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Ethnomedicinal plants of Sapi valley of Ladakh and its uses in Sowa-Rigpa System of medicine

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Sapi Valley, situated in the Kargil district of Ladakh within India's Trans-Himalayan region, is characterized by its harsh, cold, and arid climate. Despite these challenging conditions, the valley boasts a rich diversity of medicinal plants, many of which are integral to the traditional Sowa-Rigpa system of medicine. A comprehensive field study conducted from 2022 to 2024 documented 126 plant species across 39 botanical families in Sapi Valley. The vegetation predominantly comprises herbs (87%), followed by shrubs (11%) and trees (2%), a composition typical of alpine and above-tree-line ecosystems. Notably, 55 of these species are recognized for their medicinal applications within the Sowa-Rigpa tradition. The indigenous Boto and Balti Scheduled Tribes, primarily agrarian communities, heavily rely on these local plant resources for daily sustenance and healthcare needs. Traditional healers, known as Amchi, play a pivotal role in providing health services, utilizing their extensive knowledge of medicinal plants. However, the region faces increasing threats from climate change and human activities, leading to habitat degradation and a decline in plant populations. These challenges underscore the urgent need for conservation efforts and the systematic documentation of ethnomedicinal knowledge to preserve this invaluable heritage for future generations.

Keywords: Ethnobotany, Ladakh, Sowa-Rigpa, Sapi, Trans Himalaya, Traditional knowledge

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The Himalayan region has been celebrated since ancient times for its rich biodiversity and wealth of medicinal plants. In traditional Indian medical systems such as Ayurveda, Unani, and Sowa-Rigpa, the Himalayas are revered as a sacred storehouse of natural remedies. The vast altitudinal gradients of the Himalayan ecosystem contribute to this floristic richness: on average, air temperature decreases by approximately 0.65°C for every 100 m increase in elevation (equivalent to about 6.5°C per km), or roughly 2°C per 300 m. This temperature lapse facilitates distinct and specialized vegetation zones[1,2]. Ladakh, located in the Trans-Himalayan zone of India, represents a unique cold desert ecosystem. Due to its high elevation and arid climate, the region is dominated by alpine and sub-alpine vegetation, primarily comprising perennial herbs with high medicinal potential[3]. Following its separation from Jammu & Kashmir in October 2019, Ladakh became a Union Territory, opening new avenues for focused scientific research in the region particularly for the botanist[4-11]. The name "Ladakh" derives from the Bhoti words *La Dawgs*, meaning "Land of High Passes," aptly reflecting its rugged terrain[12]. Geographically, Ladakh lies between latitudes 32°15′50"-35°38′11" N and longitudes 75°36′73"-78°31′11" E, with elevations ranging from 2,700 to 7,560 meters above sea level, and covers an area of over 59,000 Km^2. Its northern and eastern borders touch China, while Pakistan borders it to the northwest, and the Indian regions of Himachal Pradesh and Jammu & Kashmir lie to the south and west[4]. Despite increasing scientific attention since the late 19th century, ethno-floristic documentation of Ladakh-particularly the Kargil district and Sapi Valley-remains limited. Stewart[8] (1913) was among the earliest botanists to explore Sapi Valley, recording 44 plant species. A more recent medico-botanical survey by Gurmet *et al*.,[10] (2015) identified 45 species in the same valley, of which 22 were traditionally used in the Sowa-Rigpa system of medicine. The high-altitude flora of Ladakh continues

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to support the ethnomedical practices of local communities, especially the Bhoto and Balti tribes, who depend on traditional healers (*Amchi*) for healthcare services[11]. The region's floral diversity not only holds scientific importance but also plays a vital role in preserving of indigenous knowledge systems. However, climate change and anthropogenic pressures observed by authors highlight the urgent need for systematic documentation, ecological assessment, and conservation of Ladakh's medicinal plant resources.

