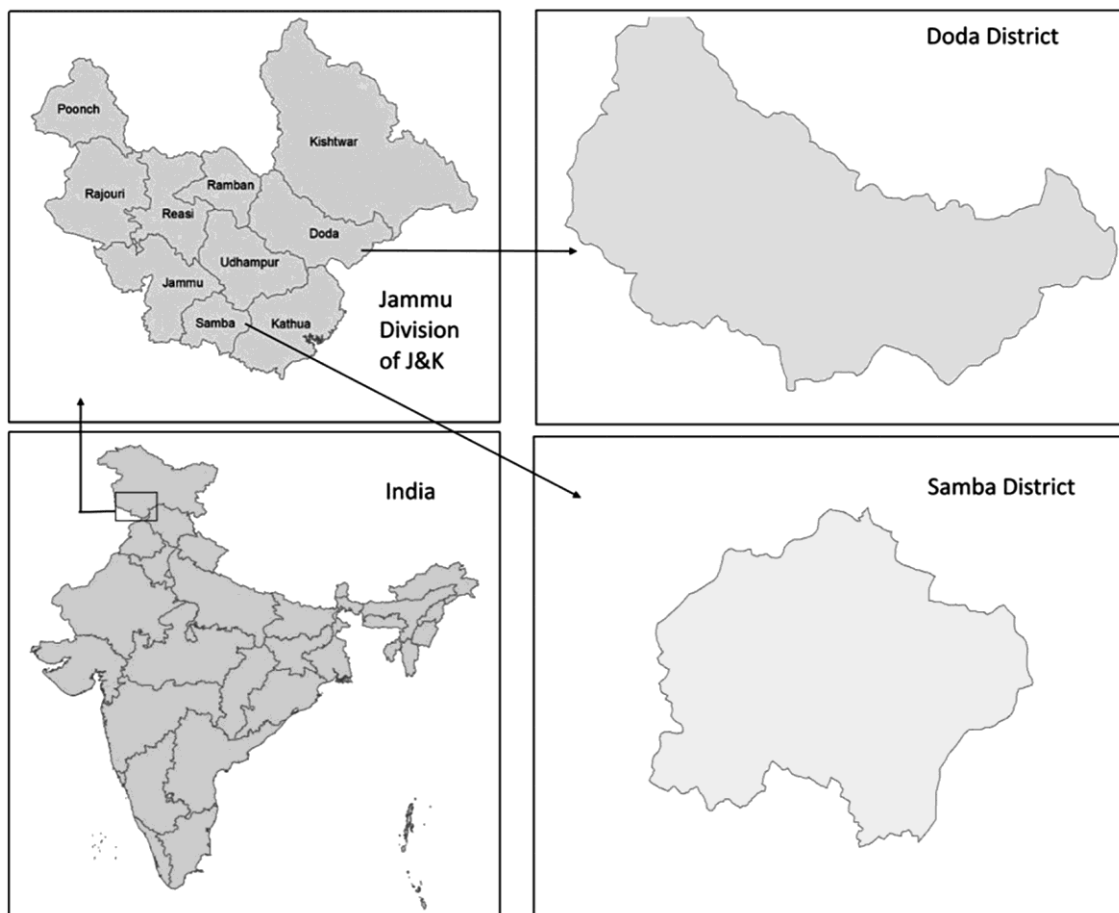


Fig. 1 — Map of Jammu and Kashmir showing Doda and Samba districts

Purmandal and Vijaypur from district Samba were selected. Within each block, 4 villages were selected on the basis of random sampling. In all, 24 villages from 6 blocks were selected. The selected villages were Humbal, Khroni, Recho, Assar, Barwah, Balote, Bhalra, Bhatoli, Gadater, Gundna, Bhart, Dal khankote, Chegsu, Bhela, Agrika and Banoia from the district Doda. Gurgani, Sangar, Nandak, Padal, Sarna, Kabilla, Lovely and Kherdi from the district Samba. Five respondents were selected randomly from each village. By this way, 80 respondents from Doda and 40 respondents from Samba were selected, making a total of 120 respondents of age above 50 years selected purposively.

## Material and Methods

### Data collection

Ethnopharmacological survey was done during the year 2018 and 2019, respectively. Visits to the study area were carried during February to May each year. The purpose of the survey was to collect information from the indigenous communities. In order to conduct the personal interview, informants residing in the area were approached and the objective of the study was discussed with them and only those who agreed were further interviewed after obtaining prior informed consent. The questions were asked in the local language (Dogri/Urdu) based on the pre-structured questionnaire. Questions were asked regarding the plants used to cure liver diseases, their local name, habit, status of the plant species, preparation of formulations, plant-part being used and the method of consumption. The data collected throughout this study was analyzed using Microsoft Excel 2016.

