



Quantitative ethnobotanical study of medicinal plants used by native people of selected areas of Chhota Bhangal, Himachal Pradesh

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Ethnobotany Research and Applications 28:46 (2024) - <http://dx.doi.org/10.32859/era.28.46.1-29>

Manuscript received: 16/11/2023 – Revised manuscript received: 09/03/2024 - Published: 09/03/2024

Research

Abstract

Background: Ethnobotanical information about medicinal plants and their indigenous uses plays a major role in the conservation of biodiversity and cultural traditions. The native people of Chhota Bhangal hold the traditional knowledge and practices of using diverse medicinal plants for treating various diseases. But this traditional knowledge base is fading gradually. Keeping this in mind, the present study aimed to document the ethnobotanical data on medicinal plants traditionally used by the native people of Chhota Bhangal.

Methods: Snowball sampling and a structured questionnaire were used to collect ethnobotanical data which was quantitatively analyzed using Use Value, Relative Frequency of Citation, and Informant Consensus Factor.

Results: A total of 66 plant species from 29 families were reported which are utilized traditionally by the residents of the study area. Different life forms of collected plants were herb (90.9%), trees (4.05%), climbers (3.03%), and shrub (1.5%). Asteraceae was the most utilized medicinal plant family (11 species) and leaves were the most utilized plant part (40%) for medicinal purposes. *Picrorhiza kurroa* was a highly used species with high UV and RFC values. ICF values range from 0.90-0.97 and the plant is used to cure gastrointestinal problems were highest in number.

Conclusion: The study revealed that the native people of Chhota Bhangal still use several plants for curing different ailments and 66 plant species are reported with medicinal value. This documented ethnobotanical information will help in the conservation of ethnobotanical knowledge as well as further research for drug discovery to treat various chronic diseases.

Keywords: Ethnobotany, Chhota Bhangal, Medicinal plants, IKS, Quantitative analysis

Background

Medicinal plants are regarded as nature's gift to humanity and play a vital role in traditional medicinal systems (Ghahremaninejad and Hoseini, 2015). In India, diverse forms of scientifically appropriate systems of indigenous medicine, such as the Ayurveda, Yoga, Naturopathy, Unani, Siddha, and Homoeopathy (AYUSH) system, are practiced in different parts of the country. Vedic literature forms the foundation of Indian traditional knowledge, and these Vedas are valuable sources of knowledge regarding medicinal plants and their applications to treat various diseases. Interest in traditional medicines is growing gradually in both developing and developed nations because people becoming much aware about the organic, non-

toxic ingredients, that have no adverse effects, and are widely accessible at reasonable rates (Raina *et al.* 2023). According to the WHO (World Health Organization), traditional medicine is used by 80% of people in underdeveloped nations and plants account for around 85% of traditional remedies (Chaudhary *et al.* 2023).

India possesses all three components necessary for a location to have a rich ethnobotanical heritage: natural biodiversity, ethnic diversity, and rich traditions. 'Ethnobotany' term which is coined by Dr. John William Hershberger in 1895 is a branch of ethnobiology that incorporates the study of interaction and relationship between plants and human beings (Ghahremaninejad, 2021). In India traditional medicine has a long record; its Materia Medica has a wealth of knowledge on folkloric traditions and traditional characteristics of medically significant natural ingredients (Pandey *et al.* 2013). Medicinal plants of the Himalayas are mentioned in Rig-Veda, Charak Samhita, Sushrut Samhita, Atharvaveda, Ayurveda and even in epic like Ramayana also mentioned the medicinal capabilities of various plants (Thakur *et al.* 2023). In India there are about 45,000 species of plant out of which several thousand species have medicinal potential (Grover *et al.* 2002), there are about 3000 plants that are officially documented for their medicinal properties, but practitioners use more than 6000 (Seth and Sharma, 2004). Around 70% of Indians reside in remote regions, and many of them are located close to forests where they rely on different parts of plants for nutrition, healthcare, and a variety of other everyday needs (Bussmann *et al.* 2009).

The Himalaya is the world's tallest and biggest mountain chain, spanning over 2400 kilometres in length and 300 kilometres in breadth, with enormous variety in terrain and temperature (Rana *et al.* 2019). Himachal Pradesh (HP) which is one of the Himalayan state; is a great repository of medicinal herbs which harbours more than 3300 distinct plant species (Rana and Rawat, 2017) and lies between 32° 22'40 to 33° 12'40 N and 75° 47'55 to 79° 04'22 E) (Figure 1). It is mostly a mountainous state altitude ranging from 247m to 7000m above sea level and due to its wide range in altitude, climatic conditions, and topographic conditions endowed with a rich diversity of flora. More than a thousand plant species have been found in the state's temperate woods, Shiwalik hills, alpine and sub-alpine meadows (Puri *et al.* 2019). Most Himachal Pradesh residents are members of several ethnicities and civilizations, each with its own set of ancient traditions (Ghahremaninejad *et al.* 2021). Many investigators or researchers from different locations of Himachal Pradesh have recorded the medicinal and ethnobotanical applications of several plant species based on knowledge offered by the local ethnic people. Because modern medical services are not available in distant places, particularly high-altitude locations, indigenous and rural societies rely mostly on natural medicinal herbs. Unfortunately, medicinal plants are under jeopardy owing to forest destruction, livestock grazing, and unscientific harvesting. As a result, it highlights the critical necessity for their preservation because preservation of indigenous knowledge requires the safeguarding of biological resources as well as their appropriate usage. Despite a number of studies on the usage and status of medicinal plants in various parts of India, such information is not thoroughly recorded in the Chhota Bhangal area of Kangra district, Himachal Pradesh. Chhota Bhangal is an interior area of Himachal Pradesh, which is a repository for many high-altitude therapeutic plants. Local people of Chhota Bhangal possess the indigenous knowledge of using various herbal medicines and are using these medicinal plants for treating various common and major diseases such as cancer, cough, fever, diabetes, arthritis etc. In most cases, traditional knowledge is typically passed down from one generation to the next, however, a problem arises when a traditional medical practitioner dies without passing on his knowledge of traditional herbal remedies to others (Ahmad *et al.* 2014). Furthermore, improper collection of medicinal plants is a big concern. The decline of traditional knowledge has been exacerbated due to modernization as well as by the development of modern medicines, which has led to younger generations underestimating their traditional values. Many essential ideas regarding drug discovery may be lost if sufficient documentation is not maintained. With this background, Chhota Bhangal area is selected on the basis of large number of medicinal plants but remained unexplored with reference to ethnobotanical studies. Thus, the current study was an attempt for documenting ethnobotanical knowledge on medicinal plants utilized traditionally by the local people of Chhota Bhangal region of Himalayas.

Materials and Methods

Study area

Chhota Bhangal is a hilly area of Northwestern (NW) Himalaya, of district Kangra (HP) located at 32.0456° N latitude and 76.8426° E longitude, at elevation extended from 2712.72 m to 5000 m high in mountainous area (Figure 1). Chhota Bhangal is one of the sub regions of Bhangal valley, which is divided into two sub regions namely Bada Bhangal and Chhota Bhangal. Thamsar pass (4500 Metres) separate the Chota Bhangal from the Bada Bhangal. Chhota Bhangal is one of the remote areas of the district Kangra (HP) which situated in the lap of Himalayas. Native people of Chhota Bhangal are known as Bhangalis and agriculture is the primary employment of the inhabitants in the region, which is supported by livestock farming. The bulk of the people in the region keep cattle, sheep and goats for their everyday needs. The distance among the villages ranges from 5-6 km. The market is situated at 19-25 km from different villages. The forest area is about 1-5 km far from villages.

They communicate using the Pahadi dialect, but they can also speak Hindi. There are many attractive places such as Rajgundha, Nalohata Village, Dharman village, Plachak Valley, Dehansar Valley in Chhota Bhangal, due to which it has become a center of attraction for tourists. Two sacred lakes i.e. Dehnasara Lake and Thamsar Lake are present in the area which remains covered with snow during winters and the trek is open only for a few months during monsoon. Dehansar trek is about 14 km from Lohardi village. The climate covers from subtropical to alpine, with typical temperature ranging from 10 to 20°C. From July to September, the area experiences considerable rainfall, with an annual rainfall of close to 150 cm. The four main seasons of this region are summer (April-June), monsoon (June-August), autumn (September-November), and winter (December-March), during winters most of the area remains covered with snow, and temperature falls to -10 °C at high altitudes. The area is dominated by Dhauladhar mountainous range and temperate, sub alpine and alpine forests are characteristics vegetation of the area. *Cedrus deodara* (Roxb) G.Don, *Aesculus indica* (Wall. ex Cambess.), *Pyrus pashia* (Linnaeus), *Picea smithiana* (Wall.) Boiss., *Rhododendron arboreum* Sm., etc. are the major tree species of the area. Other important vegetation of the area includes *Aconitum heterophyllum* Wall., *Aconitum violaceum* Jacquem. ex Stapf, *Rheum australe* D.Don, *Ligusticopsis wallichiana* (DC.) Pimenov & Kljuykov, and *Polygonatum verticillatum* (L.) All. The Dhauladhar Wildlife Sanctuary's Chhota Bhangal region is enrich in biodiversity and has a wide range of medicinal flora, these herbs are extracted by the locals for therapeutic and commercial purposes. Local people of the area carry plenty of knowledge about using plants medicinally which they have inherited from their ancestors.

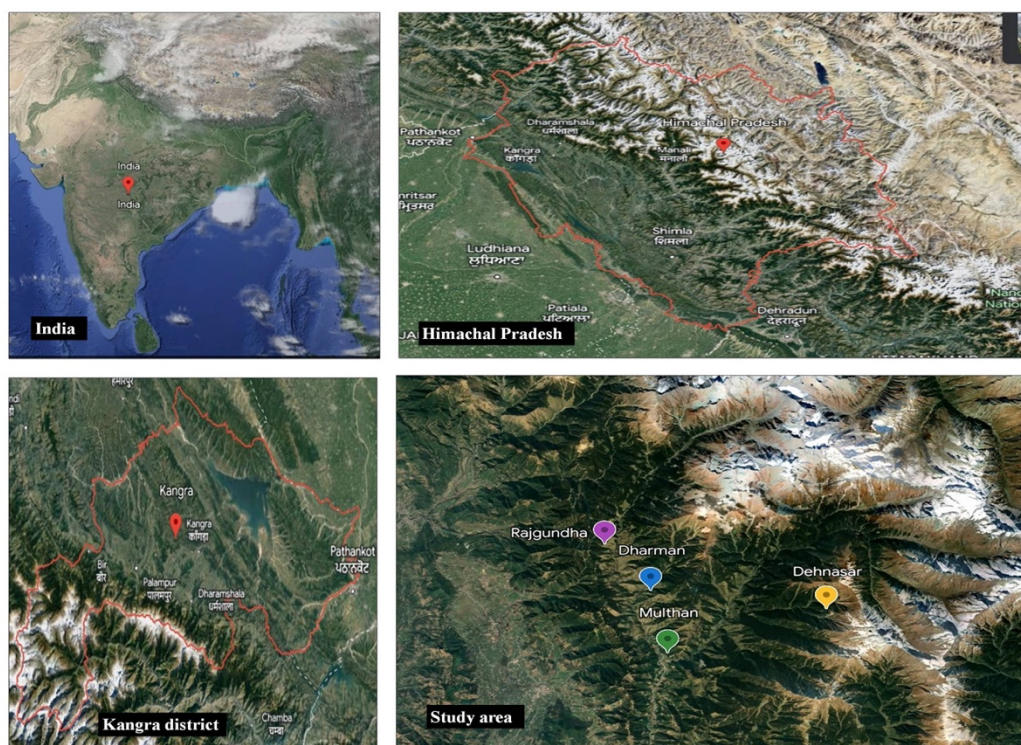


Figure 1. Map showing study area.