Sowa-Rigpa system of medicine

Sowa-Rigpa (Science of Healing) is a traditional system of medicine widely practiced in Ladakh, Tibet, and other Himalayan regions. Also known as the *Amchi* or Tibetan system of medicine, Sowa-Rigpa is considered one of the oldest, living medical traditions in the world. Its core principles are codified in the ancient medical text *rGyud-bZhi* (Four Tantras), believed to have originated from teachings of Lord Buddha in India. The system incorporates a synthesis of indigenous Tibetan knowledge, Indian Ayurvedic concepts, Chinese medicine, and Greco-Arabic influences. The philosophical and physiological foundations of Sowa-Rigpa share remarkable similarities with Ayurveda. Key concepts include *Jun-wa-lNga* (Panchamahabhuta or five elements), *Nespa-gSum* (Tridosha or three principal energies: Wind, Bile, and Phlegm), and *Lus-zung-lDun* (Saptadhatu or seven bodily constituents). However, Sowa-Rigpa distinguishes itself through its refined pharmacological knowledge and skillful application of high-altitude Himalayan medicinal plants. Additionally, it integrates Buddhist spiritual and ethical principles, rituals, and unique diagnostic approaches. Sowa-Rigpa is not only the dominant traditional healthcare system in Ladakh but is also widely practiced across other Himalayan regions including Tibet, Nepal, Bhutan, parts of China, Mongolia, and areas of the former Soviet Union[13-15]. Historically, this medical tradition was transmitted through familial lineage (*rGyud-pa*) or the master-disciple model[16]. Over time, the system has undergone formalization, and today practitioners are trained through institutionalized education. A minimum of five and a half years of study is required to obtain a Bachelor's degree in Sowa-Rigpa medicine, aligning the system with other recognized healthcare disciplines in India and beyond.

Materials and Methods

Study area

Sapi Valley is located in the western part of Ladakh, within the Kargil district, at an altitude ranging from 3,600 to 5,000 meters above sea level. The valley is approximately 220 km from Leh and 72 km from Kargil city[4] (Fig. 1 a-d). Access to Sapi Valley involves turning off the national highway at Mulbek village, crossing the Shargol Bridge, and traveling an additional 38 km. Along the route, prominent villages include Shargol, Karamba, and Foker, culminating in the Sapi La (Sapi Peak-Pass), which serves as the gateway to the valley at an elevation of 14,337 feet (4,369.9 meters) above sea level.

Sapi Valley is one of the most remote and high-altitude regions of the Kargil district. It is known for its rich diversity of medicinal plant species and lush green vegetation, comprising predominantly alpine and sub-alpine flora. The region receives significant winter precipitation, historically up to 4-4.5 feet of snowfall, although recent winters have seen a decline

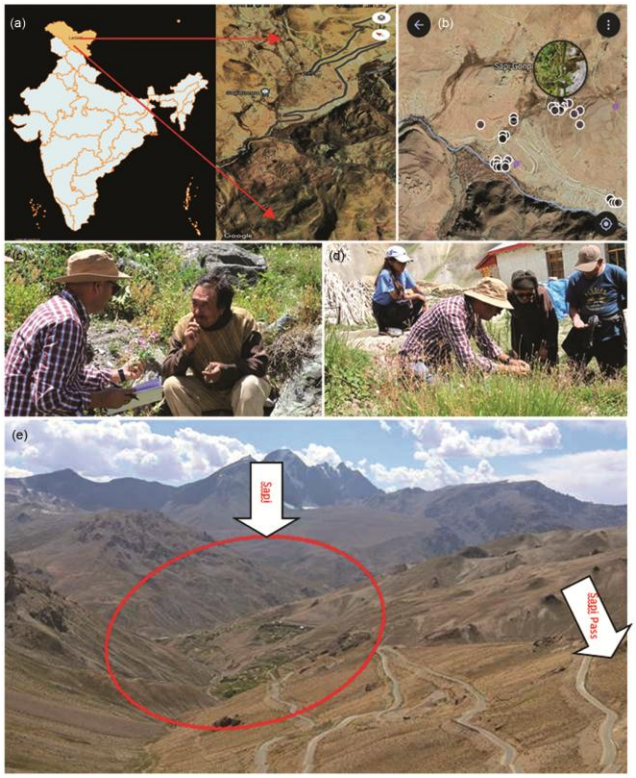

Fig. 1 — (a) Location map of Ladakh region and Google Earth image (map) of study area (b), GPS location of plants in the study area (c,d) Interview with the local Amchi and informants. (e), View of Sapi valley from Sapi pass

to around 1 foot of snowfall, persisting for nearly three months. The valley spans an area of approximately 20 square kilometers and comprises small villages such as Gill, Shanil, Doks, Gonglam-Chorsten-chan, Gongma-la, Marpo-youl, and Spanglung[10]. The total population is estimated to be around 1,000 individuals, primarily belonging to the 'Boto' and 'Balti' Scheduled Tribe communities. These communities rely heavily on traditional health systems and native *Amchies* for primary healthcare.

The vegetation of the valley is dominated by alpine herbs, mosses, and a few shrub species including *Rosa webbiana*, *Myricaria elegans*, *Epilobium angustifolium*, *Lonicera spinosa*, and *Astragalus* spp,[17]. Unlike other parts of Ladakh, Sapi Valley does not support the cultivation of typical trees and fruit-bearing plants such as poplar, apricot, and apple due to its extreme climate. Instead, it is a repository of high-value medicinal herbs.

