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Ethnobotanical Survey of Wild Edible Plants of Leh District, Ladakh

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ABSTRACT

Ethnobotanical exploration was undertaken to document the Wild Edible Plants (WEPs) utilised by the inhabitants of the Leh district. Traditionally exploited WEPs are an indispensable part of every household culinary. This place is known for its unique culture and cuisine which diversifies it from the rest of India. Pre-structured questionnaires, guided field visits, field examinations, and group discussions were conducted to gather ethnobotanical data. Detailed inquiries were made on the plant's part used, time of collection and method of food preparation. In the present study, 40 wild consumable plants were documented, these belong to 18 families and spreads to 31 genera; out of which four are new records as wild food plants. They are *Cotoneaster integerrimus*, *Dracocephalum heterophyllum*, *Astragalus frigidus*, and *Turritis glabra*. Diverse use of wild leafy plants was observed and some of the most famous dishes are 'Shangsho tsodma' and 'Kabra tsodma' vegetables. The utilisation of wild plants helps enrich diet diversity and enhances the availability of green vegetables hence broadening food choices. Our study also reveals that the gathering of wild plants is confined to village people, shepherds, and farmers, and a majority of this knowledge exists in the memory of the elderly and these wild resources are under threat due to various anthropogenic activities. Therefore, the present finding highlights the value of these plants along with maintaining regional traditional knowledge and preserving the old ethnic traditional way of living and eating. Further, this information will provide baseline data to upcoming researchers dealing with nutrition and nutraceutical aspects. In addition, these wild plants are nutritionally rich and their consumption should be encouraged.

Keywords: Wild edible plants; Ethnobotany; Traditional knowledge; Ethnic food; Ladakh

1. INTRODUCTION

Wild edible plants provide food, medicine, and other valuable products, which are life-supporting commodities essential for the survival of human beings. Wild plants refer to non-cultivated native species gathered from their untamed natural habitat. They have been an integral part of dietary diversity throughout human history and around the globe.[1] Despite such wide varieties of cultivated crop plants, the tradition of eating wild food plants still exists and is cherished by various rural communities of developing countries.[2] Many researchers have repeatedly mentioned the nutritional and therapeutic potential of these plants and are also life-supporting food for wild animals. Indigenous people have traditionally exploited many wild edible plants, and they harbor a rich traditional knowledge about wild plant usage.

The snow-capped mountainous region of Ladakh comes under the rain shadow of the Himalayas, thus making the region devoid of seasonal monsoon precipitation. The high-altitude climate is exceptionally harsh, with extreme temperature fluctuation combined with deficient rainfall and humidity, which has resulted in no natural forest, mighty naked mountains, and vast barren lands. Despite such geographical position and unfavourable climatic conditions, the flora of Ladakh is rich and diverse, and many among them is traditionally eaten as wild edibles.[3] Trans Himalayan cold desert has unique flora comprising endangered and rare plants, which may not thrive in the rest of the Himalayas.[4] Ladakh witness a long cold winter, and heavy snowfall on its passes made the region geographically isolated for more than six months. During this freezing period, the Ladakh region is entirely devoid of vegetation, and local inhabitants chiefly rely on stored dried produce, along with supportive domestic animals for dairy and meat products. Furthermore, domesticated vegetables are stored in good condition for 5-6 months by using various indigenous storage techniques.[5] Such habits and techniques help locals offer variety in the family diet.

Subsistence agriculture is the primary livelihood of Ladakhi people, and they grow their main staple food crops such as wheat (*Triticum aestivum* L.) and barley (*Hordium* Vulgare L.).[6] Due to environmental constraints, the vegetation period is short, leading to a single crop season. Against all these odds, the people grow sufficient food and make optimal use of available natural resources. After the long-extended winter, the earliest source of green vegetables available to locals are WEPs, which emerge at the earliest and provide refreshment to natives.