Four locations of the study area were selected for collection of medicinal plants namely Dehnasara Lake, Rajgundha, Multhan, and Dharman. Dehnasara Lake is a high altitude glacial-fed fresh water alpine lake located deep within the snowy mountains of Chhota Bhangal valley in the Kangra district of Himachal Pradesh. The route winds through the magnificent mountains of the Dhauladhar Wildlife Sanctuary. It is located at 32.1 N to 76.93 E at an elevation of about 4280 meters (14,040 feet) from the mean sea level. Rajgundha is a remote village with spectacular views of the Dhauladhar hills comes under Baragran panchayat of tehsil Multhan, district Kangra. It is located at 32.09° N longitude, 76.76° E latitude, at an altitude of 2712.72 meters (8900 feet) in the region of Chhota Bhangal. Multhan is a small village in Multhan tehsil present in the Chhota Bhangal region of district Kangra (HP). It is located at 32.0456° north, 76.8426° east at an elevation of 1042 meters from mean sea level (MSL). It is situated at the bank of river uhl about 39 km from Joginder Nagar city and 117 km away from district headquarters. Dharman is village present in tehsil Multhan in Chhota Bhangal region of district Kangra (HP). Village has 80 houses, and the population of the village is 448 with a geographical area of 37.65 hectares. It is located at an altitude range from 2000-2800 meters and coordinates are 32.0748 N to 76.8266 E.

Ethnobotanical data collection

Ethnobotanical data was gathered through interviews and group discussions with informants and indigenous practitioners on the plant species traditional usage. Discussions were made in different villages of the study area which were randomly selected in such a way that it covers the study area more conveniently. Total of 10 villages were selected from the study area and respondents were selected by using snowball sampling. Door-to-door interviews were conducted to interact with villagers for the collection of ethnobotanical data. The questionnaire method was used to gather data about the local name, indigenous use, parts used, preparation and commercial value of the plants. Respondents were native people and traditional healers including male and female ages between 20 to 85 years in the study area. A structure questionnaire was framed and used to collect the ethnobotanical information, both open and close ended questions were used during discussion and field visits. Snowball sampling technique was used for selecting samples, and information gathered in this way will approximate the information collected from the total study area. Participatory observation was used by being a part of their community to collect the primary data and to know their views about the various medicinal plants and their uses. The information about the threatened plant was taken from the IUCN red list and Himachal Pradesh Biodiversity Board India.

Data analysis

After the collection of ethnobotanical information from the participants data was subjected to analysis. Various quantitative indices were used for data analysis and to derive meaningful result from the raw data namely Use Value (UV), Informant Consensus Factor (ICF), and Relative Frequency of Citation (RFC).

Formulae, equations of each quantitative index:

UV: The relative importance of species known locally to the informants will be demonstrated by use value. Use value determines the relative importance of plant species in the area by local inhabitants.

$UV = Nur/Ni$ (Khoja *et al.* 2022). Where UV stands for Use Value, Nur refers to Numbers of use reports and Ni refers to the numbers of informants.

ICF: The ICF was developed to assess the consistency of information acquired about a plant used to treat a certain condition. $ICF = (Nur - Nt) / (Nur - 1)$ (Trotter and Logan, 2019). Where Nur refers to number of use reports for each category of disease and Nt refers to number of species of plants used to treat that particular category of disease.

RFC: It determines the importance of a plant species used for treatment of a particular disease. RFC values range from 0 to 1, a RFC number of '0' indicates that no informant reported the usage of the species, whereas a higher RFC value indicates that the species was mentioned by numerous informants for healing a certain ailment. The RFC value determines the importance of a plant species used for treatment of a particular disease. RFC value is based upon Frequency of Citation (FC). $RFC = FC/N$ (Tardío and Pardo-de-Santayana, 2008). FC refers to Frequency of Citation means how many informants cite the species for curing a disease and N is total no. of informants.

Results

Informants

Total 50 informants, between the age of 20 and 85 years were approached for the purpose of collecting information regarding the ethnobotanical plants and practices. Among these 50 people 46 were locals and 4 were traditional practitioners. All the informants were composed of 65% women and 35% were men, but all the traditional healers were men. Most of the female informants were uneducated and a few informants were there with formal educational qualifications, most of them were only literate and had attended school from 1-8 classes. During the current research, it was discovered that younger informants have less understanding about the use of medicinal herbs than older informants. This might be due to the reason like modernization and under estimation of the traditional values & knowledge by the younger generation

Floristic characteristics of collected medicinal plants

Present study revealed total 66 floral species from 29 families, which were utilized traditionally by the native people of the study area for the treatment of 14 different disease categories. Plant species were gathered from several areas around the research region, including 20 species from the Dehnasar valley, 14 species from Multhan, 27 species from Dharman village, and the remaining 5 species collected from Rajgundha valley. There are many species of plants which were present in more than one site but were collected only from one site (Figures 2-7).



Figure 2. 1. *Achillea millefolium* L., 2. *Acorus calamus* L., 3. *Aconitum heterophyllum* Wall. Ex Royle, 4. *Aconitum violaceum* Jacquem. ex Stapf, 5. *Aesculus indica* (Wall. ex Cambess.) Hook., 6 *Agrimonia japonica* (Miq.) Koidz, 7. *Ainsliaea aptera* DC., 8. *Ajuga parviflora* Benth., 9. *Allium wallichii* Kunth, 10. *Androsace lanuginosa* Wall., 11. *Angelica glauca* Edgew., 12. *Artemisia sieversiana* Ehrh. ex Willd.

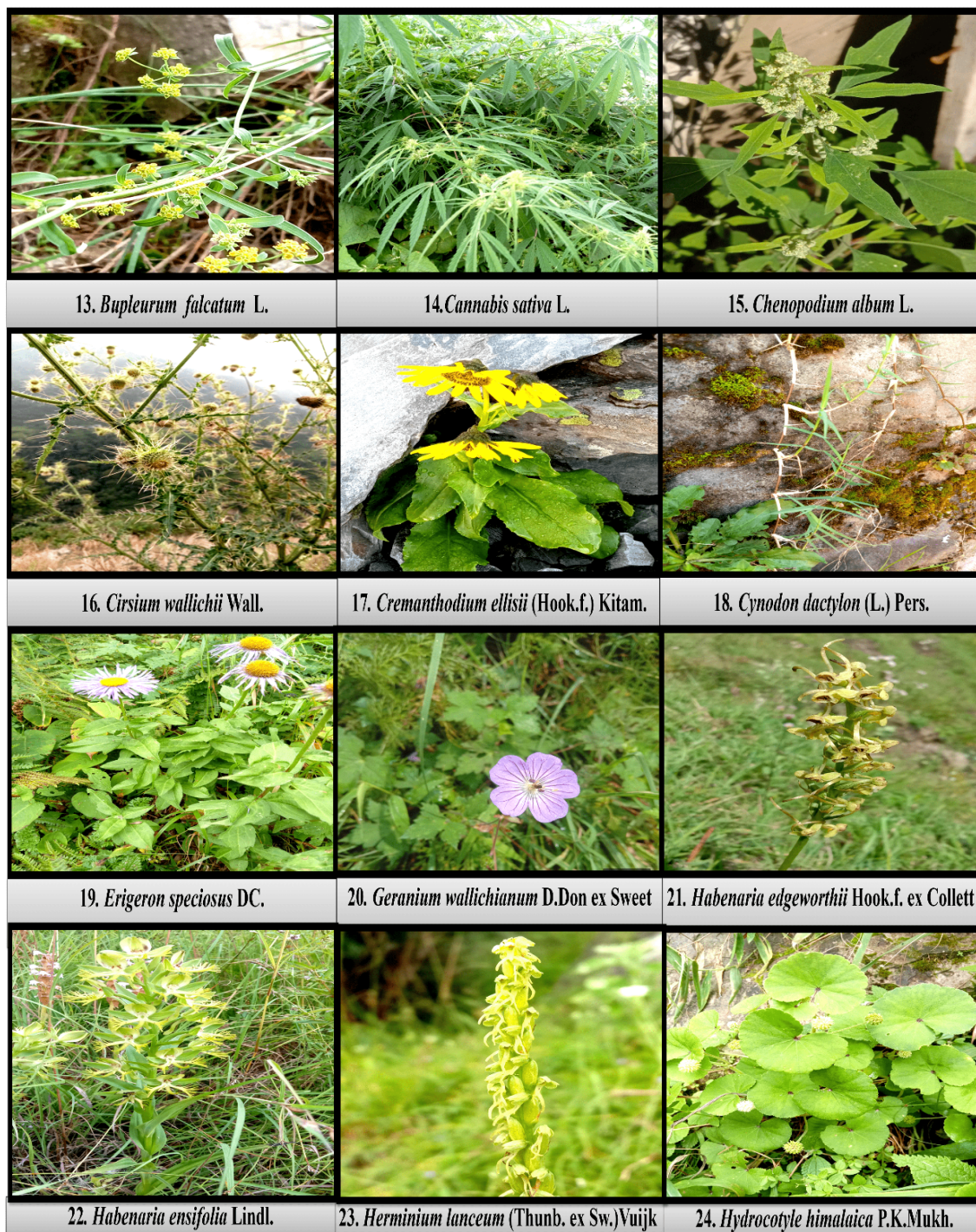


Figure 3. 13. *Bupleurum falcatum* L., 14. *Cannabis sativa* L., 15. *Chenopodium album* L., 16. *Cirsium wallichii* DC., 17. *Cremanthodium ellisii* (Hook.f.) Kitam., 18. *Cynodon dactylon* (L.) Pers., 19. *Erigeron speciosus* (Lindl.) DC., 20. *Geranium wallichianum* D.Don ex Sweet, 21. *Habenaria edgeworthii* Hook.f. ex Collett, 22. *Habenaria ensifolia* Lindl., 23. *Herminium lanceum* (Thunb. ex Sw.) Vuijk, 24. *Hydrocotyle himalaica* P.K.Mukh.

