

# Ethnoecological Survey of Underutilized Plant Diversity of Hamirpur District, Himachal Pradesh, India: An Edibility Assessment

Ram Chand, Anand Narain Singh\*, C. Nirmala

Department of Botany, Panjab University, India

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**Abstract** The present study was conducted to explore diversity and status of underutilized wild edible plants of Hamirpur district, Himachal Pradesh, India. Total 85 plant species of 66 genera belonging to 39 families under various life forms and origins were recorded; in which, 30 species as trees (25 native and 5 exotic), 11 shrubs (6 native and 5 exotic), 28 herbs (10 native and 18 exotic) and remaining 16 were creepers (12 native and 4 exotic). Edibility index (EI) showed 100% score of edibility by two species, while 80% was shown by 11 species, 40% by 3 species and remaining 69 species showed 10 to 30% only. Across family, maximum utilization efficiency (10 score) was found only in 2 families (Apiaceae and Violaceae), while 5 families (Chenopodiaceae, Commelinaceae, Liliaceae, Oxalidaceae and Portulacaceae) have shown 8 and one family (Amaranthaceae) exhibited 5.8 score followed by 31 other families. In this study, it was observed that consumption mode of various plant parts were either fresh or cooked. In conclusion, present study may help in alleviating food scarcity, malnutrition and can be employed further as commercial crop plants for the welfare of human in developing countries.

**Keywords** Wild Edible Plant, Utilization Efficiency, Edibility Index, Consumption Mode, Traditional Knowledge

## 1. Introduction

Plants have been playing an important vital role in human society. Evidently, about 40k to 100k species of plants have been used regularly in different geographical region for food, fodder, medicine, fiber, fuel, oil, timber, cultural and industrial purposes etc. ([1], [2], [3]). There are over 20,000 edible species as wild plants in the world [4], until now only 30(thirty) plants are used to meet the 90% world's food

requirement ([5], [4]). Only few staple crops such as wheat, rice, maize and millet produces majority of food supply globally. Due to global rise in population with projected nine billion people by 2050 [6], one of the greatest challenges facing world today is to feed the teeming population.

Several countries including India suffer famines and food shortage, although they have the potential to produce adequate nutritional food for the population [7]. It will be difficult to meet daily global requirement calories by three or four staple crops. Therefore, broader range of plant species which are neglected or underutilized plants can contribute significantly to meet the requirement of healthy diet, appropriate food and energy requirements of each human being. These underutilized plants can be a good alternative source of food demand and contribute toward food security, nutrition, health and income generation [8].

Information regarding these plants is not properly documented from certain remote areas especially from hilly regions. Some plant species have regional importance grown by local people and some plants grow wild and are used by local people to meet their energy need and to get healthy food. Some such plants like Buckwheat (*Fagopyrum esculentum*) and Raggi (*Eleusine coracana*) with high nutritive content have been introduced as substitute of staple crops in some region but still remain unexplored or underutilized ([9], [10], [11]). Similarly, Bamboo shoots are underutilized as food but now are being projected as a health food ([12], [13]). However, a large proportion of wild edible plants are used for eating and for medicinal purposes in different regions of India but use of wild plants without sufficient knowledge may give rise to adverse effects [14]. Though ethno-botanical studies are increasing, but traditional knowledge of many plants has not been documented yet properly [15]. Although, wild edible plants is a main component of underutilized plants, in various life forms, while distributed in different ecosystems. However, there are about 1532 edible wild food species reported in India [16]; in which, over 675 species are known from Indian Himalayan region [3], and it is estimated that 800 species are

consumed as wild edible plants chiefly by tribal people [17].

Himachal Pradesh is a hilly state having vast diversity of plants and also known as store house of traditional, locally adopted indigenous and naturalized species (might be exotic) that providing fruits, vegetable and medicines etc. are lesser known or unexploited. These plants might have high nutritive potential and could be of great potential towards solving problems of food security. Evidently, some studies have been conducted and provided ample information regarding edibility of wild species. For example, Chauhan et al., [18] documented 34 tree plants of 14 families from Pabbar valley district Shimla; Rana et al., [19], studied 67 species and reported 22 species used as food from remote and tribal areas of Panghi valley from Chamba district; whereas, Sharma et al., [20] reported 43 wild edible plants from Murari Devi and surrounding area of Mandi district. Similar studies also been reported from other parts of Himachal Pradesh ([21], [22], [23]).