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These are indigenous species well adapted to the harsh environment and managed to flourish amid acute water shortages and low temperatures. Ladakhi has rich traditional knowledge of WEPs, and the region has a unique diet and culture from the rest of India. After going through an extensive literature review, it has been found that the wild edible flora of Ladakh has been explored by several researchers. Previous studies highlight the importance of 31 raw edible plants commonly consumed by tribal communities of the Ladakh region.[7]

A study on phytofood of Nubra valley documented 27 traditional WEPs used for making traditional cuisine.[8] A similar study was conducted on the use of WEPs by tribal communities of India living in cold arid region.[9] Further, nutrient analysis of wild edible plants has been carried out by a few researchers.[10,11] However, a detailed study in the context of WEPs specifically concerning the Leh district was sparse. Earlier reported work either focused on one valley or dealt with raw edibles, and the majority of them explored other ethnobotanical aspects.[7,8,9,12] The focus of the present study is to explore all the significant valleys of the Leh district and document the wild edible usage in the region. Besides, the area of Leh district is vast, and some pockets remain isolated without road and network connectivity. So, there is always a potential to reach untouched areas and record new edible species. On the other hand, this valuable traditional knowledge handed down by forefathers is facing extinction in the times of the modern era. Therefore, our study contributes to comprehensive documentation of the traditional usage of wild edibles and their multiple contributions to the livelihood of local people. Further, the present enlisted wild edible plants (Table 1) will be added to the repository of wild edibles of the Ladakh region.

2. METHODOLOGY

The extensive field expeditions started in 2018 and lasted up to 2021. During this period, the study was mainly conducted in major valleys and high passes of Leh district namely; Indus, Nubra, Sham and Changthang valleys and three high passes i.e. Chang La, Khardung La and Taklang La. Each visit was extended up to 7-8 weeks. For accurate identification, the surveys were conducted during the peak summer months of June to August when plants were at the flowering and fruiting stage. Ethnobotanical information was gathered by interviewing local farmers, shepherds, elderly men, women, and the head of the village. Around 127 respondents of different ages between 27 to 85 were consulted. The study was conducted using pre-structured questionnaires aiming at plant part used, time of collection, method of food preparation, local name, and economic value, which were meticulously noted. People with good traditional knowledge were approached to guide for field visits, and tracks to high mountains were executed to identify the species in its natural habitat. Gathered data is further supplemented by direct field observation and group discussion. Received information was subsequently cross-checked with at least 12 interviewers for authenticity. Plants were photographed, collected, and pressed for herbarium preparation. Earlier published work was consulted to identify the collected plants using Flora of vascular plants of Ladakh[13] and Flora of cold desert, western Himalayan Vol.[14] Later, authentic identification was done with the help of keys, monographs, and specimens lying in the herbarium of the Botanical Survey of India, Dehradun.

Study Area: Ladakh is the northernmost union territory of India, which has two districts, *i.e.*, Leh and Kargil. Leh is spread over an area of 45,110 km^2 which marks the second-largest district in the country. It is located at 34° 17′ N latitude and 77° 58′ E longitude. It is situated at an altitude stretch between 2900 to 5900 meters.[15] The region is drained by Indus, Nubra, and Shyok rivers; human settlements and vegetation are found along the river banks. Glacier meltwater is the main source of water for the locals which supports livestock and vegetation. The area is rich in plant wealth, some of the wild plant hotspot are, Chang La, Khardung La, Taglang La, *etc.* Many of the local healers (Amchi) can be seen collecting medicinal herbs during peak summer months.

3. RESULTS

People of Ladakh have traditionally exploited many WEPs and the custom of using them in many dishes still exists in the region. These plants are cherished and adored not just for their savor but also for aiding diversity in family diet and also for supporting region food security.

3.1 Species Diversity

After four years of an extensive search, around 40 wild consumable plants were identified, these belong to 18 families and spreads to 31 genera. The dominating family was found to be Lamiaceae with 7 spp., followed by Polygonaceae with 6 spp., Brassicaceae with 4 spp., Amaryllidaceae, and Rosaceae with 3 spp., Boraginaceae, Asteraceae, Fabaceae, and Amaranthaceae, with 2 spp., each and the rest of the families consist of only 1 spp., each.