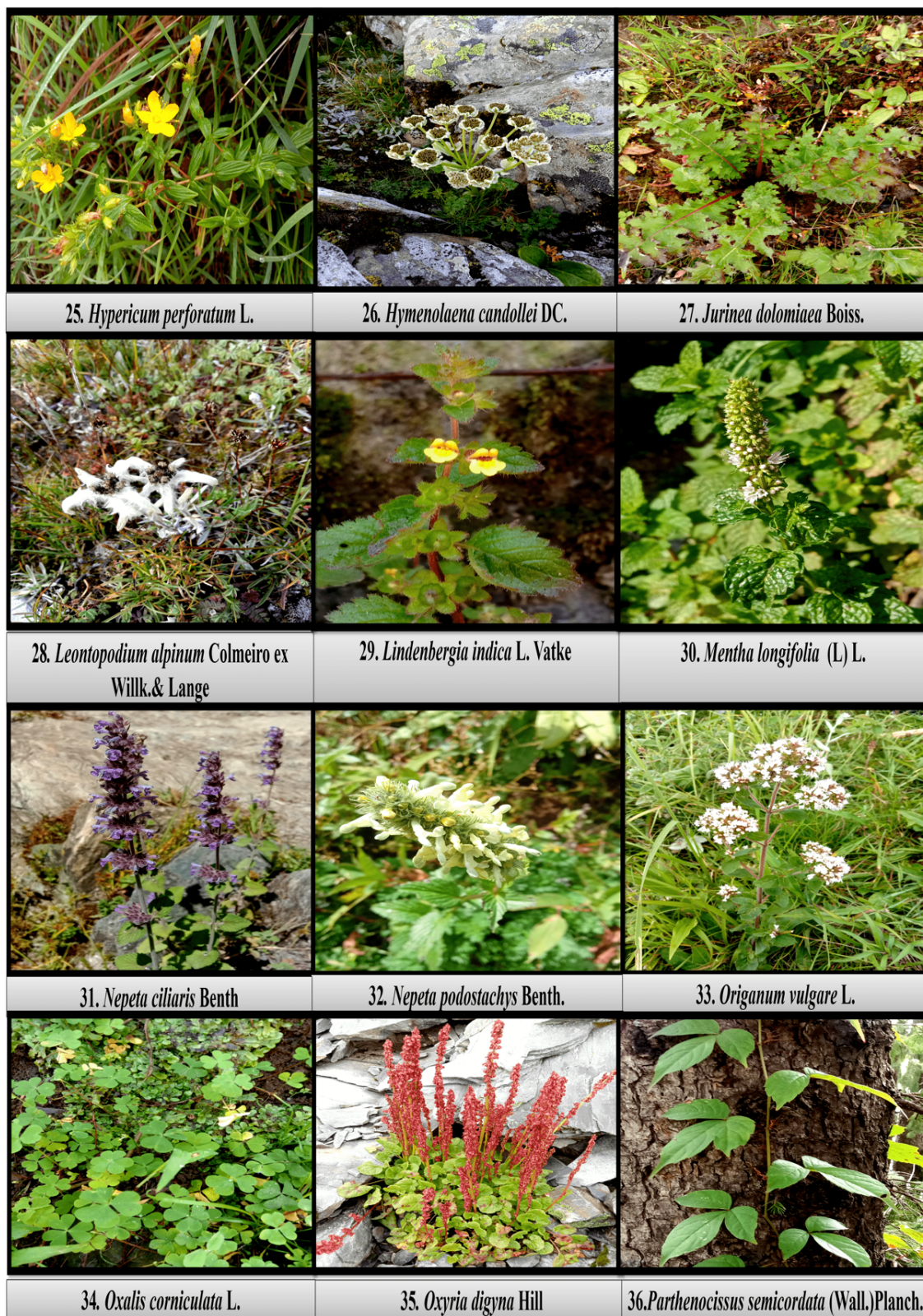


Figure 4. 25. *Hypericum perforatum* L., 26. *Hymenolaena candollei* DC, 27. *Jurinea dolomiaea* Boiss., 28. *Leontopodium alpinum* Colmeiro ex Willk. & Lange, 29. *Lindenbergia indica* (L.) Vatke, 30. *Mentha longifolia* (L.) L., 31. *Nepeta ciliaris* Benth., 32. *Nepeta podostachys* Benth., 33. *Origanum vulgare* L., 34. *Oxalis corniculata* L., 35. *Oxyria digyna* (L.) Hill, 36. *Parthenocissus semicordata* (Wall.) Planch.

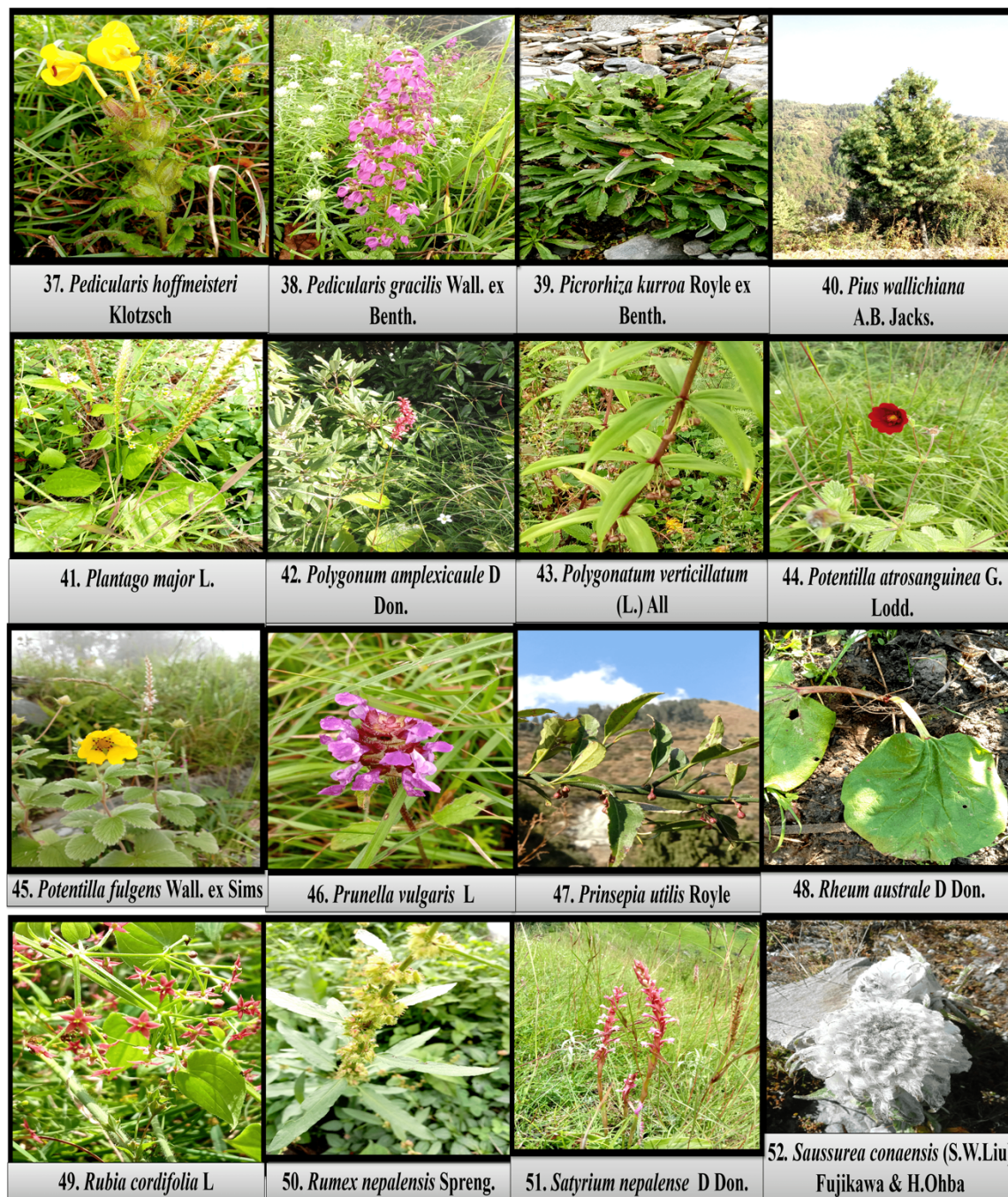


Figure 5. 37. *Pedicularis hoffmeisteri* Klotzsch, 38. *Pedicularis gracilis* Wall. ex Benth., 39. *Picrorhiza kurroa* Royle ex Benth., 40. *Pinus wallichiana* A.B.Jacks., 41. *Plantago major* L., 42. *Polygonum amplexicaule* D.Don, 43. *Polygonatum verticillatum* (L.) All., 44. *Potentilla atosanguinea* G.Lodd., 45. *Potentilla fulgens* Wall. ex Sims, 46. *Prunella vulgaris* L., 47. *Prinsepia utilis* Royle, 48. *Rheum australe* D.Don, 49. *Rubia cordifolia* L., 50. *Rumex nepalensis* Spreng., 51. *Satyrium nepalense* D.Don, 52. *Saussurea conaensis* (S.W.Liu) Fujikawa & H.Ohba