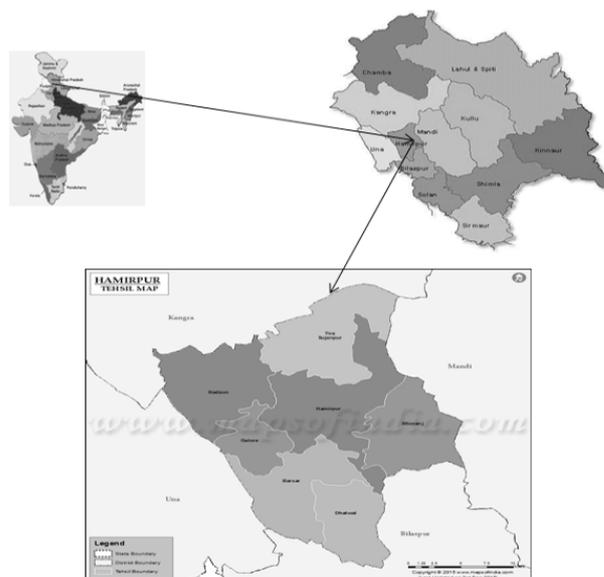
However, information regarding the ethno-ecological purpose of the plants has not been documented extensively in Himachal Pradesh as whole and no work has been conducted in the selected study area Hamirpur. Hence there is a need to document the folk and traditional knowledge of edible underutilized plants used by local people. So present study was conducted to estimate diversity and status of edible underutilized and wild plants and its edibility, utilization efficiency and consumption mode with following objectives: a) to estimate the diversity, utilization efficiency and consumption mode of collected plant species, b) to explore the traditional information of plants used for edible purposes by local people and c) to find out the probability of proper utilization of these underutilized plants for the food and pharmaceutical industry. We consider collected all these underutilized plants as “edible wild plants” because they are directly produced from pristine nature and growing without intentional cultivation which includes prevalently being indigenous and naturalized species. Also, admitted with two assumptions, 1) that wild edible plants are indeed having with multiple uses from several components (root, stem, leaf etc.) for food and medicinal purposes if collecting at any appropriate stage of growth and properly prepared; 2) we did not pay any attention on negative role of the plant species listed as exotic species excepts its edibility and uses. Although, many floristic assessments from various parts of India conducted and reported that about 30-40 % herbaceous flora of the total are not indigenous in nature while they are from other place of origin. Many of them from exotic species have been naturalized and pay good ecosystem services to the local people.

## 2. Methods

### 2.1. Study Sites

The study area comprises of several villages of Hamirpur district located at the south western part of Himachal Pradesh.

It lies between  $76^{\circ}17'50''$  to  $76^{\circ}43'42''$  east longitudes and  $31^{\circ}24'48''$  to  $31^{\circ}53'35''$  north latitudes (Figure 1). It is covered by lower Himalayas; the elevation varies from 400 to 1100 meters. The district is covering an area of 1118  $\text{km}^2$  of total geographical region of the state and it is bounded in the north by river Beas which separates from Kangra district and in the east, Bakar and Seer Khads separates from Mandi district, whereas in the south, it is bounded by Bilaspur district and in the west by Una district. The climate is mainly sub-tropical and is not much hilly being closer to the plains. Annual average rainfall is about 1520 mm, where maximum rain fall occurs in the month of July to September and minimum in the months of April to June. In this region, demographic structures are mixed tribal communities along with other different castes such as Brahmins, Rajputs, Kolis, Khatti, and Dumanas etc. However, tribal population in this region is mainly Gujjar and Gaddis at the interior parts migrated from Chamba and Lahul Sapiti.



**Figure 1.** Location of the selected study sites at Hamirpur district, Himachal Pradesh.

### 2.2. Experimental Design, Sampling and Monitoring Methods

Field study was conducted at selected sites of Hamirpur district (sub-divisional area of the district known as tehsil), Himachal Pradesh during the period of 2013 to 2015. Therefore, three tehsils named as: Nadaun, Barsar and Hamirpur, in each tehsil, 10 Panchayat (includes of several villages) were selected for study. At each Panchayat, five households were taken from each village as informants for inquiring and collecting information. Selection of informants at each village at Panchayat was made by following criteria: 1) each household should have knowledge about plants, 2) household must have awareness about use and application of local plants for edible as well as for medicinal purposes, 3)

household must have used to local climate and environment 4) household must be resident of the selected area. Therefore, in total, 300 informants (100 informants per tehsil) were interviewed across sites.

Field survey and sampling was carried out to collect information regarding status, utilization and edible sense of wild plants with involvement of local informants from each selected number of villages (2 villages of each Panchayat). Therefore, collected information was monitored at each selected Panchayat to take proper interaction and interview in respect to proper utilization of wild plants for food purposes.

In order to get satisfactory survey, a questionnaire was prepared pertaining to several required aspects and it was circulated among the informants. The information was collected in the native dialect (Pahari- close to Hindi), and recorded on the native names of the plants and their various uses for which plants are employed or used by the local people. The plant and its utility were assessed on the basis of consensus and confirmation by agreement of number of informants when data were pooled and subjected for statistical calculation.