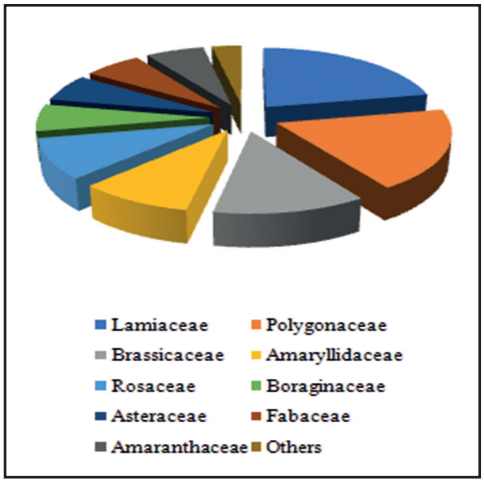

Figure 1. Distribution of WEPs in families.

Table 1. List of identified WEPs

S. No.	Botanical names	Family	Local names	Edible part	Uses and Recipe	References
1.	*Allium tuberosum* Rottler exSpreng.	Amaryllidaceae	Rergok	Leaves	Leaves are used as an alternative to garlic or for flavoring, in various traditional dishes like (Sku, Thukpa), *etc*.	-
2.	*Allium auriculatum* Kunth.	Amaryllidaceae	Skotse	Leaves	Leaves are used as a substitute for onions or boiled first then chopped into small pieces and fried along with spices and other ingredients and consumed as vegetables.	-
3.	*Allium carolinianum* Redoute	Amaryllidaceae	Aroom	Leaves	-do-	13
4.	*Arnebia euchroma* (Royle) Johnston.	Boraginaceae	Demok	Rootstock	Reddish color dried rootstock is mixed with heated butter to prepare (Demok), which is used for coloring various food items during religious ceremonies by Buddhist monks.	3,13
5.	*Arnebia guttata* Bunge.	Boraginaceae	Demok	Rootstock	-do-	3
6.	*Astragalus frigidus* (L.) A. Gray.	Fabaceae	Mashang	Leaves, Shoots	Young shoots and leaves as a vegetable.	-
7.	*Berberis ulicina* Hook.f Thomson	Berberidaceae	Kiraring	Fruit	Berries as fruit.	7
8.	*Capparis spinosa* L.	Capparidaceae	Kabra	Young leaves	Young tender leaves are collected in bulk and then boiled in hot water or put in a sack and dipped into running water for 1-2 days to reduce the bitterness. Then the leaves are chopped into small pieces and fried along with other ingredients and served as (Kabra tsodma) vegetables. Taken along with rice or roti.	3,13,7
9.	*Capsella bursa pastoris* (L.) Medik	Brassicaceae	Shamsho	Young leaves	Young leaves as a vegetable.	8
10.	*Carum carvi* L	Apiaceae	Kosnyot	Seeds	Aromatic seeds are used for flavoring various ethnic dishes.	13,3
11.	*Chenopodium album* L	Amaranthaceae	Sneou	Young leaves	Tender leaves are thoroughly crushed and mixed with buttermilk and the recipe is called (Tangtur). Taken along with local dishes (Kholak and Paba).	3
12.	*Cicer microphyllum* Bent	Fabaceae	Sari	Seeds	Seeds are usually consumed.	7