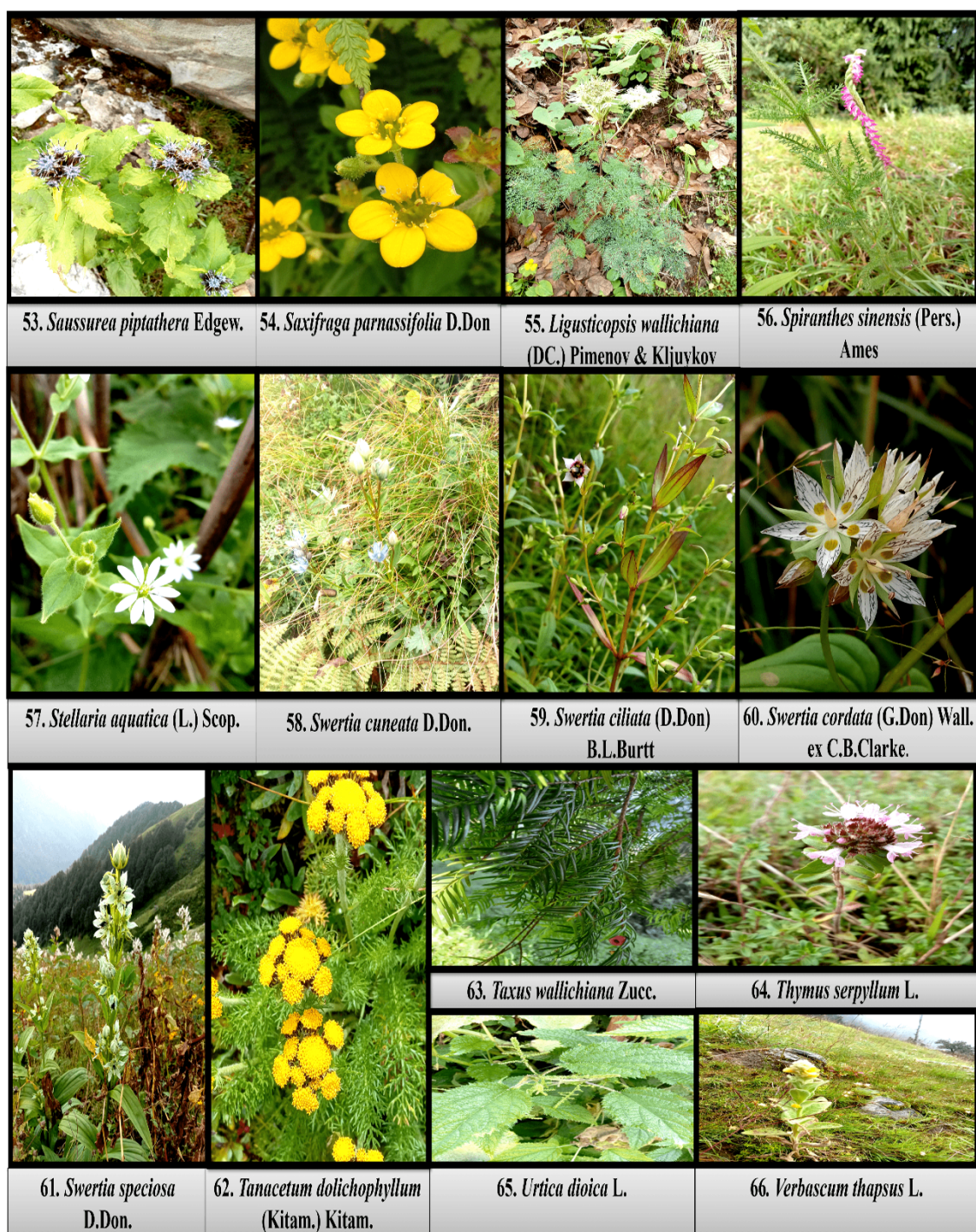


Figure 6. 53. *Saussurea piptathera* Edgew., 54. *Saxifraga parnassifolia* D.Don, 55. *Ligusticopsis wallichiana* (DC.) Pimenov & Kljuykov, 56. *Spiranthes sinensis* (Pers.) Ames, 57. *Stellaria aquatica* (L.) Scop., 58. *Swertia cuneata* D.Don, 59. *Swertia ciliata* (D.Don) B.L.Burt, 60. *Swertia cordata* (G.Don) Wall. ex C.B.Clarke., 61. *Swertia speciosa* D.Don, 62. *Tanacetum dolichophyllum* (Kitam.) Kitam., 63. *Taxus wallichiana* Zucc., 64. *Thymus serpyllum* L., 65. *Urtica dioica* L., 66. *Verbascum thapsus* L.

Herbs were the mostly used life forms by the native people which makes 90.9% of total life forms followed by trees (4.5%), climbers (3.03%) and shrub (1.5%), similar results were reported in other studies by Chauhan *et al.* (2020) Rani *et al.* (2013) and Kumar *et al.* (2011). Ease of collection of herbs and temperate and sub alpine regions of the study area explains the dominance of herbaceous plant in usage. Locals utilised leaves the most for medicinal reasons (40%), followed by roots (34%), stem (6%), aerial parts, rhizome, tuber, bark (4% each), bulb and fruit (2% each), concurrent with the findings of Faruque *et al.* (2018). Because of the presence of active chemicals and the relative simplicity of preparation, leaves are widely

utilised in the creation of herbal remedies. Decoction (44%) is the mostly used method of preparation by the local inhabitants followed by direct consumption (14%), paste (11%), Powder (8%), infusion (7%), poultice and massage with 6% each. The efficacy of herbal medicines increases in decoction form due to the considerable extraction of secondary metabolites and other biologically active compounds during boiling, which explains why decoction preparation is dominating, concurrent with the studies of Umair *et al.* (2017). Ethnobotanical data was collected during the survey for each plant and following information is provided for each plant species their scientific name, local name, ethnomedicinal uses, part used and preparation (Table 1)

All these plants belong to 29 families among which Asteraceae was the most used medicinal family (11 species), followed by Lamiaceae (7 species), Apiaceae and Orchidaceae (5 species each), Gentianaceae, Rosaceae and polygonaceae (4 species in each), Orobanchaceae (3 genera and 3 species), Plantaginaceae (2 genera and 2 species). As many as 20 families were represented by only one species each. Similar results were also given by Bisht and Adhikari (2018). The preponderance of Asteraceae, Lamiaceae, Apiaceae, and Orchidaceae may be attributable to the area's appropriate habitat for their growth. Aromatic characteristics of Asteraceae and Lamiaceae families explain the extensive dominance of these family's medicinal plants for curing various ailments. A number of polyacetylene compounds were reported from Asteraceae family which possess cytotoxic, antimicrobial (Malekpourzadeh *et al.* 2024), anti-inflammatory, neurotoxic, phototoxic, and several other types of activity (Konovalov, 2014). Lamiaceae family is characterized by plants (*Mentha longifolia*, *Thymus serpyllum*, *Ajuga parviflora*) with a number of phenolic compounds (Menthol, carvacrol, thymol) which explains their complex pharmacological activities (Abdelhalim and Hanrahan, 2021) (

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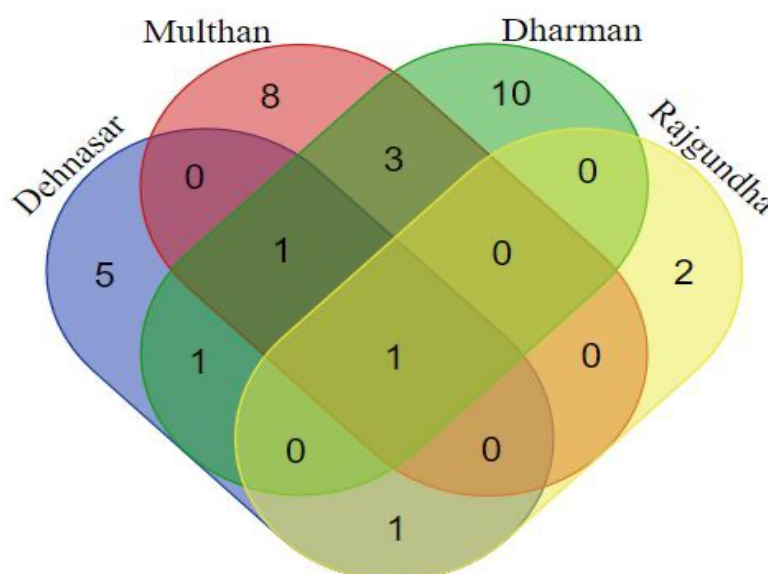


Figure. 7: Venn diagram showing relationship among 4 villages (Dehnasar, Multhan, Dharman, and Rajgundha) and families of plants found in these areas.

Table 1. List of collected medicinal plants along with their common name, family, life form, used parts, ethnobotanical uses and scientific validation

Scientific name	Common name	Family	Habit	Parts used	Ethnobotanical uses	Scientific validation	References
<i>Achillea millefolium</i> L. (Figure 2)	Losru gha	Asteraceae	Herb	Leaves and root.	Roots are chewed directly for treating toothache and tea prepared using its leaves also used to treat gastrointestinal disorders.	Antioxidant, antimicrobial, antibacterial, anti-inflammatory, antiparasitic.	(Candan <i>et al.</i> 2003)
<i>Acorus calamus</i> L. (Figure 2)	Bara	Acoraceae	Herb	Root	Rhizome of plant is used for treating common health problems including chest congestion in children, cough, and joint pain. Decoction of rhizome is made using ½ glass of water (hot water) and one spoon of honey for treating cough and poultice of rhizome used to treat chest congestion. Oil obtained from rhizome used for massaging and curing joint pain.	CNS depressant, anticonvulsant, anti-inflammatory, antioxidant, antimicrobial, antidiabetic.	(Rajput <i>et al.</i> 2014)
<i>Aconitum heterophyllum</i> Wall. Ex Royle (Figure 2)	Atish, Patish	Ranunculaceae	Herb	Roots	Root powder of 'Atish' has been used for treating various ailments including gastric pain, stomachache, dysentery, cough, fever, and as a carminative agent.	Antiinflammatory, antioxidative, antifatulent, carminative, expectorant.	(Paramanick <i>et al.</i> 2017)
<i>Aconitum violaceum</i> Jacquem. ex Stapf (Figure 2)	Mitha Telia	Ranunculaceae	Herb	Roots	<i>A. violaceum</i> has been used for treating Stomachache, gastric problems, heart diseases, and also as an anti-inflammatory agent.	Antimicrobial, antioxidant.	(Khan <i>et al.</i> 2021)
<i>Aesculus indica</i> (Wall. ex Cambess.) Hook. (Figure 2)	Kanhor	Sapindaceae	Tree	Fruit	Flour made from fruits used to treat menstrual problems in women, leucorrhea and given to diabetic patients also. It is given to women after pregnancy as a healthy meal.	Antioxidant, anti-inflammatory, antiviral, immunomodulatory, antispasmodic.	(Yadav <i>et al.</i> 2022)
<i>Agrimonia japonica</i> (Miq.) Koidz (Figure 2)	Hairy agrimony	Rosaceae	Herb	Whole plant	Decoction of the plant used to treat stomachache, fever, white discharge, and cardiac problems.	Antioxidant, antitumor, neuroprotective.	(Kubinova <i>et al.</i> 2012)
<i>Ainsliaea aptera</i> DC. (Figure. 2)	Kandyari	Asteraceae	Herb	Roots	Decoction and infusion of roots is used for curing stomachache, gastric pain and fever.	Antibacterial, antifungal.	(Bisht <i>et al.</i> 2021)