Voucher number of each recorded plant was indexed with an established code (13E001 to 13E0085) and specimens of all the plants reported to be edible were collected, and herbarium was prepared. Each plant specimen was also visually documented with digital camera (Nikon P-500 model) for future prospect and proper records. Collected plant specimens were commonly available and known by the local people were identified in the field; while unidentified plants were identified at the herbarium center of Department of Botany, Panjab University Chandigarh (one of key herbarium Centre in country), India for proper identification.

In this paper, we simply reported edibility of total collected plant species based upon collected information across various informants and sites, also explained their mode of consumption, utilization efficiency and the number of uses as species-wise, family-wise of each species is discussed. Informant consensus data was subjected to statistical analyses, for example, to understand role of informants and variability of sites were analyzed for analyses of variance by SPSS version 14.0.

### 2.3. Edibility Index

In this study, a component wise use was developed and given weighted scale values according to the use size of each component; it was categorized into ten components of each plant having utilization for edible purposes, therefore, each component is allocated with 10 percent weighted score to calculate the values for this index.

In addition, summation of each aerial component use of each edible plant such as leaf, flower, fruit, seed, stem, resin, gum and shoot has been categorized as a whole aerial plant parts (WAP) and further summation of total component use as whole plant (WP) is given as 100 percent weighted score.

Therefore EI (%) of each component will have minimum score as 10 percent and maximum will be 100 percent, therefore, EI of each species is calculated as:

$$EI(\%) = \frac{PUI}{WPU_i} \times 100$$

Where, EI = Edibility index, PUI = parts used of  $i^{\text{th}}$  species, WPU<sub>i</sub> = whole plant use of  $i^{\text{th}}$  species.

### 2.4. Utilization Efficiency (UE)

Utilization efficiency (UE) is calculated on the basis of edible plant parts used of all species recorded within each family, hence, summation of total number of plant parts used of all species divided by total number of plant species of each family:

$$UE = \sum_i^n \frac{TNPPsU}{TNPS}$$

Where, UE = Utilization Efficiency, TNPPsU = Total number of plant parts used of all species and TNPS = Total number of plant species within family.

## 3. Results

### 3.1. Status of Edible Plants Diversity

In this study, total 85 plant species of 66 genera belonging to 39 families were collected as edible plants from selected sites at Hamirpur district, Himachal Pradesh (Table 1). Vegetation composition at selected sites were distributed in various life forms; of which, 30 species areas trees (35.3%, 25 native and 5 exotic), 11 shrubs (12.9%, 6 native and 5 exotic), 28 herbs (33.0%, 10 native and 18 exotic) and remaining 16 as creepers (18.8%, 12 native and 4 exotic) are presented in Figure. 2. However, significant number of the recorded edible plant species were trees followed by herbs (most dominant life form), while other growth forms of the plant like shrubs and creepers were sparsely distributed (Figure 2).

In order to get more clarity and status of edible plant species, a family-wise distribution of collected plants is assessed and presented in Figure 3. Out of all plant species, maximum number of species were found from family Moraceae (11) followed by Cucurbitaceae (8), Fabaceae (6), Amaranthaceae and Rosaceae (5 each); whereas, 14 families like Araceae, Asparagaceae, Asteraceae, Boraginaceae, Chenopodiaceae, Combretaceae, Dioscoreaceae, Euphorbiaceae, Lythraceae, Myrtaceae, Oxalidaceae, Rhamnaceae, Rutaceae and Solanaceae were sparsely found (2 to 4 species), while remaining 20 families had minimally one species each (Figure 3).

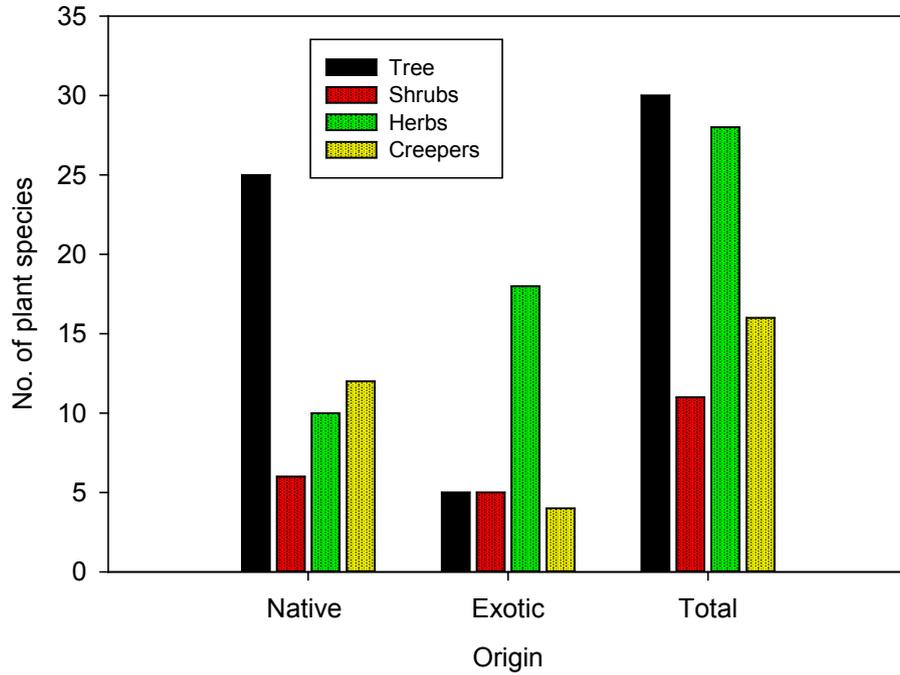


Figure 2. Total number of plant species recorded in various Life-forms at research site of Hamirpur district, Himachal Pradesh.