13.	*Cotoneaster integerrimus* Medik	Rosaceae	Sonam-shespa	Leaves and shoot	Young leaves and shoots are used for tea making. Leaves are boiled in water until dark brown color is achieved; salt, butter, milk, and more water are added and churned well in traditional cylindrical wooden utensils (Gur-gur) and served as salted butter tea.	-
14.	*Dracocephalum heterophyllum* Benth	Lamiaceae	Zypsi	Inflores-cence	The inflorescence is chewed as sweet candies.	-
15.	*Dysphania botrys* (L.) Mosyakin & Clemants	Amaranthaceae	Sagani	Young leaves	Tender leaves are thoroughly crushed and mixed with buttermilk and the recipe is called (Tangtur). Taken along with local dishes (Kholak and Paba).	16
16.	*Elsholtzia ciliate* Thumb	Lamiaceae	Sanik	Leaves	Young leaves are thoroughly washed and cut into small pieces and mixed with onion, tomatoes, and local dried powder Mirchi (Thaner) and served as a chutney.	16
17.	*Elsholtzia densa* Benth.	Lamiaceae	Sanik	Leaves	-do-	7
18.	*Fagopyrum tataricum* (L.) Gaerth	Polygonaceae	Tao	Leaves and shoot	Leaves and stems as a vegetable.	3
19.	*Fagopyrum esculentum* Moench	Polygonaceae	Chotsodma	Leaves and shoot	-do-	3
20.	*Hippophae rhamnoides* L.	Elaeagnaceae	Tsestalulu	Leaves and berries.	Wild fruits are used for making juices, and leaves are used for making herbal tea.	7,13
21.	*Lactuca tatarica* (L.) C.A. Mey	Asteraceae	Khawa	Young leaves	Tender leaves are first boiled in water to lessen the bitterness, then chopped into small pieces and mixed with other vegetables to make a local dish (Thukpa).	-
22.	*Lepidium latifolium* L.	Brassicaceae	Shangsho	Young leaves	Young leaves and shoots are boiled for 20 minutes to reduce the bitterness and then fry in oil with other ingredients like onion, salt, and pepper and served as (Shangsho tsodma) vegetables.	3
23.	*Lepidium capitatum* Hook. f. & Thomson Brassicaceae	Brassicaceae	Ditander	Leaves and shoot	Young leaves and stems are used in ethnic dishes.	3
24.	*Lepyrodiclis holosteoides* (C.A.Mey.) Fenzl ex Fisch. & C.A.Mey.	Caryophyl-laceae	Shichi	Leaves	Young plants are used as vegetables in various ethnic dishes.	13
25.	*Lycium ruthenicum* Murray	Solanaceae	Khezer	Berries	Edible berries.	-
26.	*Mentha longifolia* L.	Lamiaceae	Phololing	Leaves	Young leaves and shoots are crushed and mixed with other ingredients to make phololing chutneys.	7

27.	*Nepeta flocossa* Benth	Lamiaceae	Shalmago	Leaves	Tender leaves are crushed thoroughly and mixed with curd or buttermilk and eaten along with many local dishes.	17
28.	*Nepeta longibracteata* Benth	Lamiaceae	Biangkhu	Leaves and shoots	-do-	18
29.	*Nepeta batalica* Reshi	Lamiaceae		Leaves	Aromatic leaves are used as a spice.	18
30.	*Oxyria digyna* (L.) Hill	Polygonaceae	Lamanchu	Leaves	Leaves as a salad.	7
31.	*Potentilla anserina* L.	Rosaceae	Toma	Roots	The underground part is collected and washed thoroughly and then pan-fried with salt, and butter and taken as an evening snack by children or prepared for guests.	19
32.	*Rheum tibeticum* Maxim.ex Hook. f.	Polygonaceae	Laachu	Petioles	Raw petioles are cherished by children for their sour taste.	-
33.	*Rheum spiciforme* Royle. Polygonaceae	Polygonaceae	Laachu	Petioles	-do-	25
34.	*Rhodiola imbricata* Edgew.	Crassulaceae	Shrolo	Leaves	Young fleshy leaves are crushed and mixed with buttermilk and are locally known as (Tangtur). Tangtur is taken along with (Pabha and kholak).	3
35.	*Ribes glaciale* Wall.ex Decne	Grossulariaceae	Kimkolia	Berries	Fruits are raw edible.	-
36.	*Rosa webbiana* Wall.ex Royle	Rosaceae	Sya- men-tok	Fruits	Edible fruits.	25
37.	*Rumex patientia* L.	Polygonaceae	Shoma	Young leaves	Young leaves as vegetable.	3
38.	*Taraxacum harbhajan-singhii* Sunsp. *harbhajan-singhii*	Asteraceae	Gyama-gyashak	Leaves	Young leaves as vegetable.	13
39.	*Turritis glabra* L. Brassicaceae	Brassicaceae	Snyungkar	Young leaves	Young leaves and stem as vegetable.	-
40.	*Urtica hyperborea* Jacq. Ex Wedd.	Urticaceae	Zatsod	Leaves	Sundried leaves are mixed with other ingredients to prepare a local dish known as Zathuk.	3