<i>Ajuga parviflora</i> Benth. (Figure. 2)	Neelkanthi, kadcha	Lamiaceae	Herb	Whole plant	Decoction or crude form of plant is used to treat sore throat, inflammation, stomachache, and arthritis. Juice from the leaves is extracted and a few (2-3) drops of that juice are poured from the anus.	Anti-inflammatory, antioxidant, analgesic, antidepressant and anticoagulant.	(Kayani <i>et al.</i> 2016)
<i>Allium wallichii</i> Kunth (Figure. 2)	Ban pyaaz	Amaryllidaceae	Herb	Bulbs and leaves	Bulbs of plants are used to treat loose motion, dysentery, stomachache, cough and cold. Bulbs can be eaten in its crude form or can be cooked in Ghee.	Anti- microbial, antioxidant, anti-cancerous, antibacterial.	(Bhandari <i>et al.</i> 2017)
<i>Androsace lanuginosa</i> Wall. (Figure. 2)	Wolly rock jasmine	Primulaceae	Herb	Flowers and leaves	Decoction of leaves and flowers is used to treat abdominal pain and stomachache.		
<i>Angelica glauca</i> Edgew. (Figure. 2)	Chora	Apiaceae	Herb	Roots	Roots of plants are used for curing problem of constipation, dysentery, wound healing, and stomach-ache. It is also used against bronchitis and colic pain. Paste of root is made and applied on wounds for its faster healing.	Antioxidant, phytotoxic activities, antimicrobial activities.	(Nengroo and Rauf, 2021)
<i>Artemisia sieversiana</i> Ehrh. ex Willd. (Figure. 2)	Charmarua	Asteraceae	Herb	Leaves	Poultice of leaves is used to treat painful joints. Decoction of leaves is used as abortifacient. Decoction of leaves used to abort the child thus acts as an abortifacient.		
<i>Bupleurum falcatum</i> L. (Figure. 3)	Shut puti	Apiaceae	Herb	Whole plant	Decoction of fresh plant used to cure various elements including cold, cough, fever, digestive disorders and liver disease.	Antioxidant, anti-inflammatory, anti-depressant.	(Kwon <i>et al.</i> 2010)
<i>Cannabis sativa</i> L. (Figure. 3)	Bhang, bijia	Cannabaceae	Herb	Seed, leaves and stem	Oil obtained from seeds used for the purpose of massaging and curing musculoskeletal disorders. And leaves are used to treat stomach ache, loose motions, depression, and allergy. It can be taken with water for curing these ailments.	Antimicrobial, antioxidant.	(Fathordoobady <i>et al.</i> 2019)
<i>Chenopodium album</i> L. (Figure. 3)	Bithoo	Amaranthaceae	Herb	Whole plant	It acts as a blood purifier, diuretic, sedative and also used to treat urinary problems. Young plant is cooked and eaten as vegetable	Antibacterial, anthelmintic.	(Jabbar <i>et al.</i> 2007)

<i>Cirsium wallichii</i> DC. (Figure. 3)	Bursha	Asteraceae	Herb	Roots	Dried root powder of the plant used to treat Gastric problem and decoction of roots used to treat liver diseases.	Anti-inflammatory, antimicrobial, hepatoprotective, antioxidant, anticancerous.	(Aggarwal <i>et al.</i> 2022)
<i>Cremanthodium ellisii</i> (Hook.f.) Kitam. (Figure. 3)	Sooraj mukhi	Asteraceae	Herb	Leaves and flowers	Paste of leaves and flowers is used to treat fever and headache.		
<i>Cynodon dactylon</i> (L.) Pers. (Figure. 3)	Drub	Poaceae	Herb	Aerial parts	Decoction of the aerial parts of the plant used to treat constipation and piles. Juice extracted from the leaves used for treating nasal bleeding	Antimicrobial, antioxidant, antidiabetic, diuretic, cardiovascular.	(Al-Snafi, 2016)
<i>Erigeron speciosus</i> DC. (Figure. 3)	Himalayan fleabane	Asteraceae	Herb	Whole plant	Decoction of plant is used for the treatment of cough.	Antifungal, molluscicide.	(Meepagala <i>et al.</i> 2002)
<i>Geranium wallichianum</i> D.Don ex Sweet (Figure. 3)	Nili dori	Geraniaceae	Herb	Roots	It is used for the purpose of relieving back pain, eye disorders, and in increasing blood level in the body. Decoction of roots is formed, and that decoction is used in the preparation of 'halwa' in place of normal water.	Antibacterial, antifungal, insecticidal, cytotoxic, phytotoxic.	(Ismail <i>et al.</i> 2012)
<i>Habenaria edgeworthii</i> Hook.f. ex Collett (Figure. 3)	Vradhi	Orchidaceae	Herb	Tubers	Tubers of this orchid have high medicinal properties and used ethnomedicinally for treating diabetes, heart diseases and cancer. Powder of Tuber or decoction of tuber is used for curing these ailments.	Antioxidant.	(Giri <i>et al.</i> 2012)
<i>Habenaria ensifolia</i> Lindl. (Figure. 3)	Doodhali	Orchidaceae	Herb	Leaves and flowers	It is used by local people for curing Arthritis, Chest pain, and stomachache. Decoction of fresh plant is used to treat stomachache and chest pain and paste of leaves is used for curing Arthritis		
<i>Herminium lanceum</i> (Thunb. ex Sw.) Vuijk (Figure. 3)	Lanceleaf herminium	Orchidaceae	Herb	Whole plant	Decoction of the fresh plant is used treat urinary problems such as suppressed urination.		

<i>Hydrocotyle himalaica</i> P.K.Mukh. (Figure. 3)	Brahmsutri	Apiaceae	Herb	Leaves	Decoction of leaves is used for the purpose of abortion thus it acts as an abortifacient and paste of leaves is used externally for the purpose of wound healing		
<i>Hypericum perforatum</i> L. (Figure. 4)	John's wort	Hypericaceae	Herb	Whole plant	Decoction and paste of the plant is used for the treatment of cuts and burns, anxiety, depression and headache.	Anti-depressant, antibacterial, anti-inflammatory.	(Greeson <i>et al.</i> 2001)
<i>Hymenolaena candollei</i> DC. (Figure. 4)	Baan	Apiaceae	Herb	Whole plant	It is used for the treatment of epilepsy. The plant is burnt on a plate and the smoke from the burnt plant is used to treat epilepsy.		
<i>Jurinea dolomiaea</i> Boiss., (Figure. 4)	Dhup	Asteraceae	Herb	Roots	Decoction and paste of root is used for the treatment of gastric problems and wound healing respectively, acts as antidepressant also.	Antioxidant, antibacterial, antimicrobial.	(Sigh <i>et al.</i> 2015)
<i>Leontopodium alpinum</i> Colmeiro ex Willk. & Lange (Figure. 4)	Jota ra losar	Asteraceae	Herb	Whole plant	Decoction of plant is used to treat fever, bronchitis, and abdominal ache. It is also used for the treatment of epilepsy and for this smoke of plant is given to the patient.	Anti-aging, antibacterial.	(Cho <i>et al.</i> 2020)
<i>Lindenbergia indica</i> (L.) Vatke (Figure. 4)	Pathhr chhati	Orobanchaceae	Herb	Whole plant	This plant is used traditionally by local healers against diabetes, breathing problems and stone problems. Decoction of plant is prepared and consumed to treat these ailments.	Antioxidant, antibacterial.	(Singh <i>et al.</i> 2013)
<i>Mentha longifolia</i> (L.) L. (Figure. 4)	Pudina	Lamiaceae	Herb	Leaves	It is used locally to cure various ailments such as cold, cough, fever, headache, digestive problems, colic pain and vomiting. Its decoction is used to cure these illnesses. Two to three drops of the juice extracted from the leaves are taken for the treatment of vomiting.	Antimicrobial, antioxidant	(Gulluce <i>et al.</i> 2007)
<i>Nepeta ciliaris</i> Benth. (Figure. 4)	Catnip	Lamiaceae	Herb	Whole plant	Decoction of plant is used to cure common cold, cough, and stomach disorders.	Antioxidant, antibacterial.	(Shankar <i>et al.</i> 2012)
<i>Nepeta podostachys</i> Benth. (Figure. 4)	Long stalked catnip	Lamiaceae	Herb	Root and stem	Decoction of fresh plant is used to treat kidney disorders.		

<i>Origanum vulgare</i> L. (Figure. 4)	Ban tulsi	Lamiaceae	Herb	Whole plant	Plant is used by local people in curing menstrual problems in women and also in curing respiratory problems such as asthma & bronchitis. Decoction of fresh plant is used for treatment of these ailments and in its dried form it is also used as a spice.	Antioxidant, antispasmodic, ant urolithic.	(Khan <i>et al.</i> 2011)
<i>Oxalis corniculata</i> L. (Figure. 4)	Khhat mlori	Oxalidaceae	Herb	Whole plant	Fresh plant is used for curing loose motion, headaches, wound healing, and to prevent inflammation. It is also used against the ulcers, snake bites and burns. For curing loose motion decoction or <i>chutney</i> of fresh plant is prepared and consumed. And paste of plant is used to prevent inflammation and wound healing.	Antibacterial, antimicrobial, antioxidant, antifungal, anti-inflammatory, anticancer.	(Badwaik <i>et al.</i> 2011)
<i>Oxyria digyna</i> Hill (Figure. 4)	Jhemlu	Polygonaceae	Herb	Whole plant	It is used locally for curing diarrhea, constipation and stomach ache. It is also sour in taste and used to improve digestion and treat scurvy.		
<i>Parthenocissus semicordata</i> (Wall.) Planch. (Figure. 4)	Amru bail	Vitaceae	climber	Aerial parts	Decoction of aerial plant's part is used to control blood pressure (BP), leucorrhea, and piles. Paste of aerial part of plant is used for the treatment of wound also.		
<i>Pedicularis hoffmeisteri</i> Klotzsch (Figure. 5)	Hoffmeister's Lousewort	Orobanchaceae	Herb	Whole plant	It is used traditionally to treat problem of indigestion. Decoction and infusion of plant used for the purpose of curing indigestion.		
<i>Pedicularis gracilis</i> Wall. ex Benth. (Figure. 5)	Slender lousewort	Orobanchaceae	Herb	Leaves and flowers.	Decoction of leaves and flowers is used locally to treat various ailments including fever, leucorrhea, urinary problems, and in improving digestion also.		
<i>Picrorhiza kurroa</i> Royle ex Benth. (Figure. 5)	kurro	Plantaginaceae	Herb	Rhizome	It is widely used by the local people to treat fever, indigestion, gastric pain, and stomach pain. An infusion of the root or rhizome of the plant is prepared in an earthen or bronze vessel and the water of that infusion is drunk daily in the morning on an empty stomach and the roots can be chewed directly.	Hepatoprotective, antioxidant, anticarcinogenic, antineoplastic, immunostimulatory activity.	(Vaidya <i>et al.</i> 1996)