### Plant collection and identification

The medicinal plants cited by the respondents were gathered from the study area during recurring field trips. Help from informants such as herbal healers, elderly peoples, shepherds were sought for identification of plants and their local names. In case of herbs, whole plants were collected, while fruiting or flowering shoots of trees and shrubs were collected. In field notebook, the detailed information of the collected specimens was recorded that included their local name, habit, date of collection, and locality. Initially, the plants were collected in Vasculum which were later placed between the sheets of blotting paper and pressed in wooden frame. The blotting papers were changed as and when required

till the plants dried completely. Final identification of the samples was done as per their field characters and confirmation was done by consulting various floras. Finally, the plants were mounted on herbarium sheets and deposited in the Division of Silviculture and Agroforestry, Sher-E-Kashmir University of Agricultural Sciences and Technology (SKUAST) of Jammu for future records. Inventory of entire plants was made according to the International Plant Names Index (<http://www.ipni.org>).

### Quantitative analysis

During the study various parameters like FC (frequency of citation), RFC (relative frequency of citation) and FIV (family importance value) were determined from the recorded data.

### Frequency of citation

FC (Frequency of citation) was calculated by dividing the n number of times a particular species was mentioned by the total number of times all species were mentioned and multiplied by 100.

### Relative frequency of citation

The RFC value was determined by dividing the number of citations per species (FC) by the total number of informants (N). This value represents the objective importance attributed to a plant by the informants and not the researcher's opinion. RFC values range from 0 to 1<sup>12</sup>.

### Family importance value

FIV (Family Importance Value) was calculated to determine the level of consensus among informants on the use of medicinal plant species in the area<sup>13</sup>. The FIV was obtained by multiplying the ratio of the number of informants mentioning the family (FC) to the total number of informants (N) by 100. The formula used for FIV calculation was  $FIV = FC/N \times 100$ , where FC is the number of participants who stating the family and N is the total informants who undertook the survey.

## Results

### Demographic profile of the respondents

Out of 120 respondents, 46% informants belonged to the age range of 50-60 years, 38% belonged to the age range of 60-70 years and the rest were more than 70 years (16%) old. Majority of the informants fall in the age group of 50-60 years. Majority of the informants were male (87.5%) whereas female informants were only 12.5%. Low percentage of

female informants could be due to their shy nature as well as hesitation to talk to strangers. Most of the respondents were illiterate (29.16%), 19.16% received education upto primary level, 22.5% had education upto middle school, 19.16% had completed high school and only 10% were above high school level.

#### Diversity of medicinal plants used for treating liver diseases

The present survey conducted in Jammu Division in the districts of Doda and Samba reveals that over-all 40 medicinal plant species from 39 genera belonging to 25 families are being used to treat liver diseases in Jammu province. All the medicinal plants along with their common name, scientific name,

voucher number, district, family, status, official part, habit, method of consumption and statistical analysis (FC, RFC) are presented in Table 1. In the present study, species like *Coriandrum sativum*, *Berberis lycium*, *Acorus calamus* and *Prunella vulgaris* are being used to treat liver diseases as reported by the respondents. Similar results for these species have also been reported earlier<sup>14-17</sup>. Some other ethnobotanical studies<sup>18-20</sup> have reported that species like *Cichorium intybus*, *Taraxacum officinale*, *Colchicum luteum*, *Picrorhiza kurroa* and *Rubia cordifolia* are being traditionally used to cure liver diseases in the Himalayan region.