Importantly, the local communities have implemented sustainable resource utilization practices, including regulating grazing activities and preventing overharvesting by external collectors. The traditional knowledge of medicinal plants is well preserved in the valley, with several Amchis possessing extensive expertise. These local healers served as the primary source of ethnomedicinal knowledge for the present study, which was later corroborated through literature.

Ethnomedicinal surveys

Ethnomedicinal field surveys were conducted during multiple seasons June-August 2022-2024 to ensure comprehensive data collection. The primary objective was to document medicinal plant resources and their applications in the traditional Sowa-Rigpa system of medicine. The study incorporated inputs from relevant literature, consultations with local *Amchies* (traditional Tibetan medical practitioners), and interviews with elderly and community members possessing indigenous knowledge. A total of 78 informants participated in the study, including 26 females and 52 males age between 25 to 85 years. Semi-structured interviews and participatory observations were employed to gather data on plant use, preparation methods, and local therapeutic applications.

Voucher specimen collection and identification

Specimens of the reported medicinal plants were collected; each plants samples were pressed on the spot during survey and dried. The specimens were mounted on the herbarium sheet and assigned voucher/collection numbers (101-201, 301-327), (Fig. 2. a-k) and processed following standard herbarium procedures. These specimens were deposited in the National Institute of Sowa-Rigpa (NISR) and the Trans-Disciplinary University (FRLH) herbaria for future reference.

Documentation of traditional knowledge

The ethnobotanical fieldwork conducted between June-August 2022 to 2024 aimed to document traditional medicinal knowledge within the Sowa-Rigpa system. The information was gathered using ethnobotanical methodologies, including participant observation and both open and semi-structured interviews, to gather comprehensive data from local informants and experts. All participants were native of the Ladakh, ensuring that the information collected was rooted in authentic local practices. Prior informed consent was obtained from participants. Informants were thoroughly briefed on the study's objectives, methodologies, and the nature of the data being collected. Specific consent was also secured for the documentation of traditional knowledge, including the capturing of photographs and videos of traditional healers.

Plant data collection and compilation

Field-based data collection regarding medicinal plant diversity, raw drug materials, and herbarium specimen preparation was conducted during the peak growing seasons of July and August in the years 2022-2024. Plant specimens were collected in the field, identified using standard floras and verified through authentic publications and online plant databases[18-20]. Preliminary field data included detailed records of plant collection sites, geographic coordinates, and altitudinal ranges. For each plant species encountered, information such as scientific name, family, habitat type, life form (e.g., herb, shrub, climber), part used, and traditional usage was documented. Medicinal uses were further recorded through interviews with traditional Amchis, shepherds, and elderly members of local communities who possess indigenous knowledge. To supplement primary field data, relevant books, peer-reviewed publications, and ethnobotanical references were consulted as sources of secondary information. Validation of recorded uses and botanical identities was performed through consultations with experienced resource persons and scholars in the field. Final authentication was carried out by cross-referencing classical medical

texts of *Sowa-Rigpa*, as well as other literature references[13,21-25]. In order to record the most important plant species in the study area based on number of uses cited by the number of people, use value (UV) was calculated according to the formula[26]:

$$UV=\sum U/n$$

Where, U is the total number of used reports each informant mentioned for a particular plant species, and n is the total number of information for that plant that were questioned. It shows the relative value of locally popular plant.

Results and Discussions

Diversity and quantitative analysis of ethnomedicinally significant plants

A total of 126 plant species (Table 1), (Supplementary Table S1) belonging to 39 families were recorded during the ethnobotanical surveys conducted in Sapi Valley. The plant species were categorized into three primary growth forms in the study area: herbs, shrubs, and trees. Herbs comprised 87% of the total, followed by shrubs at 11%, and trees at 2%. This distribution aligns with the ecological characteristics of high-altitude trans-Himalayan regions, particularly in areas located above the tree line where alpine and sub-alpine vegetation predominates.