<i>Pinus wallichiana</i> A.B.Jacks. (Figure. 5)	Kail	Pinaceae	Tree	Bark, leaves	Oil obtained from the plant is used to treat various ailments of body such as for curing burns, boils, wounds, swelling and musculoskeletal disorders.	Antibacterial, antifungal, insecticidal, Phytotoxic activities.	(Rahman <i>et al.</i> 2016)
<i>Plantago major</i> L. (Figure. 5)	Chopdu gha	Plantaginaceae	Herb	Whole plant	Decoction of plant is used for the purpose of curing various skin diseases, fever, diarrhea, wound healing and against diabetes. It is also used to treat the <i>Hematuria</i> in cows.	Antiviral, cytotoxic, immunomodulatory.	(Chiang <i>et al.</i> 2003)
<i>Polygonum amplexicaule</i> D.Don (Figure. 5)	Mindal	Polygonaceae	Herb	Roots	Decoction of root is used for treatment of fever, heart blocking, liver damage, and gastrointestinal disorders. Paste of root is also applied to cure painful joints.	Antioxidant.	(Mirza <i>et al.</i> 2015)
<i>Polygonatum verticillatum</i> (L.) All. (Figure. 5)	Salmishri	Asparagaceae	Herb	Roots	Infusion of roots is used to treat piles, high blood pressure, heart disorders, and liver disorders. Root can be chewed directly, and it is sweet in taste. It is also used by <i>Gaddis</i> during travel to high altitude areas for the purpose of maintaining the water level in the body.	Antioxidant, anti-inflammatory, anticancer.	(Singh and Patra, 2018)
<i>Potentilla atrosanguinea</i> G.Lodd. (Figure. 5)	Lal dori	Rosaceae	Herb	Roots	Decoction and paste of roots is used locally for the purpose of curing wound healing, inflammation, increases blood level and back pain.	Antioxidant.	(Kalia <i>et al.</i> 2008)
<i>Potentilla fulgens</i> Wall. ex Sims (Figure. 5)	Pili dori	Rosaceae	Herb	roots	Decoction of plant is used for curing back pain, increasing blood level in the body, and against diabetes.	Antioxidant, anthelmintic, Gastroprotective.	(Jaitak <i>et al.</i> 2010)
<i>Prunella vulgaris</i> L. (Figure. 5)	Heal all	Lamiaceae	Herb	Leaves	Tea is prepared by using leaves of the plant and consumed to treat fever, upset stomach and sore throat and mouth. Paste of leaves or whole plant is used to treat inflammation and wound healing.	Anti-allergic, anti-inflammatory.	(Ryu <i>et al.</i> 2000)
<i>Prinsepia utilis</i> Royle (Figure. 5)	Bhekhal	Rosaceae	Shrub	Roots and leaves	A decoction of leaves is used to treat fever and cold. Decoction of bark of its root is used to cure diabetes.	Antioxidant, immunosuppressive.	(Zhang <i>et al.</i> 2018)

<i>Rheum australe</i> D.Don (Figure. 5)	Chukri	Polygonaceae	Herb	Roots	Roots of plant are used for the treatment of inflammation. Poultice of leaves is used to treat swelling and its decoction also used to cure stomach problems and liver disorders. It is also used as an astringent and laxative.	Antibacterial, antioxidant, cytotoxic activity.	(Gupta <i>et al.</i> 2014)
<i>Rubia cordifolia</i> L. (Figure. 5)	Manjistha	Rubiaceae	Climber	Roots and leaves	Root powder of manjistha is used to treat stone problems and acts as a blood cleanser. Paste of leaves is also used to cure skin diseases and swelling.	Anticancer, hepatoprotective, antioxidant,	(Rao <i>et al.</i> 2006)
<i>Rumex nepalensis</i> Spreng. (Figure. 5)	Albar	Polygonaceae	Herb	Leaves	Poultice and paste of leaves is used to treat wounds and used as wound healer. Leaves are also used to treat irritation and allergy.	Antioxidant, anti-inflammatory, antimicrobial.	(Devkota <i>et al.</i> 2015)
<i>Satyrium nepalense</i> D.Don (Figure. 5)	Salam mishri	Orchidaceae	Herb	Tubers and leaves	Tuber's powder is used as energetic tonic and decoction of plant is used to treat fever, dysentery and diarrhea.	Antimicrobial, antioxidant.	(Singh, 2019)
<i>Saussurea conaensis</i> (S.W.Liu) Fujikawa & H.Ohba (Figure. 5)	Ghughi	Asteraceae	Herb	Whole plant	It is one of the sacred plants of the area used to treat cuts and wounds, due to its woolly nature it stops bleeding from cuts and heals wounds. Poultice of plant is also used to treat rheumatism and skin diseases.	Antibacterial, antioxidant.	(Mishra <i>et al.</i> 2021)
<i>Saussurea piptathera</i> Edgew. (Figure. 6)	Himalayan saw-wart	Asteraceae	Herb	Leaves	Decoction of leaves is used to treat cough, cold and stomachache.		
<i>Saxifraga parnassifolia</i> D.Don (Figure. 6)	Himalyan saxifrage	Saxifragaceae	Herb	Whole plant	Decoction of fresh plant is used for the treatment of kidney stone.		
<i>Ligusticopsis wallichiana</i> (DC.) Pimenov & Kljuykov (Figure. 6)	Mathoshal	Apiaceae	Herb	Roots and rhizome	Powder of rhizome with lukewarm oil is massaged to treat swelling in the body specially to treat post-partum edema in women, as an antidepressant.	Antimicrobial	(Singh <i>et al.</i> 2012)
<i>Spiranthes sinensis</i> (Pers.) Ames (Figure. 6)	Ghrotnu ghas	Orchidaceae	Herb	Whole plant	Decoction of leaves and tuber is used to treat cough, leucorrhea, and diabetes. Paste of plant also applied to treat snake bites.	Antioxidant, anti-inflammatory, anticancer.	(Kuo <i>et al.</i> 2022)

<i>Stellaria aquatica</i> (L.) Scop. (Figure. 6)	Kokhuwa	Caryophyllaceae	Herb	Whole plant	It is eaten as vegetable in the local area and decoction of the plant is used to treat fever, constipation and sore throat. Excessive eating may result in loose motion.		
<i>Swertia cuneata</i> D.Don (Figure. 6)	Chirayta	Gentianaceae	Herb	Whole plant	Decoction of plant is used to treat diabetes, ulcers, and skin diseases.		
<i>Swertia ciliata</i> (D.Don) B.L.Burtt (Figure. 6)	Chirayta	Gentianaceae	Herb	Whole plant	Decoction of plant is used to treat diabetes.	Antimicrobial, antifungal	(Saeed and Ford, 1998)
<i>Swertia cordata</i> (G.Don) Wall. ex C.B.Clarke (Figure. 6)	Chirayta	Gentianaceae	Herb	Whole plant	Decoction of plant is used to treat fever, headache, and stomachache.	Antioxidant, antidiabetic, antibacterial.	(Roy <i>et al.</i> 2015)
<i>Swertia speciosa</i> D.Don (Figure. 6)	Chirayta	Gentianaceae	Herb	flower	Flowers of plant are used to treat throat pain		
<i>Tanacetum dolichophyllum</i> (Kitam.) Kitam. (Figure. 6)	Jota ra losru	Asteraceae	Herb	Leaves	Leaves juice is consumed to get rid of alcohol intoxication.	Antimicrobial.	(Haider <i>et al.</i> 2011)
<i>Taxus wallichiana</i> Zucc. (Figure. 6)	Rkhala	Taxaceae	Tree	Bark and leaves	It is used to cure diabetes, cold, cough, fever and cancer. Decoction or tea is prepared using bark and leaves of the tree to cure these ailments.	Antifungal, anticonvulsant, analgesic, antipyretic, antibacterial.	(Nisar <i>et al.</i> 2008)
<i>Thymus serpyllum</i> L. (Figure. 6)	Ban ajwain	Lamiaceae	Herb	Whole plant	Used to treat constipation, blood pressure problem, respiratory disorders, and gastric problem. The crushed plant is boiled for a while in water to prepare the decoction. It is also used to increase the hunger.	Antimicrobial, antioxidant, antitumor.	(Nikolic <i>et al.</i> 2014)
<i>Urtica dioica</i> L. (Figure. 6)	Kushak	Urticaceae	Herb	Stem and leaves	Plant is used to cure painful muscles, joint pain, arthritis, and to purify blood. The painful area is beaten with the plant and hot water is also added along with it to cure these problems.	Antioxidant, antimicrobial, antiulcer, analgesic.	(Gulcin <i>et al.</i> 2004)
<i>Verbascum thapsus</i> L. (Figure. 6)	Bandr lingnu	Scrophulariaceae	Herb	Leaves and flowers	Tea prepared by using mullein flowers is used to cure migraine, headache, inflammation and pulmonary problems. Paste of leaves is used to treat inflammation.	Antibacterial activity.	(Prakash <i>et al.</i> 2016)

Quantitative ethnomedicinal indices of ethnomedicinal plants**Informant consensus factor (ICF)**

The ICF is used to evaluate the uniformity of the data obtained about a plant that is used to cure a certain ailment. The high value of ICF indicates that there is a strong consensus among respondents for the use of plants to cure a disease category, and vice versa. Different diseases which are treated by the use of medicinal plants were also grouped under 14 categories using namely respiratory problems, gastrointestinal problems, ENT problems, dermatological problems, reproductive problems, urinary problems, anti-poisonous, dental problems etc. (Staub *et al.* 2015) (Table 2). In present study the ICF values for these diseases category ranges from 0.90 (Urinary problems) to 0.97 (gastrointestinal problems and anti-poisonous). Local inhabitants use highest plant species for the treatment of gastrointestinal problems (33 species) similar to the studies of Heinrich *et al.* (1998) followed by respiratory problems (26 species), musculoskeletal problems (20 species), dermatological problems (17 species), liver problems (13 species) and least species used for cancer, anti-poisonous, and dental problems with 2 species in each disease category. The highest plant use citation was for Gastrointestinal problems (945) followed by, respiratory problems (653) dermatological problems (437), musculoskeletal problems (420) and cancer with least citation (28). Similar results were reported by Chauhan *et al.* 2020, Kumar *et al.* 2015. The high ICF value indicates that they are the most prevalent illnesses in the studied region, which might be attributed to harsh climatic conditions and inadequate sanitary facilities. Most of the local people of the area were indulged in agriculture activities which might be a reason for dermatological problems which include cuts, burns and wounds.

Table 2. List of different disease types in a particular disease category with numbers of plant used for treatment, Use reports and ICF values.

Disease category	Disease types and symptoms	No. of plants used for the treatment	Use Reports	ICF
Respiratory problems	Cough, bronchitis, asthma, chest congestion, cold, and fever.	26	653	0.96
Gastrointestinal problems	Gastric pain, loose motion, dysentery, stomachache, colic pain, abdominal pain, diarrhoea, constipation, vomiting, ulcers, and piles.	33	945	0.97
ENT problems	Eyes, nose and throat problems	6	135	0.95
Dermatological problems	Skin disorders, burns, inflammation, and allergy.	17	437	0.95
Musculoskeletal problems	Wounds, cuts, arthritis, rheumatism, joint pain, back pain, and bone fracture.	20	420	0.94
Reproductive problems	Leucorrhea, abortifacient, menstrual problems, and post-partum edema.	8	182	0.95
Urinary problems	Suppressed urination and kidney stone.	6	54	0.90
Blood realated problems	Blood purifier and hemoglobin count.	6	76	0.93
Liver problems	Jaundice and diabetes.	13	240	0.95
Anti-poisnous	Snake bites and insect bites.	2	48	0.97
Dental problems	Toothache and scurvy.	2	58	0.97
Nervous system related problems	Depression, epilepsy, and anxiety.	7	134	0.94
Cardiac problems	Blood pressure problem, heart disorder.	7	177	0.96
Cancer problems	Lung, breast cancer, and brain tumor.	2	28	0.95

Table 3. Medcinal plants with their local name, Recommended uses, Σu , use values, FC and RFC values