Table 1 — List of plants used to treat liver diseases in Jammu province

S No	Scientific name	VR	District	Local name	Family	Habit	Status <sup>a</sup>	Part used	Mode of consumption	FC <sup>b</sup>	RFC <sup>c</sup>
1	<i>Acorus calamus</i> L.	1039	Samba	Vach	Acoraceae	Herb	W/C	Root	Powder	16	0.32
2	<i>Adhatoda vasica</i> Nees	1053	Samba	Branked	Acanthaceae	Shrub	W	Leaf	Decoction	4	0.10
3	<i>Aegle marmelos</i> (L.) Corr.	1040	Samba	Bil patri	Rutaceae	Tree	C	Fruit	Juice	27	0.67
4	<i>Aloe barbadensis</i> (L.) Burm.f.	1012	Samba	Kwargandhal	Liliaceae	Herb	C	Leaf	Paste	4	0.10
5	<i>Azadirachta indica</i> A. Juss	1007	Samba	Nimb	Meliaceae	Tree	C	Leaf	Decoction	12	0.30
6	<i>Bauhinia variegata</i> L.	1042	Samba	Krankal	Fabaceae	Tree	W	Flower	Vegetable	6	0.15
7	<i>Berberis lycium</i> Royle	1028	Doda	Kaimal	Berberidaceae	Shrub	W	Root	Decoction	29	0.36
8	<i>Bunium persicum</i> (Boiss.) Fedt.	1048	Doda	Kalazeera	Apiaceae	Herb	C	Seed	Powder	4	0.05
9	<i>Bupleurum falcatum</i> L.	1036	Doda	Bormuje	Apiaceae	Herb	W	Root	Powder	5	0.06
10	<i>Calotropis procera</i> (Aiton) W.T. Aiton	1020	Samba	Aak	Apocynaceae	Shrub	W	Root	Powder	3	0.07
11	<i>Cichorium intybus</i> L.	1015	Doda	Kasni	Asteraceae	Herb	W	Root	Decoction	19	0.23
12	<i>Citrus limetta</i> Risso.	1016	Samba	Mosami	Rutaceae	Shrub	C	Fruit	Juice	9	0.22
13	<i>Colchicum luteum</i> L.	1047	Doda	Suranjan	Colchicaceae	Herb	W	Corm	Powder	11	0.13
14	<i>Coriandrum sativum</i> L.	1022	Samba	Dhania	Apiaceae	Herb	C	Leaf	Eaten raw	8	0.20
15	<i>Cydonia oblonga</i> Mill.	1013	Doda	Bih dana	Rosaceae	Tree	W	Seed, Fruit	Powder, Vegetable	31	0.38
16	<i>Echinacea angustifolia</i> DC.	1030	Doda	Adel	Asteraceae	Herb	W	Root	Decoction	13	0.16
17	<i>Emblica officinalis</i> Gaertn.	1058	Samba	Amla	Euphorbiaceae	Tree	C	Fruit	Juice	7	0.17
18	<i>Euphorbia hirta</i> L.	1034	Samba	Doodhal	Euphorbiaceae	Herb	W	Whole plant	Decoction	5	0.12
19	<i>Ficus carica</i> L.	1044	Doda	Anjeer	Moraceae	Tree	W	Fruit	Ripe fruits eaten	15	0.18
20	<i>Fumaria indica</i> (Hausskn.) Pugsley	1014	Doda	Shahtar	Fumariaceae	Herb	W	Whole plant	Decoction	12	0.15
21	<i>Gentiana kurroa</i> Royle	1023	Doda	Tikta	Gentianaceae	Herb	W	Whole plant	Decoction	8	0.10
22	<i>Geranium wallichianum</i> D. Don ex sweet	1051	Doda	Sapjadi	Geraniaceae	Herb	W	Root	Powder	9	0.11
23	<i>Lagenaria siceraria</i> (Molina) Standl.	1004	Samba	Loki	Cucurbitaceae	Climber	C	Fruit	Juice	4	0.10
24	<i>Mentha arvensis</i> L.	1038	Samba	Pootna	Lamiaceae	Herb	C	Leaf	Decoction	8	0.20
25	<i>Mentha longifolia</i> (L.) Huds.	1021	Doda	Janglipootna	Lamiaceae	Herb	W	Leaf	Decoction	22	0.27

Contd.

Table 1 — List of plants used to treat liver diseases in Jammu province (Contd.)

