Inventory of medicinal herbs utilized for the treatment of musculoskeletal disorders in district Kupwara of Jammu and Kashmir

Tawseef Ahmad Mir, Muatasim Jan, Rainer W. Bussmann and Tuybia Bilal

Correspondence

Tawseef Ahmad Mir[1,2,3*], Muatasim Jan[1,2], Rainer W. Bussmann[4,5], Tuybia Bilal[6]

[1]Centre of Research for Ethnobotany, Govt. Model Science College, Jiwaji University, Gwalior-474009, India
[2]Department of Botany, BFIT Group of Institutions, Suddhowala, Dehradun, Uttarakhand-248007, India
[3]Commission on Environmental, Economic and Social Policy, IUCN
[4]Department of Botany, State Museum of Natural History Karlsruhe, 76133 Karlsruhe, Germany
[5]Department of Ethnobotany, Institute of Botany, Ilia State University, 0105 Tbilisi, Georgia
[6]Department of Forestry, SKUAST, Benhama, Ganderbal, J&K-191202, India

[*]Corresponding Author: tawseefbot@gmail.com

Ethnobotany Research and Applications 24:30 (2022)

Research

Abstract

Background: The medicinal plants are used for the treatment of various disorders and are believed as a promising agent in the local traditional health care system throughout the globe. This paper provides noteworthy information regarding the use of medicinal herbs for the treatment of musculoskeletal disorders in district Kupwara of Jammu and Kashmir.

Methods: Extensive surveys (31 visits) were conducted in the study area during August 2020 to January 2021 for the collection of medicinal plants and the traditional knowledge associated with them. A total of 75 participants were interviewed using group discussions (n=12 with n=6 people each) and semi structured interviews (n=59). Documented ethnomedicinal data was analyzed using quantitative ethnobotanical indices including use value (UV).

Results: During the study a total of 45 plants belonging to 20 different families were reported with their medicinal usage to treat musculoskeletal disorders. Asteraceae (13 species) was found to be the dominant family and leaves (41%) were found to be used for the preparation of most of the remedies. Herbs were reported to be the dominant plants utilized with paste as the common method of preparation and topical method as the dominant method of administration. The highest use value (0.49) was reported for *Foeniculum vulgare.*

Conclusion: It can be concluded that, local inhabitants still prioritize herbal medicines as an effective way to treat MSK disorders. This comprehensive investigation helps in phytochemistry and pharmacological research to screen such medicinal plant species for future drug discovery development which give more interesting information with global interest. Scientific authentication of the bio-activity of the particular medicinal plants will validate the integration and use of these natural medications for primary health care of local populations.

Keywords: Musculoskeletal disorders, Ethnomedicine, Use value, Kupwara, J&K

Manuscript received: 05/08/2022 – Revised manuscript received: 30/10/2022 - Published: 01/11/2022
http://dx.doi.org/10.32859/era.24.30.1-13

Background

Musculoskeletal (MSK) disorders such as arthritis and back pain effect more than 1.7 billion communities worldwide and have the 4th greatest influence on the complete fitness of the world populations, causing both disability and death (Cavero and Calvo 2015). Diverse sorts of manual treatments and prescriptions such as no steroidal opioids or anti-inflammatories possibly will use to treat inflammation or ache (Hignett and Fray 2010). At global level people treat musculoskeletal sicknesses by different approaches using ultrasound management, non-ultrasound treatment and sham-ultrasound treatment (Gam and Johannsen 1995). Muscular treatment strategies aim to either alleviate the symptoms with analgesics and anti-inflammatory agents, and/or to somehow modify the disease process through the use of disease modifying anti-rheumatic drugs (DMARDs) (Aletaha *et al.* 2003). These managements are costly and have a lot of side effects so substitute handlings are required to treat musculoskeletal complaints. In this regard alternative herbal therapies are one of the good choice among the tribal communities to treat MSK disorders (Cameron and Chrubasik 2013). This situation speeds the necessity for accessible, harmless, and effective yields and be able to deal with these frequently devastating situations (Payyappallimana 2010). Due to the fact that herbal remedies are available, reasonably priced, ethnically satisfactory, publicly authorized, and easy to get ready with slight easily, a lot of individuals favor them to the exceedingly assessed fitness care facilities (Kipkore *et al.* 2014).

The indigenous knowledge of using medicinal plants for the treatment of various disorders is an old age practice of human evolution (Gertsh 2009; Jan *et al.* 2022a). Approximately 85% of world's population living in developing countries is solely dependent on traditional medicinal plants for obtaining their health care (Calixto 2005; Mir *et al.* 2021a; Khoja et al 2022c). Ethnic communities living adjacent to forest areas rely on medicinal plants collected from wild for their primary health care. Traditional medicine is an uncodified system of medicine and plays pivotal part in the healthcare system of people living in remote areas (Sen and Chakraborty 2016). This traditional knowledge of use of medicinal plants is transferred from one generation to another generation between the local communities (Pieroni and Quave 2005; Mir *et al.* 2021b). In countries like India and Pakistan, about 75% of the population is still relied on traditional indigenous medicine for the treatment of their day-to-day ailments (Jan *et al.* 2022b). However, due to modernization and fast lifestyle changes, this valuable knowledge is disappearing from the societies (Jan *et al.* 2017).