Plants name	Common name	Recommended Uses	Σu (Use reports)	Use value	FC	RFC
<i>Achillea millefolium</i> L.	Losru gha	Toothache (45), Gastrointestinal disorders (2)	47	0.94	40	0.8
<i>Acorus calamus</i> L.	Bara	Chest Congestion (20), Cough (5), Joint pain (2)	27	0.54	25	0.5
<i>Aconitum heterophyllum</i> Wall. Ex Royle	Atish, Patish	Stomachache (48), Gastric pain (30), Cough (2), Fever (2)	82	1.64	48	0.96
<i>Aconitum violaceum</i> Jacquem. ex Stapf	Mitha Telia	Stomachache (25), Gastric Pain (5), Heart diseases (2), Respiratory problems (2)	34	0.68	30	0.6
<i>Aesculus indica</i> (Wall. ex Cambess.) Hook.	Kanhor	Antidiabetic (2), Leucorrhea (4), Menstrual problems (7)	13	0.26	13	0.26
<i>Agrimonia japonica</i> (Miq.) Koidz	Hairy agrimony	Abdominal pain (3), White discharge (1), Heart stroke (2)	6	0.12	5	0.1
<i>Ainsliaea aptera</i> DC.	Kandyari	Stomachache (45), Gastric pain (40), Fever (5)	90	1.8	46	0.92
<i>Ajuga parviflora</i> Benth.	Neelkanthi,	Piles (3), Rheumatism (2), Sore throat (30), Anti-Inflammatory (2)	37	0.74	33	0.66
<i>Allium wallichii</i> Kunth	Ban pyaaz	Cholera, Dysentery (5), Cold (1)	6	0.12	6	0.12
<i>Androsace lanuginosa</i> Wall.	Wolly rock jasmine	Stomachache, Abdominal pain	5	0.1	5	0.1
<i>Angelica glauca</i> Edgew.	Chora	Constipation (9), Dysentery (5), Gastric pain, Wound healing (6), Bronchitis (4), Carminative (5)	29	0.58	22	0.44
<i>Artemisia sieversiana</i> Ehrh. ex Willd.	Charmarua	Joint pain (40), Abortifacient (2), Wound healing (11)	53	1.06	30	0.6
<i>Bupleurum falcatum</i> L.	Shut puti	Cold, Cough, Fever (7), Digestive disorder (2), Liver diseases (3)	12	0.24	27	0.54
<i>Cannabis sativa</i> L.	Bhang, bijia	Stomachache (8), Allergy (11), Musculoskeletal disorders (2), Antidepressant (5)	27	0.54	25	0.5
<i>Chenopodium album</i> L.	Bithoo	Blood purifier (3), Anti-helminthic (2), Urinary problem (2), Sedative (1)	8	0.16	7	0.14
<i>Cirsium wallichii</i> DC.	Bursha	Gastric Problem (10) and Liver diseases (8)	18	0.36	8	0.16
<i>Cremanthodium ellisii</i> (Hook.f.) Kitam.	Sooraj mukhi	Fever, Headache (5)	3	0.06	5	0.1
<i>Cynodon dactylon</i> (L.) Pers.	Drub	Constipation (22), Piles (18), Nasal bleeding (5)	45	0.9	27	0.54
<i>Erigeron speciosus</i> DC.	Himalayan fleabane	Cough	6	0.12	6	0.12
<i>Geranium wallichianum</i> D.Don ex Sweet (Figure. 3)	Nili dori	Blood Level Enhancer (2), Back pain reliever (5), Eye disorders (3)	10	0.2	9	0.18
<i>Habenaria edgeworthii</i> Hook.f. ex Collett	Vridhi	Diabetes (2), Inflammation (2), cardiovascular diseases (2), Carminative (3), Anticancer (2)	11	0.22	10	0.2
<i>Habenaria ensifolia</i> Lindl.	Doodhali	Arthritis (3), Chest pain (1), Stomachache (2)	6	0.12	5	0.1

<i>Herminium lanceum</i> (Thunb. ex Sw.) Vuijk	Lanceleaf herminium	Urinary problems	5	0.1	5	0.1
<i>Hydrocotyle himalaica</i> P.K.Mukh.	Brahmsutri	Abortifacient (5), Wound healing (5).	10	0.2	7	0.14
<i>Hypericum perforatum</i> L.	John's wort	Anxiety, Depression, Headache (7), Cuts and burns (6)	13	0.26	10	0.2
<i>Hymenolaena candollei</i> DC.	Baan	Epilepsy (13)	13	0.26	13	0.26
<i>Jurinea dolomiaea</i> Boiss.,	Dhup	Wound healing (3), Gastric pain (9), Antidepressant (3)	15	0.3	11	0.22
<i>Leontopodium alpinum</i> Colmeiro ex Willk. & Lange	Jota ra losar	Abdominal ache (1), Dysentery and fever (2), Bronchitis and angina (3), Epilepsy (7)	13	0.26	11	0.22
<i>Lindenbergia indica</i> (L.) Vatke	Pathhr chhati	Antidiabetic and Stone problem	15	0.3	12	0.24
<i>Mentha longifolia</i> (L) L.	Pudina	Cold, Cough, Fever, Headache, Indigestion (33), Anti flatulent, Vomiting (5)	43	0.86	40	0.8
<i>Nepeta ciliaris</i> Benth.	Catnip	Cold, Cough, Stomachache	9	0.18	8	0.16
<i>Nepeta podostachys</i> Benth.	Long stalked catnip	Kidney disorders	3	0.06	3	0.06
<i>Origanum vulgare</i> L.	Ban tulsii	Menstrual problems (7), Respiratory disorders (7), Asthma and Bronchitis (3)	17	0.34	13	0.26
<i>Oxalis corniculata</i> L.	Khhat mlori	Loose motion (10), Antiulcer, Wound healing (5), Anti Inflammatory (5)	23	0.46	21	0.42
<i>Oxyria digyna</i> Hill	Jhemlu	Diarrhea, Constipation, Stomachache, Treat scurvy	11	0.22	9	0.18
<i>Parthenocissus semicordata</i> (Wall.) Planch.	Amru bail	Piles (3), High B.P (14), Leucorrhea, Wound healing (4)	21	0.42	19	0.38
<i>Pedicularis hoffmeisteri</i> Klotzsch	Hoffmeister's Lousewort	Indigestion	7	0.14	7	0.14
<i>Pedicularis gracilis</i> Wall. ex Benth.	Slender lousewort	Fever, Leucorrhea, Urinary problems, Indigestion	16	0.32	6	0.12
<i>Picrorhiza kurroa</i> Royle ex Benth.	kurro	Fever (30), Gastric pain (29), Indigestion (37), Stomachache (40)	136	2.72	50	1
<i>Pinus wallichiana</i> A.B.Jacks.	Kail	Wounds, Burns and Boils (13), Swelling and Musculoskeletal disorders (7)	20	0.4	15	0.3
<i>Plantago major</i> L.	Chopdu gha	Skin diseases, Fever, Diarrhea, Wound healing, Antidiabetic	17	0.34	18	0.36
<i>Polygonum amplexicaule</i> D.Don	Mindal	Fever (4), Heart blocking (2), Liver damage (4), Joint Pain (5), Gastrointestinal disorders (7)	22	0.44	22	0.44
<i>Polygonatum verticillatum</i> (L.) All.	Salmishri	Piles (7), High B.P (5), Heart diseases (5), Liver diseases (2)	19	0.38	17	0.34
<i>Potentilla atrosanguinea</i> G.Lodd.	Lal dori	Wound healing (8), Back pain reliever (1), Inflammation (2)	11	0.22	11	0.22
<i>Potentilla fulgens</i> Wall. ex Sims	Pili dori	Blood level enhancer (4), Antidiabetic (2), Back pain reliever (7)	13	0.26	10	0.2
<i>Prunella vulgaris</i> L.	Heal all	Stomachache, Fever (9), Anti-Inflammatory (6), Wound healing (2)	17	0.34	15	0.3
<i>Prinsepia utilis</i> Royle	Bhekhal	Anodyne, Antidiabetic (9), Fever and Cold (5)	14	0.28	16	0.32
<i>Rheum australe</i> D.Don	Chukri	Stomach problems (2), Liver diseases (5), Inflammation (46)	53	1.06	48	0.96
<i>Rubia cordifolia</i> L.	Manjistha	Skin diseases (4), Stone problem (3), Blood cleanser (2)	9	0.18	5	0.1
<i>Rumex nepalensis</i> Spreng.	Albar	Wound healing (18), Anti-allergic (13)	31	0.62	28	0.56

<i>Satyrium nepalense</i> D.Don	Salam mishri	Energetic tonic (3), Fever (2), Dysentery and Diarrhea (4)	9	0.18	8	0.16
<i>Saussurea conaensis</i> (S.W.Liu) Fujikawa & H.Ohba	Ghughi	Cuts and Wounds (10), Asthma (3), Skin diseases (1), Epilepsy (2)	16	0.32	14	0.28
<i>Saussurea piptathera</i> Edgew.	Himalayan saw-wart	Stomachache (2), Altitude sickness (2), Cough and Cold (2)	4	0.08	2	0.04
<i>Saxifraga parnassifolia</i> D.Don	Himalyan saxifrage	Kidney disorders	7	0.14	5	0.1
<i>Ligusticopsis wallichiana</i> (DC.) Pimenov & Kljuykov	Mathoshal	Post- partum edema (21), Inflammation (11), Antidepressant (5)	37	0.74	35	0.7
<i>Spiranthes sinensis</i> (Pers.) Ames	Ghrotnu ghas	Inflammation (6), Diabetes (2), Snake bites (7), Cough (5), White discharge (5)	25	0.5	17	0.34
<i>Stellaria aquatica</i> (L.) Scop.	Kokhuwa	Fever (4), Constipation (5), Sore throat (1)	10	0.2	11	0.22
<i>Swertia cuneata</i> D.Don	Chirayta	Diabetes, Ulcers and Skin diseases	11	0.22	7	0.14
<i>Swertia ciliata</i> (D.Don) B.L.Burt	Chirayta	Diabetes, Piles, Ulcers	21	0.42	16	0.32
<i>Swertia cordata</i> (G.Don) Wall. ex C.B.Clarke	Chirayta	Fevers (1), Headache (2), Stomachache (3)	6	0.12	5	0.1
<i>Swertia speciosa</i> D.Don	Chirayta	Fever (2), Throat pain (10), Headache (2), Stomachache (2)	16	0.32	10	0.2
<i>Tanacetum dolichophyllum</i> (Kitam.) Kitam.	Jota ra losru	Headache and Alcoholic intoxication	4	0.08	2	0.04
<i>Taxus wallichiana</i> Zucc.	Rkhala	Antidiabetic (2), Cold (9), Cough and Fever (5), Anticancerous (1)	17	0.34	9	0.18
<i>Thymus serpyllum</i> L.	Ban ajwain	Constipation (37), Anti-flatulent (11), Respiratory disorders (3), Control B.P (7), Increase hunger (5)	64	1.28	40	0.8
<i>Urtica dioica</i> L.	Kushak	Blood cleanser (14), Treat painful muscles (8), and Joint pain, Arthritis (3).	25	0.5	18	0.36
<i>Verbascum thapsus</i> L.	Bandr lingnu	Migraine and Headache (4), Pulmonary problems (3), Inflammation and Cold (1)	8	0.16	8	0.16