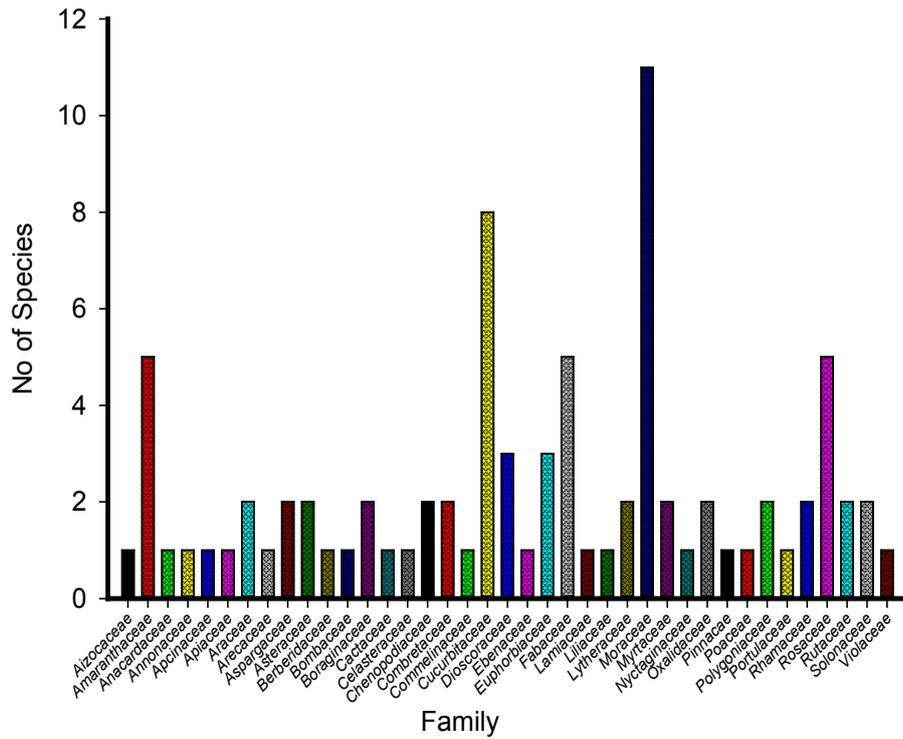


Figure 3. Family-wise distribution of recorded plant species of Hamirpur district, Himachal Pradesh