S No	Scientific name	VR	District	Local name	Family	Habit	Status <sup>a</sup>	Part used	Mode of consumption	FC <sup>b</sup>	RFC <sup>c</sup>
26	<i>Morus alba</i> L.	1011	Samba	Sehtoot	Moraceae	Tree	W	Fruit	Juice	11	0.27
27	<i>Murraya koenigii</i> (L.) Spreng.	1026	Samba	Drankri	Rutaceae	Tree	W	Leaf	Vegetable	7	0.17
28	<i>Ocimum sanctum</i> L.	1035	Samba	Tulsi	Lamiaceae	Herb	C	Leaf	Decoction	13	0.32
29	<i>Phyllanthus niruri</i> L.	1027	Samba	Bhumi amla	Euphorbiaceae	Herb	W	Whole plant	Decoction	15	0.37
30	<i>Picrorhiza kurroa</i> Royle	1054	Doda	Koad	Plantaginaceae	Herb	W/C	Rhizome	Powder	18	0.22
31	<i>Podophyllum emodi</i> Wall.	1025	Doda	Bankakri	Podophyllaceae	Herb	W	Rhizome	Decoction	22	0.27
32	<i>Prunella vulgaris</i> L.	1019	Doda	Kalvuth	Lamiaceae	Herb	W	Whole plant	Decoction	6	0.07
33	<i>Prunus domestica</i> L.	1031	Doda	Aloobukara	Rosaceae	Tree	C	Fruit	Ripe fruits eaten	21	0.26
34	<i>Punica granatum</i> L.	1029	Doda	Druni	Lythraceae	Shrub	W	Seed	Powder	37	0.46
35	<i>Quercus leucotrichophora</i> A. Camus	1002	Doda	Banj	Fagaceae	Tree	W	Bark	Decoction	14	0.17
36	<i>Rubia cordifolia</i> L.	1049	Doda	Manjithi	Rubiaceae	Herb	W	Root	Powder	25	0.31
37	<i>Tamarindus indica</i> L.	1043	Samba	Imli	Fabaceae	Tree	C	Fruit	Decoction	22	0.55
38	<i>Taraxacum officinale</i> F.H. Wigg.	1045	Doda	Hundh	Asteraceae	Herb	W	Root	Decoction	7	0.08
39	<i>Tinospora cordifolia</i> (Willd.) Miers	1057	Samba	Giloe	Menispermaceae	Climber	W	Stem	Decoction	32	0.80
40	<i>Trigonella foenum-graceum</i> L.	1003	Samba	Methi	Fabaceae	Herb	C	Seed	Decoction	5	0.12

VR=Voucher Number

Status<sup>a</sup> Wild = W, Cultivated = C, W/C= both wild and cultivated

UV<sup>b</sup>= Use Value

FC<sup>c</sup>= Frequency of Citation

RFC<sup>d</sup>= Relative frequency of Citation

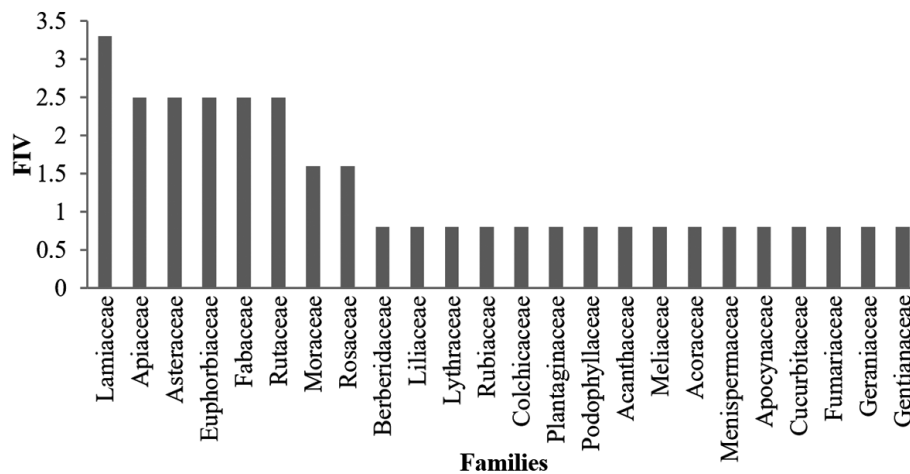


Fig. 2 — Family importance value (FIV) of plants used for treating liver diseases

#### Family importance value (FIV)

The most frequent plant families used for treating disorders of liver are represented by their family importance value (FIV). FIV varied from 0.8 to 3.3 (Fig. 2). Lamiaceae was the most dominant family (4 species) followed by Asteraceae, Apiaceae, Euphorbiaceae, Fabaceae, Rutaceae (3 species each),

Moraceae and Rosaceae (2 species each). The remaining 17 families had only one species.

#### Growth habit

As evident from figure 3, majority of the plants used for treating liver diseases were herbs (55%), trees (28%), shrubs (12%) and climbers (5%), respectively.

**Plant part used**

Almost all parts of the plants were used for treating liver diseases, *i.e.*, roots, fruits, flowers, leaves, rhizome, bark, stem and seeds (Fig. 4). The most often used plant part was root (27%) which was followed by fruit (22%), leaf (20%), whole plant

(12%), seed (10%), stem (3%) and flower, rhizome and bark (2%).