The Northern part of India is rich in terms of medicinal plant diversity. It has been estimated that about 1748 species of plants out of the 8644 total reported plant species from Indian Himalayan region are medicinally important (Samant *et al.* 1998). Jammu and Kashmir that lies in the northern region of India has a rich diversity of over 300 medicinally important plant species (Kaul 1997). A number of ethnomedicinal studies (Sarin and Kapur 1984; Haq *et al.* 2021: Jan *et al.* 2021; Mir *et al.* 2022) conducted in different parts of Jammu and Kashmir have listed medicinal plants used by local practitioners and local ethnic communities for the treatment of various ailments. However, to the best of our knowledge, the present investigation about the use of medicinal plants to treat MSK diseases is the first report from district Kupwara of Jammu and Kashmir. We hypothesized that due to the remoteness of the area, the ethnomedicinal knowledge regarding the use of medicinal plants against MSK diseases in district Kupwara would considerably differ from other areas of J&K and the wider Himalayas. This study was planned with the objective to document the indigenous knowledge about medicinal plants used against MSK diseases. The data was further analyzed by using various numerical indices to check the agreement of participants in their knowledge.

Materials and Methods

Study area

The present study was conducted in the Kupwara district of Kashmir Himalaya, which is located between the geographical coordinates of 34° 01' 60.00" N Latitude and 74° 15' 60.00 (Fig. 1).The district has a total geographical area of 2,379 square kilometers and 368 villages (https://kupwara.nic.in). The study area faces severe cold during winter and fair-weather during summer. The temperature ranges between -7° C minimum in winter and up to 35° C maximum in summers (https://mausam.imd.gov.in). The study was conducted in areas located far from the district headquarters. The climate in the region is of temperate type. This belt of Himalaya largely supports drought-resistant and cold-loving plants belonging mostly to Conifereae, Fabaceae, Asteraceae, Poaceae, Rosaceae, etc. Area also shows greater luxuriance of gymnosperms (Dar and Khuroo 2020). Among others, rice, maize, wheat and potato are the staple diets of the people in valley. Agriculture (animal husbandry and crop production) is the main livelihood strategy adopted in the region. Besides this, collection of Non-timber forest product (NTFPs) including medicinal and aromatic plants is another source of livelihood in the study area.

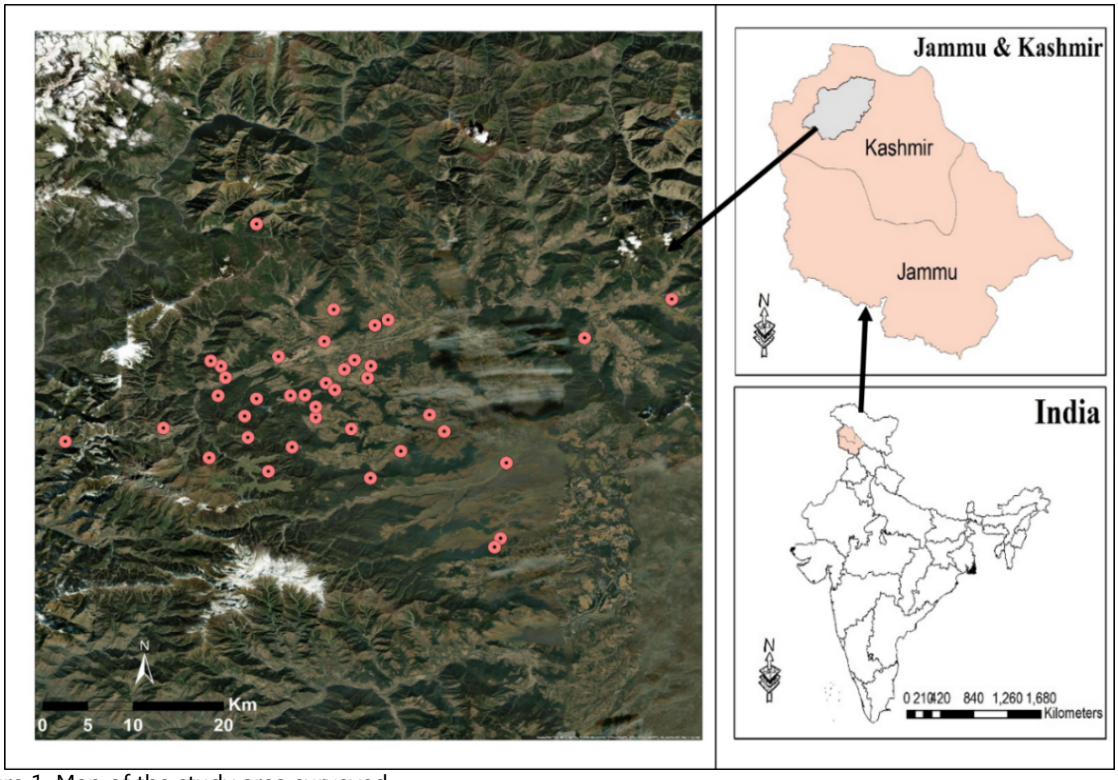

Figure 1. Map of the study area surveyed.

Demographic status of participants

To gather the information regarding the use of plants for the treatment of MSK disorders in district Kupwara of Jammu and Kashmir, a total of 75 knowledgeable participants were selected by snowball sampling method (Table 1). These participants were of different age groups ranging from 26 to 75 years. Among the selected male participants (*n*=43) had more experience in terms of knowledge sharing than female participants (*n*=32). Most of the selected participants were illiterate (*n*=35), and a small number were having education up to higher secondary level (*n*=7) and few were job holders (*n*=6). Participants were selected based on their high ethnomedicinal knowledge. To ensure the validity of traditional knowledge, continuous relationship was maintained with the local population throughout the survey.

Table 1. Demographic features of participants.

Variable	Total	Percentage
Gender		
Male	43	57
Female	32	43
Age groups		
26-35	9	12
36-45	13	17
46-55	19	25
56-65	20	27
66-75	14	19
Educational qualification		
Illiterate	35	47
Primary	20	27
Secondary	13	17
Above secondary	7	9
Occupation		
Men		
Shopkeepers	10	13
Farmers	27	36
Job holders	6	8
Women		
Housewives	23	31
Job holders	9	12

Sampling techniques and data collection

A total of 31 field surveys were conducted during August 2020 to January 2021 to collect the primary data regarding the study. To conduct this research a prior permission was sought from the respected committees of Jiwaji University, Gwalior. The help acquired from the ethnic people (Gujjar, Bakerwal, Pahadi and Kashmiri) of study area for documentation of medicinal uses was duly acknowledged and prior informant consent was taken from all the participants. Field methods for undertaking ethnopharmacological studies as well as most of recommendations as suggested by Heinrich *et al.* (2018), Haq *et al.* (2021); Bhatia *et al.* (2014) were followed and incorporated in this study.