Fig. 2 — (a) Corydalis crassifolia, (b) Epilobium anguistifolium, (c) Lagotis cashmeriana, (d) Swertia petiolate, (e) Aconitum violaceum, (f) Astragalus tecti-mundi, (g) Delphenium cashmerianum, (h) Dactylorhiza hatageria, (i) Conioselinum vaginatum, (j) Scrophularia koelzii, (k) Arnebia euchroma

Table 1 — Medicinal plants used in Sowa-Rigpa and its part used and uses in Sowa-Rigpa

S.no.	Botanical name	Family	Sowa-Rigpa	Part used	Sowa-Rigpa uses	Use values (UV)
1	*Aconitum violaceum* Jacquem. ex Stapf	Ranunculaceae	*Bong-nga-nagpo*	Root	It treats Arthritis, Gout, swelling pain, body pain, intestinal worms, cardiac disease, leprosy, paralysis, lymph fluid disease etc., [23, 38].	0.64
2	*Aconogonon tortuosum* (D.Don) H.Hara	Polygonaceae	*sNyalo*	Root	It is use for treatment of fever, disorder of small and large intestine, diarrhoea, dysentery, pain in lumber region after delivery, etc., [33,38].	0.68
3	*Allium carolinianum* Redouté	Amaryllidaceae	*rGya-sGog*	Leaf, stem, flower	It is useful to cure wind (*rLung*) disorder associated with head, worm, improve digestion, cures cold disorder etc.,[27].	0.51
4	*Anaphalis triplinervis* (Sims) C.B.Clarke	Asteraceae	*Tawa*	Whole plant	It treats contagious fever, disease of the lymph nodes, stone poison, swelling and bleeding etc.,[27,32,38].	0.45
5	*Arnebia euchroma* (Royle ex Benth.) I.M. Johnst.	Boraginaceae	*Dre-mok*	Root	Use for treatment of blood related disorder like blood purifying, blood vomiting, nose bleeding; hair loss, pulmonary disease[23,28,35,38].	0.69
6	*Artemisia persica* Boiss.	Asteraceae	*mKhan-pa*	Whole plant	Treats various types of bleeding like nose bleeding, swelling and inflammation of the limbs, cancers, wounds, lungs disorders and renal diseases etc.,[41].	0.89
7	*Askellia flexuosa* (*Ledeb.*) *W.A. Weber*	Asteraceae	*rTsa-mtris*		It is useful for inflammation of gall bladder, jaundice, headache, nausea etc.,[41].	0.72
8	*Astragalus oplites* Benth. ex R. Parker	Fabaceae	*Zomo-shing*	Whole body	Use for dermatological disorder, blood disorder, heart disease and eye problems[34].	0.83
9	*Carum carvi* L.	Apiaceae	*Go-sNyot*	Fruit	It treats ophthalmic diseases, various kinds of fever, increase appetite & digestive heat, treats phlegm disease[23,25,29,33].	0.91
10	*Cicerbita macrorhiza.* (Royle) Beauverd	Asteraceae	*rtsa-mKhres*	Seed	It is useful in treating inflammation in gall bladder, hepatitis, migraine and nausea etc.,[41].	0.56
11	*Codonopsis clematidea* (Schrenk) C.B. Clarke	Campanulaceae	*kLu-bDud Dorje* (Nagpo)	Whole plant	It treats arthritis, gout, rheumatism, elephantiasis, leprosy, nerves disorder, stiffening of ligaments and tendons, joints pains, diseases due to effect of evil spirits etc.,[31].	0.92
12	*Comastoma tenellum* (Rottb.) Toyok.	Gentianaceae	*sPangane-Snon-po*	Fruit	It is used against inflammation due to poisoning, contagious fever, pharyngitis, obstruction of vocal cord, cold and cough and other respiratory disorder[36].	0.54
13	*Corydalis flabellata* Edgew.	Papaveraceae	*Stong-ri zil pa*	Whole plant	Helpful in controlling fever, inflammation in blood, liver and gall bladder. Also useful against burn and swelling etc.,[33].	0.49
14	*Dactylorhiza hatagirea* (D. Don) Soo	Orchidaceae	*dWang-po lag-pa*	Root	It is used as tonic, improves physical strength, stimulate kidney heat, increase semen and use for longevity etc.,[23,28,33,38,39]	0.94

… Contd.

Table 1 — Medicinal plants used in Sowa-Rigpa and its part used and uses in Sowa-Rigpa (Contd.)