**Mode of consumption**

Overall, there were 7 different modes of consuming plants/parts used for treating ailments of the liver. All the medicinal plant parts were consumed through oral route most common being decoction (45.97%) followed by powder (27.79%), juice (10.13%), vegetable (7.69%), ripe fruits (6.29%), eaten raw (1.39%) and leaf paste (0.69%) (Fig. 5). Numerous studies from south East Asia report decoction as one of the major forms of herbal preparation<sup>21</sup>. It may be due to the fact that decoction can be prepared just by boiling the plant part in water. Sometimes, honey/jaggery/sugar is added to improve the taste. Some unique preparations were also recorded during the current study. For example, *Adhatoda vasica* leaves are kept in a bronze vessel filled with water and kept overnight under open sky to expose it to dew and the bitter extract is then drunk on an empty stomach next morning. *Cydonia oblonga* fresh fruit is cooked as vegetable or sliced and air dried and is

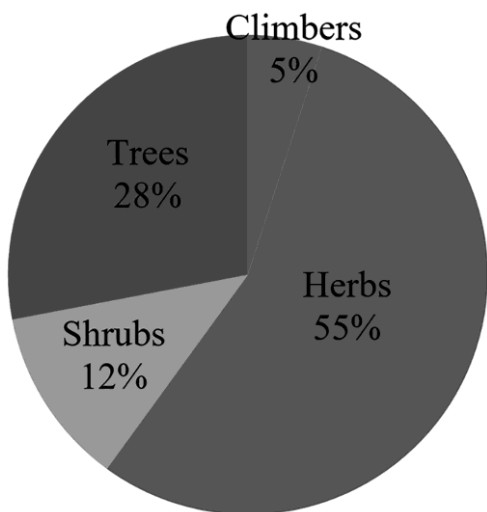


Fig. 3 — Growth habit of plants used to treat liver diseases (%)

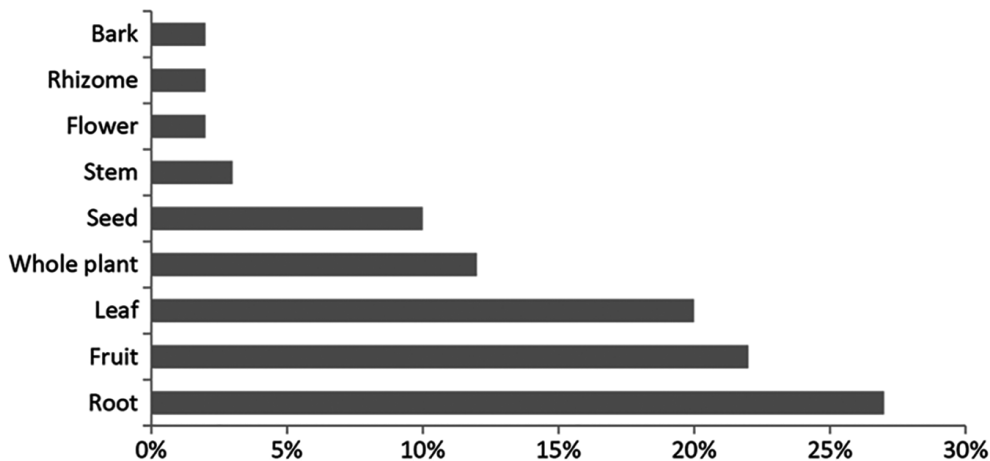


Fig. 4 — Plant part used to treat liver diseases (%)

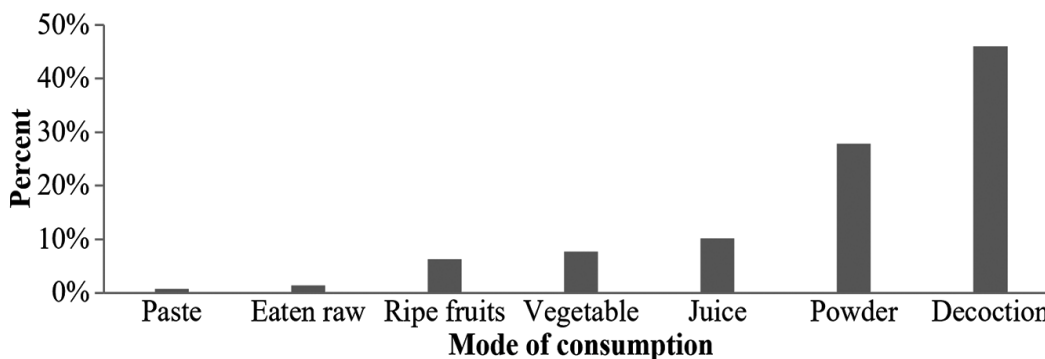


Fig. 5 — Mode of consumption (%) of medicinal plants used to treat liver diseases