The participants were selected on the basis of information regarding the use of medicinal plants. Participants were interviewed through different types of interview methods including semi-structured interviews (n=59) and group discussions (n=12 with n=6 people each) by using standard questionnaire (Martin 1995). Prior to interviews the objective of the study was explained to participants taking part in the study. The information was collected in the local language and was then translated to English language. Prior oral consent was taken from participants to make it possible to share their knowledge regarding the indigenous use of medicinal plants for the treatment of MSK ailments, cause and symptoms of the ailments they used to treat, local names of the medicinally important plant species, plant parts used in the preparation of herbal remedy and mode application of the particular remedy used in the treatment. Participants were given time as per their convenience to answer the questions (Appendix-I). During the survey we have followed two methods. First method was specimen display method in which fresh plant materials were showed to participants to gather medicinal information and the same plant was shown to other participants to confirm accuracy of data for a particular plant. In second method of survey, some of the field walks (Maundu 1995) were also followed with local knowledgeable participants. Guided field walk to the forest area (n=7 with 3 persons each) allowed us to collect best possible information about the identification and utilization of important medicinal plant species. To check the confirmation and consistency of formulations, each informant was interviewed more than once.

Identification and preparation of voucher specimens

Plants were collected, pressed and mounted on standard herbarium sheets following standard herbarium techniques (Miller and Nyberg 1995). Collected plants were authentically identified with the help of standard floras such as Flora of Jammu and Kashmir (Singh *et al.* 2002), Flora of British India (Hooker 1998), locally available literature (Kachroo and Singh 1994; Navchoo and Kachroo 1995) and taxonomists in the field (Mr. Akhtar H. Malik, Curator KASH herbarium UoK, Srinagar). Plant species were named according to the recent format followed by The IPNI (international Plant Names Index) and WFO (World Flora Online). All the collected plant specimens were photographed in the field, standard voucher specimens were made and deposited in the KASH Herbarium of Department of Botany, University of Kashmir, Srinagar, India for future reference.

Quantitative data analysis

Quantitative ethnobotanical analysis allows to select the medicinal plants for further phytochemical and pharmacological analysis. In the present study the gathered information was analyzed statistically.

Use value (UV)

The use value defines the relative importance of plants known. The use value in present study was calculated by the use of following formula (Phillips *et al.* 1994).

$$UV = \sum \frac{Ui}{N}$$

Where U refers to the use reports cited for a particular plant by each participant and N is the total number of participants participated in the study. The UV helps to determine the plant species with highest use (most frequently indicated) in the treatment of ailment. When there are many use citations for a plant, its use value is high and when use citations are low, the use value is also low.

Results and Discussions

Diversity of medicinal plants

The present study recorded 45 species of medicinal plants belonging to 20 families (Table 2).

Table 2. Enumeration of medicinal plants used for musculoskeletal disorders in district Kupwara of Jammu and Kashmir.

Family	Botanical name Voucher no.	Vernacular name	Source	Part used	Preparation	Administration	Disease treated	UV
Amaranthaceae	*Achyranthes aspera* L. 3353-KASH	Phutkunda	Wild	Whole plant	Infusion	Topical	Rheumatism	0.12
	Amaranthus viridis L. 3364-KASH	Waer liss	Cultivated	Leaf	Paste	Topical	Joint pain	0.14
Apiaceae	*Daucus carota* L. 3390-KASH	Gazer	Cultivated	Root	Cooked	Oral	Fatigue	0.22
	Foeniculum vulgare Mill. 3397-KASH	Badiyan	Cultivated	Seed, Leaf	Decoction	Oral	Backache, Swelling of bones	0.49
Araceae	*Acorus calamus* L. 3365-KASH	Vai	Cultivated	Root	Decoction	Oral	Joint pain	0.11
	Arisaema jacquemontii Blume. 2968-KASH	Hapet gogji	Wild	Whole plant	Paste	Topical	Fractured bones	0.32
Asteraceae	*Artemisia absinthium* L. 2969-KASH	Tethwan	Wild	Leaf	Infusion	Oral	Body pain	0.34
	Calendula officinalis L. 3375-KASH	Hemesh bahar	Wild	Flower	Decoction	Paste	Body pain	0.21
	Centaurea iberica Trevir. ex Spreng 3381-KASH	Krech	Wild	Whole plant	Paste	Topical	Fractured bones	0.10
	Cichorium intybus L. 2973-KASH	Kaw hand	Wild	Whole plant, Leaf	Decoction, Infusion	Oral	Body weakness, Joint pain	0.46
	Cotula anthemoids L. 3387-KASH	Thol bubul	Wild	Whole plant	Decoction, Infusion	Oral, Topical	Backache, Fractured bones	0.30
	Galinosoga parviflora Cav. 2983-KASH	Marchangan gass	Wild	Whole plant	Poultice	Topical	Muscle pain	0.15
	Lactuca saligna L. 3406-KASH	Dodhkandej	Wild	Aerial portion	Poultice	Topical	Fractured bones	0.09
	Leucanthemum vulgare Lam. 2990-KASH		Wild	Leaf	Decoction	Oral	Joint dislocation	0.20
	Ligularia fischeri (Ledeb.) Turcz. 3622-KASH	Gomchwi	Wild	Flower	Paste	Topical	Arthritis	0.23