S.no.	Botanical name	Family	Sowa-Rigpa	Part used	Sowa-Rigpa uses	Use values (UV)
15	*Delphinium brunonianum* Royle	Ranunculaceae	*bYa-rGod-sPos*	Leaf, stem, flower	Useful against disease cause by evil spirits, poisoning, inflammation of gall bladder, treats dermatological diseases, itching, snake bite, cold, cough etc.,[23,33,38].	0.81
16	*Delphinium cashmerianum* Royle	Ranunculaceae	*Cha-rKang*	All parts except root	It treats dysentery, diarrhoea with bleeding, inflammation of wounds, lymph fluids etc.,[23,30,32,35].	0.79
17	*Dracocephalum heterophyllum* Benth.	Lamiaceae	*Jib rtsi karpo*	Whole plant	It cures liver inflammation disorder, mouth and dental disorders[23,24].	0.84
18	*Epilobium angustifolium* L.	Onagraceae	*Shing-skyuruma*	Flower, stem	It treats abdominal pain and renal complaints[41].	0.62
19	*Epilobium latifolium* Matt. F.W. Schmidt	Onagraceae	*Ghar-pan chu-rtsi/ sno-duk-mo nyung*	Flower/ fruit	It treats bile (*mKhris pa*) disorder and hot disorder of gall bladder, dysentery, intestinal worms[30,35].	0.68
20	*Equisetum arvense* L.	Equisetaceae	*Khu-byug-rtsa-ljang*	All parts except root	It treats nose bleeding, excessive menstrual flow, inflammation of urinary tract, tumors etc.,[27,31].	0.64
21	*Euphrasia officinalis* L.	Orobranchaceae	*zHim-thig-sang-rgyas-Chhu-bJib*	Root, leaf, flower, fruit	It cures cataracts, headache, thirsty due to fever, edema, problem of urination etc.,[23].	0.64
22	*Gentianopsis paludosa* (Hook.f.) Ma	Gentianaceae	*lChags-tig-nagpo*	Whole part except root	used against hot disorder of the gall bladder, inflammation at infected sores, and to cure the epidemic fever[25,27].	0.41
23	*Gentianella moorcroftiana* (Wall. ex G.Don) Airy Shaw	Gentianaceae	*Spang-gyan-karpo*	All parts except root	Used as antitoxin and febrifuge. Used in inflammation of throat, pulmonary track, fever due to poison[23,28,35].	0.70
24	*Geranium himalayense* Klotzsch	Geraniaceae	*Li-gadur*	Root	It treats hot disorder of lungs channel, spleen, inflammation, swelling limbs etc.,[41].	0.58
25	*Heracleum pinnatum* C.B. Clarke	Apiaceae	*sPru-dKar*	Root and fruit	It treats leprosy, cancer, abdominal cramp due to worms, swelling, bleeding etc.,[23,32,33].	0.65
26	*Juniperus semiglobosa* Regel	Cupressaceae	*Shukpa*	Leaves and fruit	It cures fever, *mKrispa* (bile) disorder, reduce infection, treats rheumatoid arthritis, inflammation of lungs and liver, dry pus and release urine blockage etc.,[41].	0.68
27	*Lagotis cashmeriana* (Royle ex Benth.) Rupr.	Plantaginaceae	*Hong-len manpa*	Root	It is used in hot disorder, inflammation of liver, lungs, intestines, blood, reduces inflammation[23,32].	0.61
28	*Lomatogonium carinthiacu* (Wulfen) A. Braun	Gentianaceae	*dNgul tig dMan pa*	Leaf, flower	It treats bile (*mKhris pa*), liver disorder, fever and wounds[41].	0.54
29	*Leontopodium alpinum* Cass.	Asteraceae	*sPrawa*	Leaf trunk and flower	It cures infectious disease, toxicosis caused by stone poison, disorder of lymph nodes, bleeding etc.,[41].	0.52
30	*Lindelofia stylosa* (Kar. & Kir.) Brand	Boraginaceae	*Khi-lChe*	Whole plant	It cures pain and swelling of limbs due to inflammation, throat infection, swelling of tongue, inflammation of muscles etc.,[41].	0.44
31	*Melilotus officinalis* (L.) Lam.	Fabaceae	*rGya-spos*	Root, leaf, flower, fruit	It cures chronic hot disorder, hot disorder associated with toxicosis, inflammation due to epidemic diseases, cramps of spleen, diphtheria, pus formation in limbs etc.,[28,35].	0.68

… *Contd.*

Table 1 — Medicinal plants used in Sowa-Rigpa and its part used and uses in Sowa-Rigpa (Contd.)