**Table 1.** List of recorded edible plant species from selected research sites at Hamirpur district, Himachal Pradesh

S. N./V.N.	Scientific name of plant species	Local Name	Vernacular Name (Hindi & English)	Family	O/LF	Uses
13E001	<i>Aegle marmelos</i> (L.) Correa	Bil/Bael	H: Belpatthar Ka paid/ Belada mara/ Bilva/ Bael E: Golden apple/ Stone apple	Rutaceae	N/T	Ripened fruits are used to prepare Murrubba, Jam, Juice. Also, used as cooling laxative and aromatic to prepare Sharbat. Leaves are cooked in tea and young shoots used as salad. Ritual importance, offering young leaf to lord Shiva in worship.
13E002	<i>Artocarpus lakoocha</i> Buch.-Ham.	Tiau	H: Lakoocha/ Lakooch Barhal/ Dahu/ Dahua E: Monkey Fruit	Moraceae	N/T	Young and mature fruits used in pickle. Flower and its buds cooked as vegetable.
3	<i>Annona squamosa</i> L.	Sheetalphal	H: Sheetalphal E:Custard apple	Annonaceae	E/T	Fruits are eaten after ripe.
4	<i>Bauhinia variegata</i> L.	Karaal	H:Kachnar E: Orchid Tree/ Variegated Bauhinia	Fabaceae	N/T	Flower and its buds are eaten as vegetable. Boiled flower buds used with mustard oil as salads and raita.
5	<i>Bombax ceiba</i> L.	Simbal/Simmal	H:Shalmali/ Semal E Silk Cotton Tree/ Kapok Tree	Bombacaceae	N/T	Flower buds cooked as vegetable.
6	<i>Butea monosperma</i> (Lam.) Kuntze	Palah/palash	H: Palah/ Palash E: Parrot tree/ Flame of Forest	Fabaceae	N/T	Flowers are cooked as vegetable; its gum is used to prepare gond (kind of latex) i.e. for pregnant women. Whereas, its decoction made in ball shaped (laddoo) eaten during winter season.
7	<i>Cassia fistula</i> L.	Ali/Alis	H:Amaltaas E: Golden shower tree	Fabaceae	N/T	Young pods are used as pickles. Cut into small pieces, fried with sarson oil, mixed with spices like turmeric, red-chilli and salt, then kept it for 15 days for the use. Flowers are used to prepare raita and gulukand.
8	<i>Cordia dichotoma</i> G. Forst.	Lasura	H:Lasura E Indian Cherry/Clammy cherry	Boraginaceae	E/T	The leaves are cooked as vegetable whereas ripe fruits eaten directly and unripe fruits are used to prepare pickle and vegetable with unripe mango fruit slices. This preparation is very tasty and common among the local people.
9	<i>Cordia sinensis</i> Lam.	Lasuri	H: Chhoti lasuree E: Small cordia	Boraginaceae	E/T	The leaves are cooked as vegetables, ripe fruits eaten directly and unripe fruits are used to prepare pickle and vegetable with unripe mango fruit slices. This preparation is very tasty and common among the local people.
10	<i>Diospyros melanoxylon</i> Roxb.	Kinnu	H: Tendu, Timburni E: Coromandel Ebony or East Indian Ebony	Ebenaceae	N/T	Fruits are eaten after ripe.
11	<i>Ficus auriculata</i> Lour.	Tiyamal/Traymbal u	H: Timla/ Tirmal/Fagoora,/Tiaambal E: Elephant Ear Fig	Moraceae	N/T	Ripe figs are eaten while unripe fruits used as vegetable.
13E012	<i>Ficus benghalensis</i> L.	Bar/Bargadh	H: Barh, Bargad E: Banyan	Moraceae	N/T	Fruits are eaten. In the past, when resources were limited then fruits were grounded into flour to make chapati.
13	<i>Ficus carica</i> L.	Dogla	Hindi - Anjeer E: Fig	Moraceae	E/T	Ripened fruits eaten as fresh and unripe fruits are cooked as vegetable.
14	<i>Ficus glomerata</i> Roxb.	Umbar/Ummar	H: Goolar E: Cluster fig	Moraceae	N/T	Ripened fruits are eaten directly but unripe fruits are cooked as vegetable.
15	<i>Ficus hispida</i> L. f.	Dangur	H: Gobla, Kagsha, Kala Umbar, Katgularia, E: Hairy Fig/ Devil Fig	Moraceae	N/T	Unripe fruits are seldom used as vegetable.
16	<i>Ficus palmata</i> Forssk.	Anjeer	H: Abjiri/Bedu E: Wild Fig	Moraceae	N/T	Ripe fruits are eaten, also, used in sweets preparation.