	Saussurea costus (Falc.) Lipsch. 3442-KASH	Kuth	Wild	Root	Paste	Topical	Rheumatism	0.35
	Sigesbeckia orientalis L. 3444-KASH		Wild	Leaf	Decoction	Topical	Muscle pain	0.04
	Sonchus arvensis L. 3003-KASH	Dudij	Wild	Whole plant	Poultice	Topical	Joint swelling	0.14
	Taraxacum officinale F.H. Wigg. 3005-KASH	Handh	Wild	Whole plant	Poultice	Topical	Fractured bones, Joint pain, Joint swelling	0.47
Balsaminaceae	*Impatiens glandulifera* Royle 2989-KASH	Goj gash	Wild	Leaf	Infusion	Topical	Body pain	0.18
Berberidaceae	*Podophyllum hexandrum* Royle 3429-KASH	Wnwangun	Wild	Root	Decoction	Oral	Body weakness	0.37
Brassicaceae	*Lepidium didymum* L. 3410-KASH	Jangli halian	Wild	Whole plant	Decoction	Oral	Fractured bones	0.11
	Nasturtium officinale W.T. Aiton 3419-KASH	Kulhak	Wild	Whole plant	Poultice	Topical	Joint pain, Muscle pain	0.16
	Sisymbrium loeselii L. 3448-KASH	Tilgogul gash	Wild	Aerial portion	Cooked	Oral	Weak bones	0.08
Cannabaceae	*Cannabis sativa* L. 3376-KASH	Bhang	Wild	Leaf	Paste	Topical	Joint pain	0.13
Chenopodiaceae	*Chenopodium album* L. 2972-KASH	Konh	Wild	Leaf	Paste	Topical	Bone dislocation	0.29
	Chenopodium foliosum (Moench.) Asch. 3607-KASH	Konh	Wild	Leaf	Paste	Topical	Joint pain	0.27
Hypericaceae	*Hypericum perforatum* L. 2988-KASH	Shin chai	Wild	Leaf	Poultice	Topical	Muscle pain	0.34
Convolvulaceae	*Cuscuta europaea* L. 2977-KASH	Kuklipot	Wild	Whole plant	Paste	Topical	Weak bones	0.19
Equisetaceae	*Equisetum arvense* L. 2981-KASH	Bandakey	Wild	Whole plant	Paste	Topical	Weak bones, Joint swelling	0.18
Fabaceae	*Medicago polymorpha* L. 3625-KASH	Burahang	Wild	Flower	Infusion	Topical	Muscle stretching	0.25

	Melilotus albus Medik. 3413-KASH	Jangli methi	Wild	Leaf	Paste	Topical	Muscle pain	0.22
Geraniaceae	*Geranium wallichianum* Oliv. 2986-KASH	Ratanjoth	Wild	Root	Poultice	Topical	Joint pain	0.36
Lamiaceae	*Ajuga bracteosa* Wall. ex Benth. 3356-KASH	Jani adam	Wild	Leaf	Decoction	Oral	Backache	0.42
	Ajuga parviflora L. 3601-KASH	Jani adam	Wild	Leaf	Decoction	Oral	Backache, Muscle pain	0.41
	Prunella vulgaris L. 2997-KASH	Kalweuth	Wild	Leaf	Decoction	Topical	Joint swelling, Joint pain, Backache, Fractured bones	0.48
Malvaceae	*Malva neglecta* Wall. 2991-KASH	Soxal	Wild	Leaf	Cooked	Oral	Body weakness	0.17
	Malva sylvestris L. 2992-KASH	Gur soxal	Wild	Leaf	Decoction	Oral	Muscle pain	0.18
Oxalidaceae	*Oxalis corniculata* L. 3423-KASH	Chuk xanjj	Wild	Whole plant	Juice	Oral	Backache	0.22
	Oxalis acetosella L.	Chuk xanjj	Wild	Whole plant	Juice	Oral	Backache	0.23
Plantaginaceae	*Plantago lanceolata* L. 2995-KASH	Gull	Wild	Leaf	Decoction	Oral	Rheumatism	0.25
Poaceae	*Cynodon dactylon* (L.) Pers. 2979-KASH	Dramun	Wild	Whole plant	Paste	Topical	Joint pain	0.13
	Echinocola colona (L.) Link 3391-KASH	Ham gassh	Wild	Whole plant	Paste	Topical	Body pain	0.16
	Poa pratensis L. 3632-KASH	Gassh	Wild	Seed	Cooked	Oral	Joint pain, Backache	0.15
Urticaceae	*Urtica dioica* L. 3006-KASH	Soi	Wild	Leaf	Paste	Topical	Muscle pain	0.19

The most important families in terms of number of species were Asteraceae (13 species), Brassicaceae, Lamiaceae and Poaceae (3 species each), Amaranthaceae, Apiaceae, Araceae, Chenopodiaceae, Fabaceae, Malvaceae and Oxalidaceae (2 species each). The rest of the families (Balsaminaceae, Berberidaceae, Cannabaceae, Hypericaceae, Convolvulaceae, Equisetaceae, Geraniaceae, Plantaginaceae and Urticaceae, were represented by one species each (Fig. 2). Only four plant species (*Amaranthus viridis, Daucus carota, Foeniculum vulgare* and *Acorus calamus*) were cultivated in the area, rest were growing in the wild.