Use values (UV) of plants

UV demonstrates the relative importance of species known locally to the informants. UV values calculated reflect the most significant species utilised for therapeutic purposes by local residents. In present study UV ranges from 0.06 (*Cremanthodium ellisii* and *Nepeta podostachys*) to 2.72 (*Picrorhiza kurroa*). The species with highest use values ($0.94 \geq 2.72$) were *Picrorhiza kurroa* (UV= 2.72), *Ainsliaea aptera* DC. (UV=1.8), *Aconitum heterophyllum* (UV= 1.64), *Thymus serpyllum* (UV= 1.28), *Artemisia seiversiana* (UV= 1.06), *Rheum australe* (UV= 1.06) and *Achillea millefolium* (UV= 0.94) etc. (Table 3). Literature finding also showed that *Picrorhiza kurroa* has antioxidant, hepatoprotective, immunostimulatory properties (Vaidya *et al.* 1996). *Ainsliaea aptera* has antimicrobial activities (Bisht *et al.* 2021). *Aconitum heterophyllum* has antioxidant, anticholinesterase and anti-inflammatory properties (Ahmad *et al.* 2017) *Thymus serpyllum* shows antimicrobial, antioxidant and antitumor activities (Nikolic *et al.* 2014). *Rheum australe* possess antibacterial, cytotoxic and antioxidant activities (Gupta *et al.* 2014) and Candan *et al.* (2003) reported antioxidant, antimicrobial, antibacterial, anti-inflammatory and antiparasitic activities of *Achillea millefolium*. Mention of these species in literature validates their ethnomedicinal uses by the local inhabitants of the area.

Relative Frequency of Citation (RFC) values

The described species had RFC values ranging from 0.04 (*Saussurea piptathera* and *Tanacetum dolichophyllum*) to 1 (*Picrorhiza kurroa*) subsequently followed by *Aconitum heterophyllum* (RFC=0.96), *Rheum australe* (RFC=0.96), *Ainsliaea aptera* (RFC=0.92), *Achillea millefolium* (RFC=0.8), *Mentha longifolia* (RFC=0.8) and *Thymus serpyllum* (RFC=0.8) (Table 3). High RFC value indicated that large number of informants cites the species for their medicinal values used by them locally. *Picrorhiza kurroa* scores the highest RFC value which indicated that this species is the most common and preferable species of medicinal plant utilised by native people for the treatment of various maladies. RFC value also indicates that the species with high RFC value will have high number of phytochemicals and bioactive compounds which contributes for its pharmacological properties. Plants with high RFC value were less in number in the area due to overutilisation and unscientific harvesting by locals for commercial as well as personal uses (Bisht and Adhikari, 2014). Our study revealed that *Picrorhiza kurroa*, *Rheum australe* and *Aconitum heterophyllum*, which were the plants with highest RFC, had low populations in the study area due to overexploitation. Thus there is need of various strategies for the conservation of these high value medicinal plant species (Maghsoudy and Parsapajouh, 2022).

Discussion

In the current study most significant medicinal species (High UV values and RFC values) were *Picrorhiza kurroa*, *Ainsliaea aptera*, *Aconitum heterophyllum*, *Thymus serpyllum*, *Artemisia sieversiana*, *Rheum australe*, *Achillea millefolium* and *Ajuga parviflora*. *Picrorhiza kurroa* was used for the purpose of curing Fever, gastric pain, indigestion and stomach ace; this species was proposed by Srivastava *et al.* (1992) for curing gastritis, rheumatism, colic pain and liver ailment and Boktapa and Sharma (2010) reported its use to treat jaundice, stomachache and cold & cough. *Ainsliaea aptera* was the second most cited species in our study used for the curing stomachache, gastric pain and fever; similarly reported by Boktapa and Sharma, (2010) for curing stomachache, Sharma *et al.* 2020 for stomachache and diuretic. *Aconitum heterophyllum* was the third most used species utilised by native people for the purpose of curing stomachache, gastric pain, cough and fever; Negi *et al.* (2011) also claimed this plant for curing these ailments. *Aconitum heterophyllum* is mentioned in Ayurvedic scriptures for treating bronchitis, fever, and vomiting in children, as well as being an essential element of Ayurvedic formulations such as *janma ghuti*, and *laxminarayana rasa* (Bhutya, 2011). *Thymus serpyllum* was used for curing constipation, anti-flatulent, respiratory disorders, control B.P, and to improve appetite. Sharma *et al.* (2020) also reported its use as expectorant and carminative, Devi *et al.* (2013) reported other species (*T. Linearis*) for curing stomachache, cough and cold. Another most cited species was *Artemisia seiversiana* used locally for curing Joint pain, wound healing and also as abortifacient; concurrent with the study of Uniyal *et al.* (2006) for the same purpose. *Rheum australe* was also one of the most cited and utilised species of therapeutic plants in the research area for the purpose of curing stomach problems, liver diseases and inflammation. Similar uses were reported by Chauhan *et al.* (2020) for stomachache, allergy, fever, headache and swelling; Uniyal *et al.* (2006) for curing swelling; Boktapa and Sharma (2010) for the treatment of small pox. *Achillea millefolium* was found to be used for curing Toothache and gastrointestinal disorders and same species was reported for curing cold and fever by Chauhan *et al.* (2020) and Kumari *et al.* (2013) for toothache and antipyretic. *Ajuga parviflora* was also one of the most cited species used for curing piles, rheumatism, sore throat and inflammation. It is also mentioned in Ayurveda for curing gout, rheumatism, and palsy (Hussain *et al.* 2016). A total 66 plants were documented from the study area having medicinal value. Use of *Ajuga parviflora* for curing piles, *Hydrocotyle himalaica* as an abortifacient, *Prinsepia utilis* and *Taxus wallichiana* for curing diabetes is reported in this area and needs further investigation. Kunwar *et al.* (2021) also reported the use of *Ajuga parviflora* for curing piles. The important medicinal species present in the area were *Selinum wallichianum*, *Urtica dioica*, *Taxus wallichiana*, *Aconitum violaceum*, *Aesculus indica*, *Oreganum vulgare*, *Mentha longifolia*, *Cynadon dactylon*, *Cannabis sativa*,

Oxalis corniculata, *Prinsepia utilis*, and *Polygonatum verticillata*. During our study, the questionnaire was used to collect data regarding the plants and we found out that the population of medicinal plants is declining in this area. Due to the high demand for these plants in industries, they are overexploited and lack of knowledge about harvesting these plants leads to a decline in population. The people are unaware of the schemes provided by the govt. of India such as Centrally Sponsored Scheme CSS – Integrated Development of Wildlife Habitats. The government provides funds and encourages people through outreach activities to conserve these plants. The *ex situ* cultivation and sustainable harvesting can help to prevent the threats to the plants and *in vitro* cultivation of *Picrorhiza kurroa* is currently being studied (Mahajan and Kapoor, 2017). During 2001, the HAPPRC (High Altitude Plants Physiology Research Centre), Srinagar-Garhwal, Uttarakhand, encouraged some farmers in Ghes village (2300-2500 m, Chamoli, Uttarakhand) to take up planting *Picrorhiza kurroa* (Kuniyal and Negi, 2016). The govt is also providing subsidies and loans to the farmers for the cultivation of *Picrorhiza kurroa* (Daharm et al. 2016). According to IUCN *Taxus wallichiana*, *Picrorhiza kurroa*, and *Angelica glauca* are endangered, *Aconitum Heterophyllum* is threatened, *Aconitum violaceum* is vulnerable, *Rheum australe* is data deficient. These plants has commercial value and are overexploited due to high demands in industries. Emphasis is made on *ex situ* conservation of these plants. The area is rich in biodiversity and unexplored. We should value our traditional medicinal system so that we can apply this knowledge for future drug discoveries. There is a need for scientific validation of herbal formulations utilised by indigenous people, and our research emphasised the usefulness of these plants.

Conclusion

The study was initiated with the aim of recording different therapeutic plants which are used traditionally by native people of Chhota Bhangal. While some traditional practices persist in the area, they rapidly diminish due to population displacement and increased reliance on contemporary medical treatments. Our study also examined that younger generation and informants with high educational qualifications had poor ethnobotanical knowledge than the older informants. To address this issue, we create an inventory of ethnobotanical practices from the area and total 66 plant species which belongs to 29 families were reported, which are used by the indigenous people of the Chhota Bhangal for curing 14 different disease categories. The quantitative analysis of ethnobotanical data generated high-quality information on the use of many different species of plants, as well as their relative importance in the treatment of various diseases. High ICF values (gastrointestinal problems, ICF=0.97) indicated that these are the most common ailments in the area, and there is better agreement among informants about the usage of plant species for treatment of particular disease categories. The plants with high UV values were those plants whose population was low in the region due to overexploitation for medicinal as well as commercial purposes. There are many other plants with high use values and require scientific validation of pharmaco-chemical investigations to estimate the effectiveness and safety of any reported therapeutic plants. For the first time, the use of *Hydrocotyle himalaica* as an abortifacient, *Prinsepia utilis*, and *Taxus wallichiana* to treat diabetes was recorded from the region that requires further investigation. Leaves (40%) and roots (34%) were the mostly used plant parts for medicinal purpose which pose threat to the survival of the plant species and lead to extinction of the plant. The majority of the species identified in this study are high altitude medicinal plant species, several of which are classified as vulnerable, endangered, or severely endangered by the IUCN. Appropriate efforts and strategies are required to maintain and safeguard these medicinal floral species in the local area for sustainable usage in future. Encouraging the native people to cultivate the plants having commercial value such as *Aconitum Heterophyllum*, *Aconitum violaceum*, *Picrorhiza kurroa*, *Rheum australe*, *Taxus wallichiana*, *Angelica glauca*, *Selinum wallichianum* etc., is one of the efforts to prevent the loss of these plants. To conserve the traditional practices and knowledge regarding therapeutic plants, younger generation should be encouraged to communicate with older generation. This documented ethnobotanical information will help in conservation of ethnobotanical knowledge as well as in future research and drug discovery to treat various chronic diseases.

Declarations

List of abbreviations: Not applicable

Ethics approval: Not applicable

Consent for publication: Not applicable

Availability of data and materials: None

Competing interests: The author declares that he has no conflict of interest.

Funding: Financial assistance to Ruchika Kumari from UGC-NFSC (NSFDC/E-81088) is duly acknowledged.

Authors' contributions: Anchal Thakur and Ruchika Kumari contributed equally. Anchal Thakur involved in the collection of plant data. Anchal Thakur and Ruchika Kumari conceived the study and involves in the literature review, formal analysis, and writing the original draft. Ashun Chaudhary conceptualized, analyzed, and supervised the manuscript. Ashun Chaudhary and

Ashok Kumar provides technical inputs and final editing of the manuscript. All authors approved the final version of the manuscript.

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