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17	<i>Ficus religiosa</i> L.	Pipal/Piplu	H: Peepal E: Sacred Fig/Holly tree	Moraceae	N/T	Same use as of <i>Ficus benghalensis</i> (Bargad).
18	<i>Ficus semicordata</i> Buch.-Ham.ex. Sm.	Khain/ Khainu	H: Khaina/ Khunia, E: Drooping Fig	Moraceae	N/T	Ripe fruits are eaten.
19	<i>Flacourtia indica</i> (Burm. f.) Merr.	Kaangu	H: Kangu E: Indian Plum/Flacourtia/Governor's Plum	Moraceae	N/T	Ripened fruits are directly eatable and unripe used for making pickle.
20	<i>Morus alba</i> L.	Tut/ Shahtut	H: Shahtoot E: Mul berry/ Silkworm Mulberry	Moraceae	E/T	Young leaves are cooked as vegetable; ripe fruits are eaten directly.
21	<i>Phoenix sylvestris</i> (L.) Roxb.	Khajoor	H: Khajoor E: Silver Date Palm or Sugar Date Palm	Arecaceae	N/T	Ripe Fruits are eatable directly.
22	<i>Phyllanthus emblica</i> L.	Aambla	H: Amla/ Aambla E: Indian gooseberry/ Malacca Tree	Euphorbiaceae	N/T	Good medicinal plant; fruits are commonly used for pickle. Also eaten as raw or cooked for various dishes. A sweet pickle and murrubba is commonly used in northern part of India. Also prepare sugar candy. In this region, local people used it as sweet sour sausage and fruits either ripe or unripe are used in daily life.
23	<i>Pinus roxburghii</i> Sarg.	Chir/Chil/ Chalautu	H: Chirh E: Chir Pine, Three Leaved Pine	Pinaceae	N/T	Seeds are eaten as raw as well as roasted.
24	<i>Pyrus pashia</i> Buch.-Ham.	Kainth	H: Mehal/ Mole/Kainath/ E: Indian wild pear	Rosaceae	N/T	Ripe fruits are eaten.
25	<i>Spondias pinnata</i> (L.f.) Kurz.	Ambara, Buara, Jangli Aam	H: Ambara/ Ambari/ Amra E: Wild Mango/Indian hog plum	Anacardiaceae	N/T	This is a valuable tree for food and medicine. Its unripe fruits are acidic and eaten fresh as well as cooked as pickle and vegetable, Chuttaney etc. Sometime Juice or Jam of ripped fruits is also prepared. Ripe or unripe fruits are cut into small pieces; dried, powdered and preserved form is useful in off season.
13E026	<i>Syzygium jambolanum</i> (Lam.) DC.	Pataman/Jamoa	H: Jamoon E: Black Plum	Myrtaceae	N/T	Fleshy ripened fruits are eaten directly.
27	<i>Syzygium cuminii</i> (L.) Skeel.	Jamman, Jammun	H: Jamun E: Java plum	Myrtaceae	N/T	Ripe fruits are eaten, but uses have declined in villages and the fruits are being sold in the cities.
28	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Bahera	H: Bahera E: Bastard myrobalan	Combretaceae	N/T	Fruits are used to prepare triphala and pickles
29	<i>Terminalia chebula</i> Retz.	Harar	H: Hara / Harada , E: Chebulic myrobalan	Combretaceae	N/T	Fruits are used to prepare triphala and pickles
30	<i>Ziziphus jujuba</i> Mill. Gard.	Ber	H: Ber E: Indian Jujube/ Indian Plum	Rhamnaceae	N/T	Ripe fruits are eaten directly.
31	<i>Agave americana</i> L.	Kayora	H: Gwarpatha E: Century plant/ maguey/American aloe	Asparagaceae	E/S	Young shoot is peeled off and cut into small pieces , boiled in water, squeezed and then fried with oil to prepare a dish along with using certain common Indian spices.
32	<i>Berberis asiatica</i> Roxb. Ex DC.	Kashmal	H: Chitra/Chotra E: Indian Barberry, Tree Turmeric	Berberidaceae	N/S	The fruit is eaten as raw or dry and used as raisins. This species is said to make the best Indian raisin. Ripe fruits are juicy with pleasantly acid flavour.
33	<i>Carissa spinarum</i> L.	Garuna, Gurnu	H: Karonda E :Conkerberry /Bush plum	Apocynaceae	N/S	Fruits are eaten. Young shoots are peeled off and eaten by children. Raw fruits are used in pickle.
34	<i>Euphorbia royleana</i> Boiss.	Chhun, Thoar	H: Thoar E: Royle's Spurge	Euphorbiaceae	E/S	Young shoots of the stem is peeled off, cut into pieces and boiled in water, squeezed, then fried and cooked with vegetable.