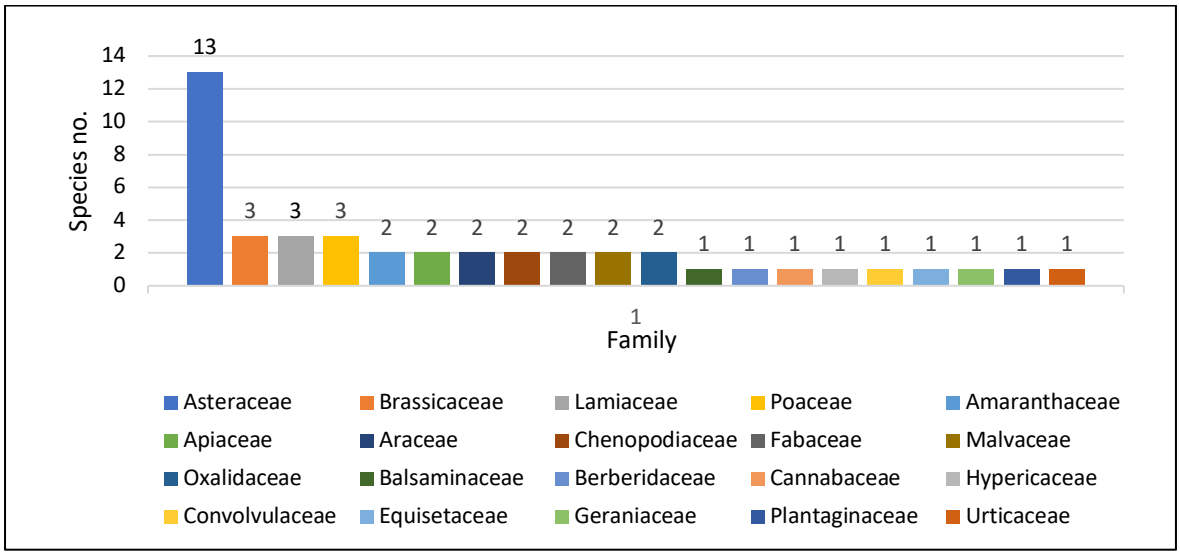

Figure 2. Species contribution of different families.

In the current study the only life form used in the treatment of various MSK ailments are herbs. Herbs grow mostly along roadsides and in home gardens, so are easily available in nature to collect (Shrestha and Dhillion 2003; Kayani *et al.* 2014).

Our results were in line with previous studies where Asteraceae has been reported as the dominant medicinal plant family in various other study regions (Bhatia *et al.* 2014; Khoja *et al.* 2022a; Bolson *et al.* 2015). The reason behind the dominance of the family Asteraceae is that members of this family are well known for aromatic quality and are easily available in nature or might be due to its herbaceous life form, extensive distribution and richness in the study area (Tariq *et al.* 2018; Khoja *et al.* 2022b).

Part(s) used and remedy preparation

Leaves were found the most commonly plant part (41%) used followed by whole plant (34%), root (11%), flowers (6%) and seed, aerial portion (4% each) (Fig. 3). The reason behind the frequent use of leaves may be because leaf acts as the center of photosynthesis and other metabolic activities and hence most of the secondary metabolites are formed in leaves (Cakilcioglu and Turkoglu 2010). Also it is easy to collect and to prepare medicinal remedies from leaves rather than other parts of the plant. In addition, the difference in plant part consumption could be due to differences in species variety, and bioactive compounds found in different plant parts (Appiah *et al.* 2019; Khoja *et al.* 2022a).

In the current study, paste (31%), was found to be the most common method of preparation of herbal medicines followed by decoction (29%), poultice (15%), infusion (13%), cooked (8%), and juice (4%) (Fig. 4). The preference and preparation was based on the potency and shelf life of the remedy (Sonibare and Abegunde 2012). Herbal drugs were used mostly by topical means (60%) in the present study. However, oral administration (40%) was also followed. Topical application is an important method of herbal medicine administration utilized in the treatment of various external ailments including MSK disorders as reported in many studies conducted earlier (Seyid *et al.* 2013; Sureshkumar *et al.* 2017).

Use value (UV)

Use value is a quantitative ethnobotanical index which indicates the relative importance of plant species in a study region. In the present study area, the use value of the plant species ranges from 0.06-0.49 (Table 3). The highest use value was reported for *Foeniculum vulgare* (0.49), followed by *Prunella vulgaris* (0.48), *Taraxacum officinale* (0.47), *Cichorium intybus* (0.46), *Ajuga bracteosa* (0.42), *Ajuga parviflora* (0.41), *Podophyllum hexandrum* (0.37),

Geranium wallichianum (0.36), *Saussurea costus* (0.35). This refers to the fact that these plants are mostly utilized in local health care system. It might be due to the transfer of indigenous knowledge from one generation in a better way. The lowest use value (0.06) was recorded for *Sigesbeckia orientalis*. If the use value is high, that indicates the higher importance of a particular plant, but if it is low the plant species is not considered so much important. However, it is not possible to distinguish if the plant is used for a single ailment or multiple ailments. There are already phytochemical reports for some of the species found to have high use value in current study. Presence of alkaloids, tannins, etc. has been reported in *Foeniculum vulgare*, in earlier studies. Due to the presence of these secondary metabolites, the plants show antibacterial, anti-inflammatory and other anti-proliferative properties (Wang *et al.* 2002; Bouyahya *et al.* 2018; Bilal *et al.* 2022). In contradiction to our study, the highest use value was recorded for *Achyranthes aspera,* in many of the similar studies conducted earlier in different regions in different communities (Bhatia *et al.* 2014; Jardat *et al.* 2017). It might be due to the poor knowledge regarding the medicinal properties of the *Foeniculum vulgare* or it less availability in the other study regions.