3.2 Some Highly Preferred WEPs of this Region

It was observed that some plants were highly treasured and widely consumed e.g., *Lepidium latifolium*, *Capparis spinosa*, *Urtica hyperborea, etc*. *Urtica,* locally known as (Zatsod), is well known for its delightful taste and designates one of the special Ladakhi dish (Zathuk). A hot bowl of zathuk is a must for keeping the body warm during cold winter days.

Another such, is an aromatic plant (Aroom) *Allium carolinianum*, found only at very high steep mountains. It is known for its taste and therapeutic value. Moreover, elderly with insomnia prefer aroom for dinner as they found this species effective for inducing sleep.

Hippophae rhamnoides treat locals with its vitamin-loaded juice. Leaves are used for making herbal tea. Locals gather berries in large quantities and sell at a local market to make juices, jam, and other valuable products. This treasured berry helps in uplifting local economy. The diets of locals are in accordance with high altitude cold climate, dishes are mostly soup based coupled with hot beverage to keep the body warm.

Figure 2. Wild edible plants: ***(A) Hippophae rhamnoides, (B) Berberis ulicina, (C) Cotoneaster integerrimus, (D) Urtica hyperborea (E) Rheum tibeticum, (F) Nepeta longibracteata, (G) Arnebia euchroma, (H) Oxyria digyna and (I) Rhodiola imbricata.***

3.3 Mode of Consumption

3.3.1 Green Leafy Vegetables

This category includes the most favored group of wild edibles. Leafy vegetables were preferred when young and tender, and the preference of edible species varied in different localities of the Leh district. Young leaves and stems of *Capparis spinosa* (Kabra) are plucked and boiled to lessen the bitterness and are traditionally cooked and served as (Kabra) vegetables. Another species *Lepidium latifolium* is cooked similarly and consumed along with rice or roti. Plants such as *Lactuca tatarica, Taraxacum harbhajan-singhi.*, *Chenopodium* spp., *and Capsella bursa pastoris* are also used as vegetables in many local dishes.

3.3.2 Soup-based Dishes

Thukpa (Soup noodle) is one of the highly consumed ethnic dishes prepared with tender leaves of *Lactuca* spp. or *Lepidium latifolium* or *Urtica hyperborea* along with dried pea, (Chhura) dried cottage cheese and to enhance the flavor spices are mixed with barley noodles. These plants must be boiled before cooking to reduce the bitterness. Thukpa is a cold climate dish that provides warmth to the body and helps locals beat chilly cold winter.

3.3.3 Raw Edibles

Hippophae rhamnoides is known for its citric berries, special local juice is produced known as Leh berry. *Ribes glaciale* and *Lycium ruthenicum* berries are seldom eaten by children, and petioles of plants such as *Rheum tibeticum, and R. spiciforme* are preferred and cherished for their sour candy taste. Other species such as *Dracocephalum heterophyllum* inflorescence is plucked and chewed for their sweet flavor.