35	<i>Murraya koenigii</i> L. Spreng.	Gandhala	H: Mitha neem, Kurry patta E: Curry leaf-tree	Rutaceae	N/S	Leaves are used as condiments as well as curry preparation.
36	<i>Opuntia dillenii</i> Haw.	Pahari choon	H: Nagphani E: Prickly Pear	Cactaceae	E/S	Ripe fruits are eaten after removing spines.
37	<i>Punica granatum</i> L.	Daran	H: Jangali Anar E: Dwarf Pomegranate	Lythraceae	N/S	Ripe fruit is eaten and also prepared as digestive ball (aanardana).
38	<i>Rosa moschata</i> Herrm.	Jangli Gulaab	H: Ban gulab E: Musk Rose	Rosaceae	E/S	Flowers are used to prepare gulukand.
39	<i>Rubus ellipticus</i> Sm.	Aakha	H: Lalanchu/ Hinsra E: Roadleaved bramble	Rosaceae	N/S	Ripened fruits are eaten.
40	<i>Woodfordia fruticosa</i> L.	Dhaun	H: Dhawai E: Fire Flame Bush	Lythraceae	N/S	Flowers have sweet nectar which is sucked by the people and these may be used as vegetable.
41	<i>Ziziphus mauritiana</i> lamk.	Malair	H: Ban Ber E: Indian Jujube, Chinese Date	Rhamnaceae	E/S	Fruits are eaten.
13E0042	<i>Achyranthus aspera</i> L.	Puthkanda	H: Chirchita E: Prickly Chaff Flower	Amaranthaceae	N / H	Husk free seeds used for halwa preparation with milk. In the past when the source was limited seed flour was used to prepare chapati. Halwa prepared with seeds are highly nutritive and energetic. Generally, Hindu monk (naga) used before starting fast and meditation for several days.
43	<i>Colocasia esculenta</i> (L.) Schott	Jangli kachalu	H: Arvi, Ashukachu, E: Taro, Colocasia root	Araceae	E/H	Tubers used as vegetable. Leaves are also used as leafy vegetable. Leaves are used for making some specific food menu in local culture.
44	<i>Aloe vera</i> (L.) Burm.f.	Kuaar/Kunwar	H: Gheekumari E: Aloe vera	Asparagaceae	E/H	Ariel part is used to prepare vegetable, pickle and juice. Roots are also used for herbal medicines in local culture.
45	<i>Amaranthus cruentus</i> L.	Kalaunji /Seul	H: Chaulai E: Red Amaranthes	Amaranthaceae	E/H	Cooked into vegetable and halwa
46	<i>Amaranthus viridis</i> L.	Chaulai	H: Jangli Chaulai E: African amaranthes	Amaranthaceae	E/H	Cooked as leafy vegetable.
47	<i>Amaranthus spinosus</i> L.	Chaulai	H: Kanta chaulai E: Prickly Amaranth, Edlebur	Amaranthaceae	E/H	Leaves or young shoots are cooked as vegetable Leaves are also used to prepare prantha.
48	<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson,	Jamikand	Zimikand	Araceae	N / H	Tubers are cooked as vegetable. Good source of iron.
49	<i>Artemisia scoparia</i> Waldst. & Kit.	Chaunkhra	H: Seeta Bani E: Redstem wormwood	Asteraceae	E/H	Leaves and inflorescence are used for flavouring dal curry, vegetable and in pickles.
50	<i>Asphodelus tenuifolius</i> Cav.	Piyaaji	H: Piyaaji E: Onion-Weed	Liliaceae	N/H	Aerial parts used as vegetable and dry seeds in condiments. Seed flour used in making chapatti.
51	<i>Bambusa vulgaris</i> Schrad.ex. J.C.Wendl.	Bans, Bainj	H: Bans E: Common bamboo	Poaceae	E/H	Young shoots are used to prepare vegetable and pickle.
52	<i>Boerhavia diffusa</i> (L.) nom. Cons.	Utshat	H: Punamava E: Hogweed	Nyctaginaceae	N / H	The leaves are cooked as vegetable. Also used with other edible vegetables to prepare a mixed vegetable.
53	<i>Centella asiatica</i> (L.) Urban	Brahmi	H: Brahma manduk E: Indian Pennywort/ Coinwort/ Asiatic coinwort	Apiaceae	N/H	Whole plant is used to prepare a juice for enhancing memory power. Raw leaf is eaten freshly.
54	<i>Chenopodium giganteum</i> D. Don.	Bara bathu	H: Bathu E: Tree spinac	Chenopodiaceae	N/H	Leaves cooked as vegetable or local dish sag.

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55	<i>Chenopodium album</i> L.	Kunna/Bathu	H: Bathua or Bathuwa E: Goosefoot	Chenopodiaceae	E/H	Leaves or young shoots are cooked as vegetable ie sag in a local preparation. Leaves are also used to prepare chapati and parantha.
56	<i>Commelina benghalensis</i> L.	Chhura	H: Kanchara E: Day Flower/ Dew Flower	Commelinaceae	E/H	Leaves are cooked as vegetable.
57	<i>Digera muricata</i> L. Mart.	Chaulai	H: Chaulai E: False Amaranthes	Amaranthaceae	E/H	Young leaves cooked as vegetable and raiyta.
58	<i>Euphorbia heterophylla</i> L.	Dudhali	H: Bari Dhudi E: wild poinsettia	Euphorbiaceae	E/H	Leaves are used as vegetable ( Bhujia).
59	<i>Ocimum basilicum</i> L.	Bashala	H: Basil/ Bhabri E: Sweet Basile	Lamiaceae	N/H	Leaves are used for flavouring dal and traditional dishes.
60	<i>Oxalis corniculata</i> L.	Khatti- Mithi	H: Teen Patia E: Yellow wood sorrel	Oxalidaceae	E/H	Whole plant used to prepare chuttney.
61	<i>Oxalis rubra</i> A.St.Hil.	Khatti Mithi	H: Teen Patia E: Window box Wood sorrel	Oxalidaceae	E/H	Leaves and young shoots are used to prepare Vegetable and chuttney.
62	<i>Physalis peruviana</i> L.	Dophalu	H: Dophali,Rasbhari E: Cape Gooseberry	Solanaceae	E/H	Ripened fruits are eaten freshly.
63	<i>Portulaca oleracea</i> L.	Naneria	H: Khursa/Kulfa E: Common purslane/ Verdolaga,	Portulacaceae	N/H	Whole plant is used to prepare vegetable and also prepared vegetable with pulses of black gram.
64	<i>Fragaria vesca</i> L.	Van Aakha	H: Van aakha E: wild strawberry	Rosaceae	E/H	Ripened fruits are eaten.
65	<i>Rumex hastatus</i> D.Don.	Bari Khatti Buti	H: Churki/Churka E: Arrow leaf Dock/Yellow Sock	Polygonaceae	E/H	Leaves and young shoots are used to prepare vegetable and chuttney.
66	<i>Solanum nigrum</i> L.	Karyaun miyaun/Jangli Mirch	H: Mokoi E: Black nightshade/ Black-berry night shade	Solanaceae	N/H	Ripened fruits are eaten and young leaves are cooked as vegetable.
67	<i>Spilanthes acmella</i> L.	Akarkara/ Karkara	H: Akarkar, Pipulka E: Toothache Plant/Para cress	Asteraceae	E/H	Flowers are eaten fresh.
68	<i>Trianthema portulacastrum</i> L.	Shanti	H: Shanti/ Safed punarnava	Aizoaceae	E/H	Leaves are eaten as vegetable.
69	<i>Viola serpens</i> Wall.ex. Roxb.	Banafsa/Banaksha	H: Banafsha E: Himalayan White Viola	Violaceae	N /H	Flowers are used to prepare hot drinks like tea.
70	<i>Bauhinia vahlii</i> Wight & Arnott, Prodr.	Taur	H: Malu/ Jallaur/Jallur/ Mahul E: Maloo Creeper	Fabaceae	N/C	Roasted seeds are eaten by the local people in past and use has been declined at present. The roasted seeds provide strength to body or act as body tonic.
71	<i>Celastrus paniculatus</i> Willd	Sankheru	H: Malkanghni E: Black oil plant	Celastraceae	N/C	Oil extracted from mature seeds, also seeds and flowers used as vegetable.
13E0072	<i>Coccinia grandis</i> L.	Kundru	H: Kunduru E: Ivy Gourd	Cucurbitaceae	N/C	Fruits are used as vegetable.
73	<i>Cucumis callosus</i> (Rottl.) Cogn.	Kachari/ Phutanu	H: Kachari E: Bitter Cucumber	Cucurbitaceae	-	Ripe fruits are tasty eaten as raw and vegetable, fruit are digestive. In off season dried fruits are used to prepare vegetable and chuttney.
74	<i>Dioscorea bulbifera</i> L.	Tararian/Jangli Aloo	H: Jangli Aloo, E: Aerial yam, Air potato, Wild yam	Dioscoraceae	N/C	The tubers are edible after processing. After removing small rootlets, the tubers are boiled in water, cooled down and skin is removed. Then they are cut into small slices. These slices are put in container or perforated basket; kept in stream of water to remove the acrid contents of the tuber. Also, chips can be prepared. Used in form of vegetable.