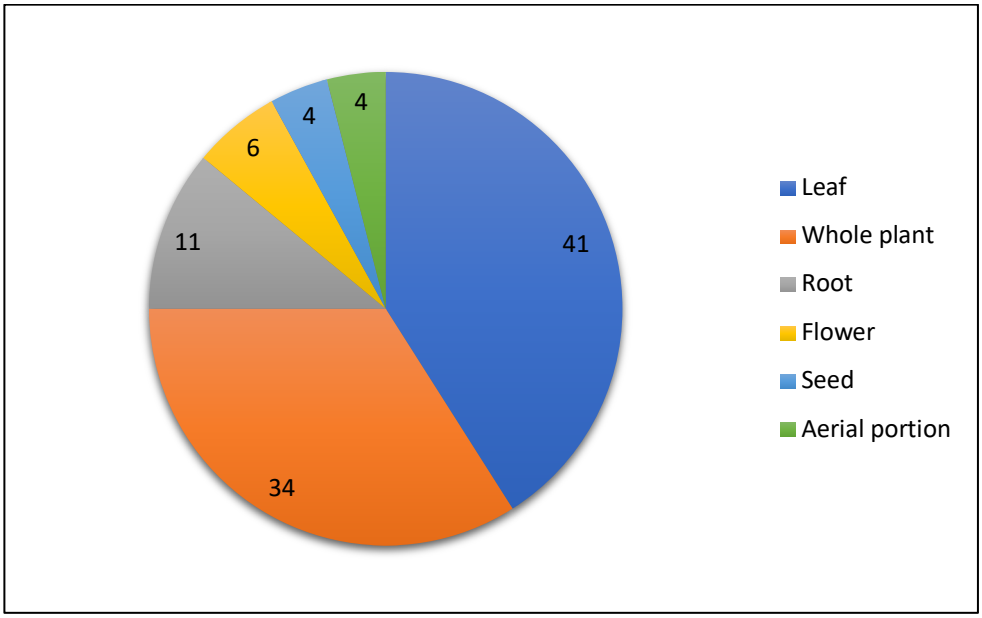

Figure 3. Percentage of plant parts used.

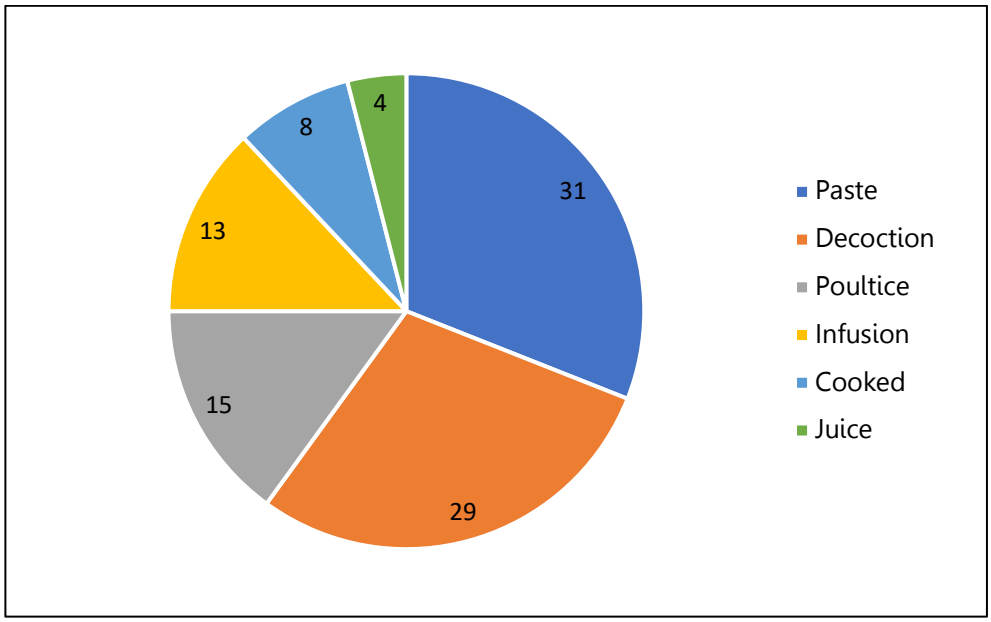

Figure 4. Percentage different remed*y applications*.

Conclusion

The study focused on traditional practices related to medicinal plant species used among the people of district Kupwara of Jammu and Kashmir to treat musculoskeletal disorders. The present investigation was undertaken to explore the local traditional knowledge of musculoskeletal diseases and to record medicinal plants for future scientific authentication through phytochemical and pharmacological studies. In this study 45 medicinal plants belonging to 20 families were reported to be used against musculoskeletal disorders. Leaves were the most frequently part used, and the dominant mode of crude drug preparation was paste. This study was the first report survey and provides significant information about the usage of medicinal plants for musculoskeletal disorders among the communities of the area. This comprehensive investigation helps in phytochemistry and pharmacological researche to screen such medicinal plant species for future drug discovery development which give more interesting information with global interest. Scientific authentication of the bio-activity of the particular medicinal plants will validate the integration and use of these natural medications for primary health care of local populations. It is need of time to develop awareness among the people to use these herbal medicines and to preserve this ethnobotanical data for future generation.

Declarations

List of abbreviations: NTFPs-Non-timber forest products, MSK-Musculoskeletal, IMD-Indian Metrological Department.

Ethics approval and consent to participate: This ethnomedicinal study was approved by the ethical committees of the Department of Botany, Government Model Science College, Jiwaji University, Gwalior, India. Before conducting interviews, individual prior informed consent was obtained from all participants. No further ethics approval was required. All work conducted was carried out under the stipulations of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity. The right to use and authorship of any traditional knowledge of all participants is maintained, and any use of this information, other than for scientific publication, does require the additional prior consent of the traditional owners, as well as a consensus on access to benefits resulting from subsequent use.

Consent for publication: Not applicable.

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

Competing interests: The authors declare no competing interests.

Funding: This study has not received any grant/funding from any agencies or forum.

Author's contributions: Tawseef Ahmad Mir: Visualization, Supervision, Methodology, Formal analysis, Writing–original draft. Muatasim Jan, Tuybia Bilai: Methodology, Formal analysis, Writing–original draft, Proof-reading, Rainer W. Bussmann: Methodology, Formal analysis, Writing–original draft, Proof-reading

Acknowledgments

The authors are thankful to management of Government Model Science College, Jiwaji University, Gwalior, India for providing necessary facilities and support to carry out this study. Authors are highly grateful to local tribes of district Kupwara, Jammu and Kashmir for sharing their indigenous medicinal plant knowledge. Authors are grateful to Mr. Akhtar H. Malik (Scientist at University of Kashmir) for helping in the identification of plant species.