3.3.4 *Raita (Tangtur)*

Tangtur is a local delicacy made with curd and is prepared by mixing any of these species such as (Srolo)

Figure 3. Wild edible plants: ***(J) Allium carolinianum, (K) Astragalus frigidus, (L) Lepyrodiclis holosteoides, (M) Potentilla anserina, (N) Lepidium latifolium, (O) Rosa webbiana.***

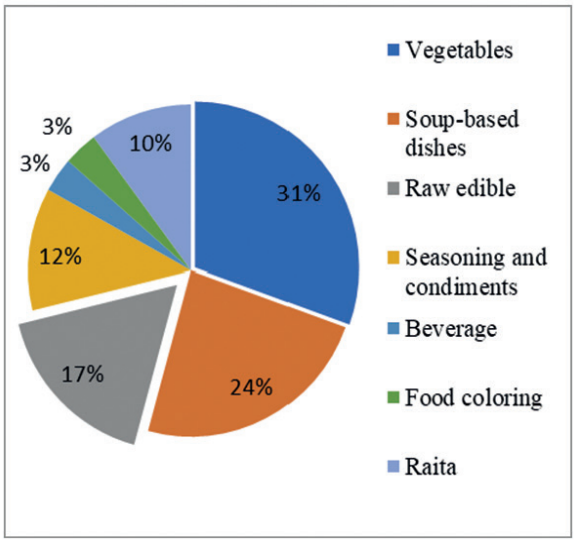

Figure 4. Mode of consumption of wild plants.

Rhodiola imbricata, Mentha longifolia, Chenopodium spp. etc and consumed along with local dishes such as (Paba) and (Kholak). Species like *Nepeta flocossa*, and *Nepeta longibracteata* are also blended with buttermilk and served as a side dish.

3.3.5 Seasonings and Condiments

Aromatic plants are an important part of local cuisine and are often used to enrich the flavor and taste of dishes. Frequently used are *Allium* spp., known for its nutrition and aroma. These species are added to main dishes, soups, meats, and in various ethnic cuisine. Seeds of *Carum carvi* are also used for their rich aroma.

3.3.6 Food Coloring

Plants like Arnebia euchroma and A. guttata, rootstock are used for colouring food items (specially tsoks) prashad during various religious ceremonies by Buddhist community.

3.3.7 Beverages

Tea is one of the most important drinks of regional traditional diet. Ladakh has unique 'salted butter tea' inspired by the culture of Tibet. Long before, when commercial tea leaves were not accessible, ethnic people used the leaves and stems of the plant *Cotoneaster integerrimus* to make salted (Gur Gur) tea. This tea is an indispensable part of Ladakhi culture and is consumed throughout Ladakh and beyond. It's a ritual of every household to make a flask full of butter tea and consumed it throughout the day, special kind of wooden cup (Shingkor) is usually used for having this tea. *Hippophae rhamnoides* leaves are used for making herbal tea known as 'seabuckthorn tea'.

3.4 Threats on WEPs

During the field expedition, it was observed that WEPs were facing threats from various human actions. One of the significant threats was overharvesting for medicinal purposes, and improper technique applied for harvesting, and other includes over-grazing and collection for fuel wood and fodder. For instance, roots of *Arnebia euchroma* are harvested for food coloring purposes. Also, they are the source of Shikonin, and traditionally it is used to treat hair problems.[20,21] *R. tibeticum* its roots are used to treat wounds and skin disease. In addition, both species face anthropogenic threats, mainly from habitat destruction by the construction of roads and excavation of ground for telecommunication. All the above factors have considerably impacted its population and placed the species under the (Near Threatened) category.[22] If the present scenario persists, then some species may get extinct in near future. Therefore, there is an urgent need to set regulations for their protection, and the wild plants should be put into cultivation.

4. DISCUSSION

This study highlights the rich traditional knowledge on WEPs possessed by the people of Ladakh and their utilisation to supplement nutritional requirements. Before the introduction of commercial vegetables, the people of Ladakh survived on wild vegetables that grew throughout the region.[23] These plants are the main ingredient of many ethnic cuisines. Data represented in (Table 1) reflects the proper utilisation of wild plants to improve vegetable intake in this cold desert area. The results illustrated that the most dominating family was Lamiaceae with maximum species. Numerous parts of a plant such as a flower of 1 spp., leaves and berries of 1 spp., leaf stalk 2 spp., seeds of 2 spp., roots of 3 spp., berries of 4 spp., leaves and shoot of 6 spp., and leaves of 21 spp. are either consumed raw or cooked as ethnic vegetables.