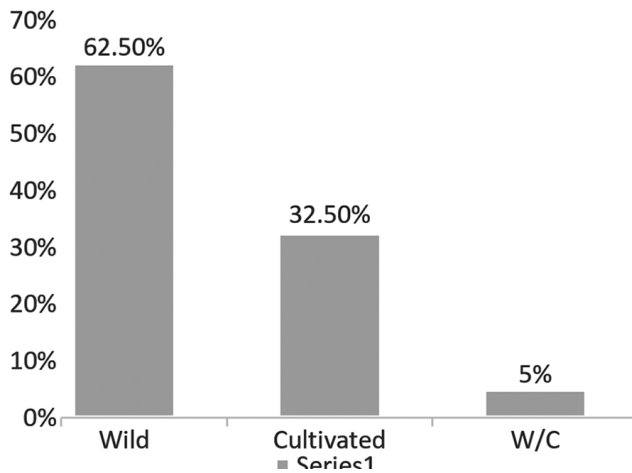


Fig. 6 — Status of plants used for treating liver diseases (%)

eaten as such throughout the year. *Prunus domestica* is consumed as a fruit, both fresh and dried. In severe cases of Jaundice, a mixture of pine resin, dried plum, tamarind pulp is soaked in a glass of water overnight and consumed empty stomach. Another common method of crude drug preparation is by crushing the plant part (mostly root) and prepare powder. This powder can be taken preferably with lukewarm water and sometimes mixed with honey, milk cream or salt to increase the palatability.

#### Status of medicinal plants

Medicinal plants used for the treatment of liver diseases were mostly (62%) collected from the wild and around 33% of them were cultivated whereas 5 % of the species were both in wild and cultivated forms (Fig. 6).

#### Discussion

The analysis of the ethnobotanical data shows that a significant number of medicinal plants are being used to treat liver diseases. The outcomes of the present study are in confirmation with similar other studies<sup>22-24</sup>. It has also been validated through scientific research that these plants possess several phytochemicals which have significant hepatoprotective activity<sup>25,26</sup>. Knowledge on medicinal use of plants is transferred from one generation to the other and the elder people of the area seem to possess knowledge about the local medicinal plants.

Maximum plants reported in the survey belonged to Lamiaceae family which shows that Lamiaceae family had great ethnobotanical importance and may have a wide distribution. Similar finding were reported in a study conducted on species used against

liver ailments by practitioners in district Multan in Pakistan where Lamiaceae was the most often used family<sup>27</sup>. Herbaceous plants were the most commonly used life form, this is expected as in traditional medicinal plants, herbs are used on a large scale as compared to trees, shrubs and climbers<sup>28,29</sup>. Efficacy of a drug depends upon the plant part used and its mode of preparation<sup>30</sup>. Root was reported to be the most frequently used plant part whereas decoction was the most popular method of consumption as it is an easiest method of preparation as well as consumption, be it any part of the plant. Similar results have also been reported in various previous studies<sup>31</sup>. Regarding the collection of the medicinal plants, it was reported that mostly the plants were wild in nature, almost half of them were cultivated whereas only two plants species occurred in wild and were cultivated as well.

#### Conclusions

The present study takes a relook into the traditional knowledge of medicinal plants regarding the use of medicinal plants for the treatment of liver diseases among the people of Doda and Samba districts of J&K UT. The study has proved that a wide variety of plants are being used for the treatment of liver ailments by the native communities in the area. *Punica granatum* L. was the major species for curing the liver diseases in the region. The results highlight the use of local vegetation in traditional medicine. The study will not only broaden the list of species used against a particular disease, but will also pave way for the discovery of hepatoprotective drugs.

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#### Conflict of Interest

All the authors declare that they have no conflict of interest.

#### Author Contributions

SS: Conceptualization and preparation of manuscript; AK: Field survey, collection and analysis of data; KKS: Data interpretation; and NSR: Identification of plant specimens.

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