Literature cited

Ahmad K, Pieroni A. 2016. Folk knowledge of wild food plants among the tribal communities of Thakht-e-Sulaiman Hills, North-West Pakistan. Journal Ethnobiology Ethnomedicine 12:17.

Aletaha D, Kapral T, Smolen J. 2003. Toxicity profiles of traditional disease modifying antirheumatic drugs for rheumatoid arthritis, Annals of Rheumatic Diseases 62(5):482-486.

Appiah KS, Oppong CP, Mardani HK, Omari RA, Kpabitey S, Amoatey CA, Agyeman SO, Oikawa Y, Katsura K, Fujii Y. 2019. Medicinal Plants Used in the Ejisu-Juaben Municipality, Southern Ghana: An Ethnobotanical Study. Medicines 6(1):1.

Bhatia H, Sharma YP, Manhas RK, Kumar K. 2014. Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India. Journal of Ethnopharmacology 151(2):1005-1018.

Bilal T, Mushtaq T, Ahmad PI, Gangoo SA, Behar B, Ayoob B, Farooq S, Mushtaq I. 2022. Botanicals their use as antimicrobial, antifungal and anti-insecticides. The Pharma Innovations 11(5):1521-1528.

Bolson M, Hefler SA, Chaves EID, Junior AG, Junior ELC. 2015. Ethno-medicinal study of plants used for treatment of human ailments, with residents of the surrounding region of forest fragments of Paraná, Brazil. Journal of Ethnopharmacology 161:1-10.

Bouyahya A, Bakri Y, Et-Touys A, Assemian ICC, Abrini J, Dakka N. 2018. In vitro antiproliferative activity of selected medicinal plants from the North-West of Morocco on several cancer cell lines. European Journal of Integrative Medicine 18:23-29.

Cakilcioglu U, Turkoglu I. 2010. An ethnobotanical survey of medicinal plants in Sivrice (Elazığ-Turkey). Journal of Ethnopharmacology 132(1):165-175.

Calixto JB. 2005. Twenty-five years of research on medicinal plants in Latin America: a personal view. Journal of Ethnopharmacology 100:131-134.

Cameron M, Chrubasik S. 2013. Topical herbal therapies for treating osteoarthritis, The Cochrane Library.

Cavero RY, Calvo MI. 2015. Medicinal plants used for musculoskeletal disorders in Navarra and their pharmacological validation, Journal of Ethnopharmacology 168:255-259.

Dar GH, Khuroo AA. 2020. Biodiversity of the Himalaya: Jammu and Kashmir State. Springer nature, Singapore Pte Ltd.

Gam AN, Johannsen F. 1995. Ultrasound therapy in musculoskeletal disorders: a meta-analysis. Pain 63(1):85-91.

Gertsch J. 2009. How scientific is the science in ethnopharmacology? Historical perspectives and epistemological problems. Journal of Ethnopharmacology 122:177-183.

Haq SM, Yaqoob U, Calixto ES, Rahman IU, Hashem, A AbdAllah EF, Alakeel MA, Alqarawi AA, Abdalla M, Hassan M, Bussmann RW. 2021. Plant resources utilization among different ethnic groups of Ladakh in Trans-Himalayan Region. Biology 10(9):827.

Heinrich M, Lardos A, Leonti M, Weckerle C, Willcox M, Applequist W, Ladio A, Long CL, Mukherjee P, Stafford G. 2018. Best practice in research: consensus statement on ethnopharmacological field studies. Journal of Ethnopharmacology 211:329-339.

Hignett S, Fray M. 2010. Manual handling in healthcare.

Hooker JD. 1998. Flora of British India, vol.1–7. Bishen Singh, Mahendra Pal Singh, Dehradun.

Jan HA, Wali S, Khan L, Jan S, Ahmad N, Ullah N. 2017. An ethnomedicinal survey of medicinal plants of Valley Chinglai District Buner, Pakistan. European Journal of Integrative Medicine. doi: 10.1016/j.eujim.2017.06.007.

Jan M, Mir TA, Ganie AH, Khare RK. 2021. Ethnomedicinal use of some plant species by Gujjar and Bakerwal community in Gulmarg Mountainous Region of Kashmir Himalaya. Ethnobotany Research and Applications 21:1-23.

Jan M, Mir TA, Jan HA, Khare RK. 2022b. Medicinal plants diversity and their uses for Gynecological Disorders of District Baramulla, Jammu and Kashmir, India. Vegetos 35:438-452.

Jan M, Mir TA, Khare RK. 2022a. Traditional use of medicinal plants among the indigenous communities in Baramulla district, Jammu and Kashmir, India. Nordic Journal of Botany 2022: e03387.

Jaradat NA, Zaid AN, Al R-Ramahi, Alqub MA, Hussein F, Hamdan Z, Mustafa M, Qneibi M, Ali I. 2017. Ethnopharmacological survey of medicinal plants practiced by traditional healers and herbalists for treatment of some urological diseases in the West Bank/Palestine. Journal of Ethnobiology and Ethnomedicine 17:255.

Kaul MK. 1997. Medicinal Plants of Kashmir and Ladakh (Temperate and Cold Arid Himalaya). Indus Publishing Company, New Delhi.

Kayani S, Ahmad M, Zafar M, Sultana S, Khan MPZ, Ashraf MA, Yaseen G. 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies–Abbottabad, Northern Pakistan. Journal of Ethnopharmacology 156:47-60.