S.no.	Botanical name	Family	Sowa-Rigpa	Part used	Sowa-Rigpa uses	Use values (UV)
32	*Myricaria elegans* Royle	Tamaricaceae	*oOm-bu*	Leaf, flower	It treats fever disorder of lungs, diarrhoea, arthritis, uterine bleeding, stomach pain, headache, poison etc.,[23,32].	0.62
33	*Nepeta discolor* Royle ex Benth.	Lamiaceae	*zHim-thig*	Leaf, flower, seed	It treats eye disease and stomach disorder [41].	0.44
34	*Oxyria digyna* (L.)	Polygonaceae	*Lug-sho*	Whole plant	Cures inflammation of wounds, pimples etc.,[23,25,31].	0.48
35	*Pedicularis bicornuta* Klotzsch	Orobranchaceae	*rKyangs-gShogpa*	All part except root	It treats vomiting due to phlegm (Pad-kan) disorders, obstruction of urine, heals wounds etc.,[23,34].	0.46
36	*Pedicularis longiflora var. tubiformis* (Klotzsch) P.C. Tsoong	Orobranchaceae	*Lug-ru-serpo*	Whole part	It treats various kinds of poisoning diseases, urine obstruction, disturbance urination, disturbance breathing, weakness, wounds, epidemic fever, drying lymph fluid and pus etc.,[31,33,38,39].	0.52
37	*Peducularis punctata* Decne.	Orobranchaceae	*Lug-ru-Marpo*	All parts except root	It treats nerves disease, dysentery, cancer, tumours, toxins in body, meat poisoning, pulmonary disease, brown phlegm, hot disorder of stomach etc.,[31,38].	0.41
38	*Physochlaina praealta* (Decne.) Miers	Solanaceae	*Langthang*	Root, fruit	Treats bacterial disease, diphtheria, sinusitis, pain in gastro-enteric region, inflammation etc.,[23,34].	0.60
39	*Plantago major* L.	Plantaginaceae	*Tha-ram*	Leaf, stem, flower, fruit	it treats burned wounds, inflammation wounds, dysentery etc.,[31].	0.45
40	*Polygonum macrophyllum* (D. Don) Soják	Polygonaceae	*Tha-ram*	Seed	It treats Diarrhea, restores loss of digestive heat[23].	0.65
41	*Potentilla anserina* L.	Rosaceae	*Tolo sazin*	Whole plant	It treats diarrhea/dysentery and act as health tonic[25].	0.68
42	*Potentilla villosa* Crantz ex Vill. (Crantz) Beck	Rosaceae	*rGyu-mKris serpo*	Whole plant	It cures hot disorder associated with common cold, epidemic disease, toxicosis etc.,[41].	0.39
43	*Rheum webbianum* Royle	Polygonaceae	*Chu-rTsa*	Root, leaf	It treats indigestion, cancer, bone fracture, wound healing, inflammation, bacterial infection, etc. Leaf-stalk as anthelmintic, in gastritis, swellings[41].	0.87
44	*Rhodiola heterodonta* (Hook.f. & Thomson) Boriss.	Crassulaceae	*sRolo-marpo*	Root	It is used for pulmonary disorder, inflammation in lungs, mouth diseases, cough, asthma and act as tonic etc.,[32,34].	0.94
45	*Rosa webbiana* Wall. Ex Royle	Rosaceae	*Se-ba*	Fruit and resins	It cures fever disorder associated with liver and after poisoning. Helps to expel poison out of body, treats serum (*chuser*) diseases[31,38].	0.81
46	*Rumex patientia* L.	Polygonaceae	*Sho-mang*	Whole plant	It treats inflammation of wounds, diphtheria, inflammation of the liver, inflammation and swelling due to internal or external microorganisms, dermatological diseases and blisters[36].	0.68
47	*Saussurea schultzii* Hook. f.	Asteraceae	*sPang-tse*	Leaf, flowers, root.	It is used in retardness and depression[41].	0.34
48	*Scorphularia koelzii* Pennell	Scorphulariaceae	*gYer-shing pa*	Leaf, stem, flowers, seed	It treats high fever due to small pox, epidemic fever, infectious common cold etc.,[23].	0.32
49	*Sedum ewersii* Ledeb.	Crassulaceae	*Tsan-rigs*	All part except root	treats all kinds of transmissible poison and infections[41].	0.27

… *Contd.*

Table 1 — Medicinal plants used in Sowa-Rigpa and its part used and uses in Sowa-Rigpa (Contd.)