We classified the WEPs into seven different categories. The most preferred and highly consumed was vegetables (31% of species) and the least was used for beverage and food coloring each represented by (3% of species). The diverse use of wild leafy plants was observed in the study area. Some famous ethnic dish, like 'Shangsho tsodma' prepared with tender leaves of *Lepidium latiflolium*, is the most prominent among tribals. The result is supported by the previous publication[8] and regarded as one of the most preferred and tastiest. Another such is 'Kabra tsodma' prepared by young leaves of *Capparis spinosa*. These vegetables are consumed at a broad level. The earlier report expressed that a dish called 'chonma' is the tastiest and most preferred in Ladakh region.[24]

Not all the species are widely consumed, it varies among species and also on the nature of its availability. Species such as *Allium carolinianum* (Aroom) are known for their therapeutic and nutritional value, but the availability of this species is sparse. The taste and its therapeutic value made people climb up mighty mountains only to fetch a handful of this plant. To the best of our knowledge, out of the total documented species, the edible value of the four species is reported for the first time from the study area. These are C*otoneaster integerriumus, Turritis glabra, Dracocephalum heterophyllum,* and *Astragalus frigidus. Cotoneaster spp.,* (locally known as Sonamshespa), is still used to make regional (salted tea). Among the villages, the people of Shang village have extensive knowledge about its usage and cherished this plant to date. Many authors have conducted ethnobotanical survey.[7,8,9,12,17]

However, none of them have reported the usage of above mention wild plants. It has been observed that these wild resources are facing threats due to overharvesting, improper techniques applied for harvesting, overgrazing, etc. In addition, infrastructure development, construction of roads, and excavation of ground for telecommunication cables are leading to habitat destruction and thereby causing threats. Similar threats were reported by other authors which has put some plants under rare, endangered, and threatened category.[21] The collection of these plants is also a way of life and reflects their rich culture and connection with nature. However, gathering of some plants has seen a considerable decline e.g., *Potentilla anserina* (Toma) is now seldomly collected, or many children completely lack the knowledge of its edible value. Earlier, this used to be a favourite snack among children and guests. It is still available at the local market and prepared during auspicious days and served to Buddhist monk during religious ceremonies. The difference in consumption is also seen by another author as this species was well known in the pre-modern Tibetan community and frequently consumed, now it is seen to be consumed occasionally.[25] Similar is the case of *Rumex patientia*. Presently, with easy access to commercial vegetables, there has been a generalised decrease in the gathering of such plants, which is mainly restricted to village people, shepherds, and farmers. The elderly above 40 is found to be more informative than the younger generation. People residing in cities possess less knowledge and interest in these valuable resources. So, most of the plant identification skills and traditional knowledge are found greater in village dwellers, shepherds, and elderlies. If this continues, then age-old ethnic traditional knowledge is on the brink of loss. So, it is essential to preserve this knowledge in a documented form. Therefore, the

present finding and study can help address the value of these plants and preserve the old ethnic traditional way of living and eating.

5. CONCLUSION

This study concludes that WEPs usage and their traditional knowledge are still well preserved in the villages of this region. They have an integral role in diversifying locals' diet and broadening the choice of dried vegetables during winter. The maintenance of this valuable knowledge reflects the profound relation of people with wild resources and their optimum utilisation. Field observation has also revealed that some species are under threat due to overexploitation and improper techniques applied for harvesting. It is, therefore, essential to make the community aware of sustainable harvesting, and proper training and technique should be encouraged. Further, this documented knowledge can provide a baseline for future studies into nutritional and nutraceutical aspects. This study also helped enrich the herbarium of BSI, Dehradun, and herbarium of PAN, Panjab University, Chandigarh, providing permanent records of the herbarium, which will be valuable for future botanical reference.

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