Khoja AA, Andrabi SAH, Mir RA, Bussmann RW. 2022.Ethnomedicine and Culture: Exploitation of plant species for traditional use in the remote area of Kashmir Himalayas. Ethnobotany Research and Applications 24:1-22.

Khoja AA, Andrabi SAH, Mir RA. 2022. Traditional medicine in the treatment of gastrointestinal diseases in northern part of Kashmir Himalayas. Ethnobotany Research and Applications 23:1-17.

Khoja AA, Haq SM, Majeed M, Hassan M, Waheed M, Yaqoob U, Bussmann RW, Alataway A, Dewidar AA, Al-Yafrsi M, Elansary HO, Yessoufou K, Zaman, W. 2022c. Diversity, Ecological and traditional knowledge of pteridophytes in the western Himalayas. Diversity 14:628.

Kipkore W, Wanjohi B, Rono H, Kigen G. 2014. A study of the medicinal plants used by the Marakwet Community in Kenya, Journal of Ethnobiology and Ethnomedicine 10(1):1.

Martin GJ. 1995. Ethnobotany: A 'People and Plants' Conservation Manual. Chapman and Hall, London.

Maundu P. 1995. Methodology for collecting and sharing indigenous knowledge: a case study. Indigenous Knowl. Developmental Monitor 3:3-5.

Miller AG, Nyberg JA. 1995. Collecting Herbarium Vouchers. Royal Botanic Garden, Edinburgh EH3 5LR, U.K. 561-573.

Mir TA, Jan M, Khare RK, Dhyani S. 2021a. Ethno-Survey of Traditional Use of Plants in Lolab Valley, Kashmir Himalaya. Indian Forester. 147(3):281-287.

Mir TA, Jan M, Khare RK. 2021b. Ethnomedicinal application of plants in Doodhganga Forest Range of district Budgam, Jammu and Kashmir, India. European Journal of Integrative Medicine. 46:101366. doi: 10.1016/j.eujim.2021.101366.

Mir TA, Jan M, Khare RK. 2022. Ethnomedicinal Practices and Conservation Status of Medicinal Plants in the Bandipora District of Kashmir Himalaya. Journal of Herbs, Spices and Medicinal Plants 28(2):125-142.

Navchoo IA, Kachroo P. 1995. Flora of Pulwama, Kashmir. Bishen Singh and Mahendra Pal Singh, Dehradun.

Payyappallimana U. 2010. Role of Traditional Medicine in Primary Health Care: An Overview of Perspectives and Challenging.

Phillips O, Gentry AH, Reynel C, Wilkin P, Galvez-Durand BC. 1994. Quantitative ethnobotany and Amazonian conservation. Conservation Biology 8:225-248.

Pieroni CL, Quave. 2005. Traditional pharmacopoeias and medicines among Albanians and Italians in southern Italy: a comparison. Journal of Ethnopharmacology 101(1):258-270.

Samant SS, Dhar U, Palni LMS. 1998. Medicinal Plants of Indian Himalaya: Diversity Distribution Potential Values. G.B.Pant Institute of Himalayan Environment and Development, Almora. 163.

Sarin YK, Kapur SK. 1984. Plant resource exploitation and their utilization in Trikuta Hills of Jammu province (J&K). Journal of Economic and Taxonomic Botany 5(5):1143-1158.

Sen S, Chakraborty R. 2016. Revival, modernization and integration of Indian traditional herbal medicine in clinical practice: importance, challenges and future. Journal of Traditional Complementary Medicine. doi: 10.1016/j.jtcme.2016.05.006.

Seyid AS, Ekrem A, Selami S. 2013. An ethnobotanical study of medicinal plants used by the local peoples of Alsehir (Manisa) in Turkey. Journal of Ethnopharmacology 150:860-874.

Shrestha PM, Dhillion SS. 2003. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. Journal of Ethnopharmacology 86(1):81-96.

Singh JB, Kachroo P. 1994. Forest Flora of Pir Panjal Range: North-Western Himalaya. Bishen Singh Mahendra Pal Singh, Dehradun, India.

Singh NP, Singh NP, Uniyal BP. 2002. Flora of Jammu & Kashmir: Pteridophytes Gymnosperms and Angiosperms, Vol. 1. Botanical Survey of India, New Delhi, India.

Sonibare M.A, Abegunde RB. 2012. Ethnobotanical study of medicinal plants used by the Laniba village people in South-Western Nigeria. African Journal of Pharmacy and Pharmacology 6(24):1726-1732.

Sureshkumar J, Silambarasan R, Ayyanar M. 2017. An ethnopharmacological analysis of medicinal plants used by the Adiyan community in Wayanad district of Kerala, India. European Journal of Integrative Medicine 12:60-73.

Tariq A, Adnan M, Iqbal A, Sadia S, Fan Y, Nazar A, Mussarat S, Ahmad M, Olatunji OA, Begum S, Mazari P, Ambreen B, Khan SN, Ullah R, Khan AL. 2018. Ethnopharmacology and toxicology of Pakistani medicinal plants used to treat gynecological complaints and sexually transmitted infections. South African Journal of Botany 114:132-149.

Wang MY, West B, Jensen CJ, Nowicki D, Chen SU, Palu AK, Anderson G. 2022. *Morinda citrifolia* (Noni): a literature review and recent advances in Noni research. Acta Pharmacologica Sinica 23(12):1127-1141.

Appendix-I - Questionnaire outline

- Name of the participant.
- Participant's age and gender.
- Address of the participant.
- Educational qualification of the participant.
- Interview date.
- How long do you live in the given area?
- Local name of the used plant.
- Which diseases are treated by the plant?
- Which part is used?
- What is the method of remedy preparation?
- What is the approximate dose?
- How long should a patient be using the plant?
- Are there any possible side effects when one uses of the plant, or specific groups (e.g. children, pregnant women) who have to be careful or should not use it?