S.no.	Botanical name	Family	Sowa-Rigpa	Part used	Sowa-Rigpa uses	Use values (UV)
50	*Silene edgeworthii* Bocquet	Caryophyllaceae	*Sukpa*	Leaf, stems, flower	It treats nasal problems, hearing defects and constipation etc.,[23,31].	0.34
51	*Swertia petiolate* D. Don	Gentianaceae	*lChags-tik*	Leaf, stems, flower	It treats, inflammation wounds, epidemic fever, hepatic disease, common cough, fever of bones, wind (rLung) associated with fever, bile (mKhris-pa), etc.,[30-32,37,39].	0.71
52	*Taraxacum officinale* F.H.Wigg.	Asteraceae	*Khur-mong*	All parts except root	It treats phlegm (Pad-khan), Chronic fever, fever due to poison, blood disorder, gall bladder disorder, dyspepsia etc.,[23,31,32].	0.89
53	*Thalictrum foetidum* L.	Ranunculaceae	*sGo sprin lcags kyu*	Whole plant.	Roots and aerial parts are used to treat all types of infections, contagious fever, plague, tumor, poisoning, and wounds[41].	0.40
54	*Thlaspi arvense* L.	Brassicaceae	*Dri-ga*	Leaf, stems, seed	It treats lung disease, kidney disorders, loss of appetite[23,35].	0.68
55	*Tribulus terrestris* L.	Zygophyllaceae	*gZema*	Fruit	It is used to treat (*rLung)* wind disorder of kidney and urinary disorder, arthritis, etc.,[41].	0.40

The traditional Sowa-Rigpa system of medicine, prevalent in the Himalayan regions, utilizes a diverse array of medicinal plants to address various health conditions. In a particular study, 55 plant species were identified and documented for their therapeutic applications within this system. The major plant species used by the informants and relative importance of the species known in the area is given in the Table 1. Among these, *Dactylorhiza hatagirea*, *Rhodiola heterodonta*, *Codonopsis clematidea*, and *Carum carvi* were rated as the most valuable, with use values ranging from 0.91 to 0.94. Other plants exhibited use values between 0.34 and 0.89. These plants are employed to treat a wide spectrum of ailments, including imbalances of the three principal energies or humors recognized in Sowa-Rigpa: phlegm (Pad-khan), bile (mKhris pa), and wind (rLung). Additionally, they are used to manage conditions such as blood disorders (e.g., purification, clotting), fevers (tSa-wa), infections, inflammations, pulmonary issues, digestive disorders, cardiac and renal ailments, and dermatological conditions. These applications align with Sowa-Rigpa literatures and with findings from other research studies in the field[24,27-41]. The integration of traditional knowledge with modern scientific research continues to validate the efficacy of these medicinal plants, emphasizing the importance of preserving both the biodiversity and the cultural heritage associated with the Sowa-Rigpa system.

Among the plant families, Asteraceae emerged as the most dominant, with 28 species. Other significant families included Gentianaceae and Ranunculaceae

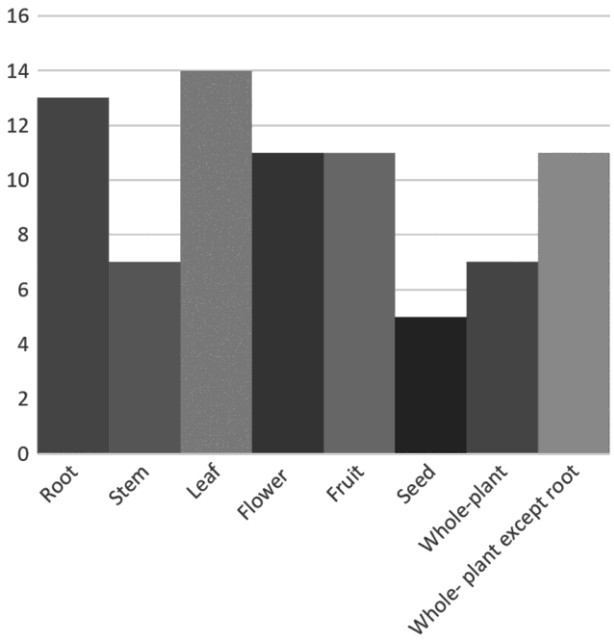

Fig. 3 — Part of plants used by the informants for treating various ailments

(9 species each), Fabaceae and Polygonaceae (7 species each), and Rosaceae (6 species). Several other families contributed to the region's botanical richness, reflecting the ecological diversity of the area (Fig. 3). In certain microhabitats within the study area, specific species were observed in high abundance, indicating zones of ecological importance. Notable examples include *Aconogonon tortuosum* (D. Don) H. Hara, *Polygonum macrophyllum* (D. Don) Soják

Acantholimon lycopodioides (Girard) Boiss., *Lindelofia anchusoides* (Lindl.) Lehm., *Epilobium angustifolium* L., and *Rheum webbianum* Royle. These species were found to dominate distinct ecological niches and may serve as indicators of habitat-specific medicinal plant communities.

Various plant parts are utilized in the preparation of traditional remedies, including seeds, roots, stems, leaves, flowers, fruits, and the entire plant. The relative usage of different plant parts is illustrated in (Fig. 4). According to the data collected, leaves were the most frequently used plant part in the Sowa-Rigpa system, followed by roots, flowers, and fruits. The whole plant (excluding roots and stems) was also used in several formulations. Seeds were the least used part

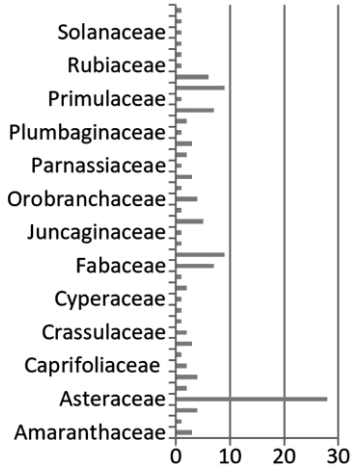

Fig. 4 — Number of plant species with family recorded

Fig. 5 — (a-p) Some important medicinal plants of Sapi valley

among all categories. This pattern highlights a trend of selective harvesting practices which may also contribute to the sustainability of plant populations, as leaf and flower harvesting is generally less destructive than root or whole-plant collection. Some of the important medicinal plants documented from Sapi Valley are illustrated in (Fig. 5 a-p).

Medicinal uses of plants and formulations

The plants selected for medicinal study are the plants identified as per *Sowa-Rigpa* literature[25,28-32] with specific uses as per Sowa-Rigpa Materia medica. Though according to Sowa-Rigpa every substance on the earth has medicinal value and therapeutic efficacy but plants are the major source of medicine. Sowa-Rigpa drugs preparation and pharmacology is based on fundamentals of *jung_wa_ lna* (five element/ Panch-Maha-Bhuta). The element composition of a drug has to determine on the basis of the six major tastes *i.e.*, sweet, sour, saline, pungent, astringent and bitter. Out of which element composition of sweet taste is predominate by *sa* (earth) and *chu* (water) elements; sour taste is predominated by *mai* (fire) and *sa* (earth); saline is predominated by *chu* (water) and *mai* (fire); bitter is predominated by *chu* (water) and *rlung* (air); pungent taste is predominated by *mai* (fire) and *rlung* (air); astringent taste is dominated by *sa* (earth) and *rlung* (air) element. The ingredients of medicine are used in compound forms with mixture of several plants and other ingredients as per the defined recipes. Compound medicine is based on two major permutation and combination that is *ro* (taste) based combination and *nus pa* (potencies) based combination. There are about seventeen different forms of medicinal preparation in Sowa-Rigpa, out of which some important preparations are decoction, powder, pills, linctus, medicated ghee, Bhasmas, medicated wine, paste, medicated bath etc.

Conclusion

The present study highlights the rich herbal biodiversity and ethnomedicinal heritage of the Sapi Valley, with a focus on the traditional knowledge system of Sowa-Rigpa as practiced by the local Amchis. A total of 126 plant species belonging to 39 families were recorded within a relatively small area of 20 square kilometres in this high-altitude cold desert region an impressive indicator of the valley's floristic richness. Centuries of reliance on local flora for medicinal and aromatic purposes have led to the accumulation of deep ethnobotanical knowledge among the indigenous communities. The Amchis of Sapi, in particular, have preserved and transmitted this knowledge across generations by actively participating in plant collection and learning from elder practitioners in the field.

Of the 126 recorded species, 55 were confirmed to have medicinal value in the Sowa-Rigpa system. These identifications and uses were established through field collaboration with local Amchis and validated through classical Sowa-Rigpa texts and ethnomedicinal literature. With significant medicinal plant wealth and biodiversity found in Sapi Valley, the region holds strong potential for development as a medicinal plant conservation area. Furthermore, sustainable cultivation of these plants by the local communities should be promoted, not only for conservation but also to support livelihood generation through the commercial use of medicinal and aromatic plants.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_24(9)(2025)821-832_SupplData.pdf

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Conflicts of Interest

There are no conflicts of interest associated with this work.

Author Contributions

PG, SL, TR carried out the survey and documentation; TR and SL compiled the data drafted the manuscript. PG, AK provided support and guidance during survey; PG, AK and TR conceptualized, methodology, data curation, analysis and edited the manuscript. The final version was read and approved by all authors.

Ethics Approval

In accordance with the International Society of Ethnobiology's Code of Ethics, verbal informed consent was obtained from each informant, including specific approval for the collection of photographs, audio recordings, and video footage.

Data Availability

The authors declare that all the data supporting the findings of this study are available from the corresponding author upon reasonable request

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