75	<i>Dioscorea deltoidea</i> Wall. ex Kunth.	Singhali-minghali	H: Shingalimngali E: Dioscorea/ Elephant foot/Yam	Dioscoraceae	N/C	Tubers are used as vegetable as dry as well as curry.
76	<i>Dioscorea alata</i> L.	Junglee aloo	E: Wild Yam/ Purple Yam	Dioscoraceae	E/C	The tubers are edible after processing as vegetable.
77	<i>Duchesnea indica</i> (Andrews) Focke	Van aakha	H: Kiphaliya E: Indian strawberry/ Mock strawberry	Rosaceae	N/C	Fruits are eaten freshly.
78	<i>Luffa operculata</i> Cogn.	Van tori	H: Jangli Tori E: Ridge cucumber	Cucurbitaceae	N/C	Cooked as vegetable
79	<i>Momordica dioica</i> Roxb. ex Willd	Kakora	H: Meetha Karela / Kankeda/ Poraru E: Spine Gourd	Cucurbitaceae	E/C	Fruits used as vegetable
80	<i>Melothria</i> <i>heterophylla</i> (Lour.)	Bon Kaduri/Jangli Kakri	H: Kaduri E:Creeping Cucumber	Cucurbitaceae	N/C	Fruits are edible.
81	<i>Mucuna pruriens</i> (L.) DC. Prodr.	Durangal	H: Kiwach E: Velvet bean/Cowitch	Fabaceae	N/C	Unripe pods are used to prepare vegetable and seeds are used for preparing dal curry.
82	<i>Pueraria montana</i> (Lour.) Merr.	Salod/ Banaar	H:kudzu E: Kudzu vine	Fabaceae	N/C	Young tubers are eaten without any processing.
83	<i>Sechium edule</i> (Jacq.) Sw.	Loku	H: Chayote E: Chow-Chow	Cucurbitaceae	E/C	Fruits are cooked as vegetable and sour fermented preparation as salads.
84	<i>Trichosanthes</i> <i>cucumerina</i> var. <i>cucumerina</i> L.	Mais	H: Charchinda/Chichonda E: Round Gourd	Cucurbitaceae	N/C	Fruits are cooked as vegetable.
85	<i>Trichosanthes</i> <i>cucumerina</i> var. <i>anguina</i> (L.) Haines	Pandol	H: Charchinda/Chichonda E: Snake Gourd	Cucurbitaceae	N/C	Fruits used as vegetable.

O= origin, LF = Life form, N= Native, E= exotic, T= tree, S= shrub, H= herb, C= creeper, H= Hindi, E= English

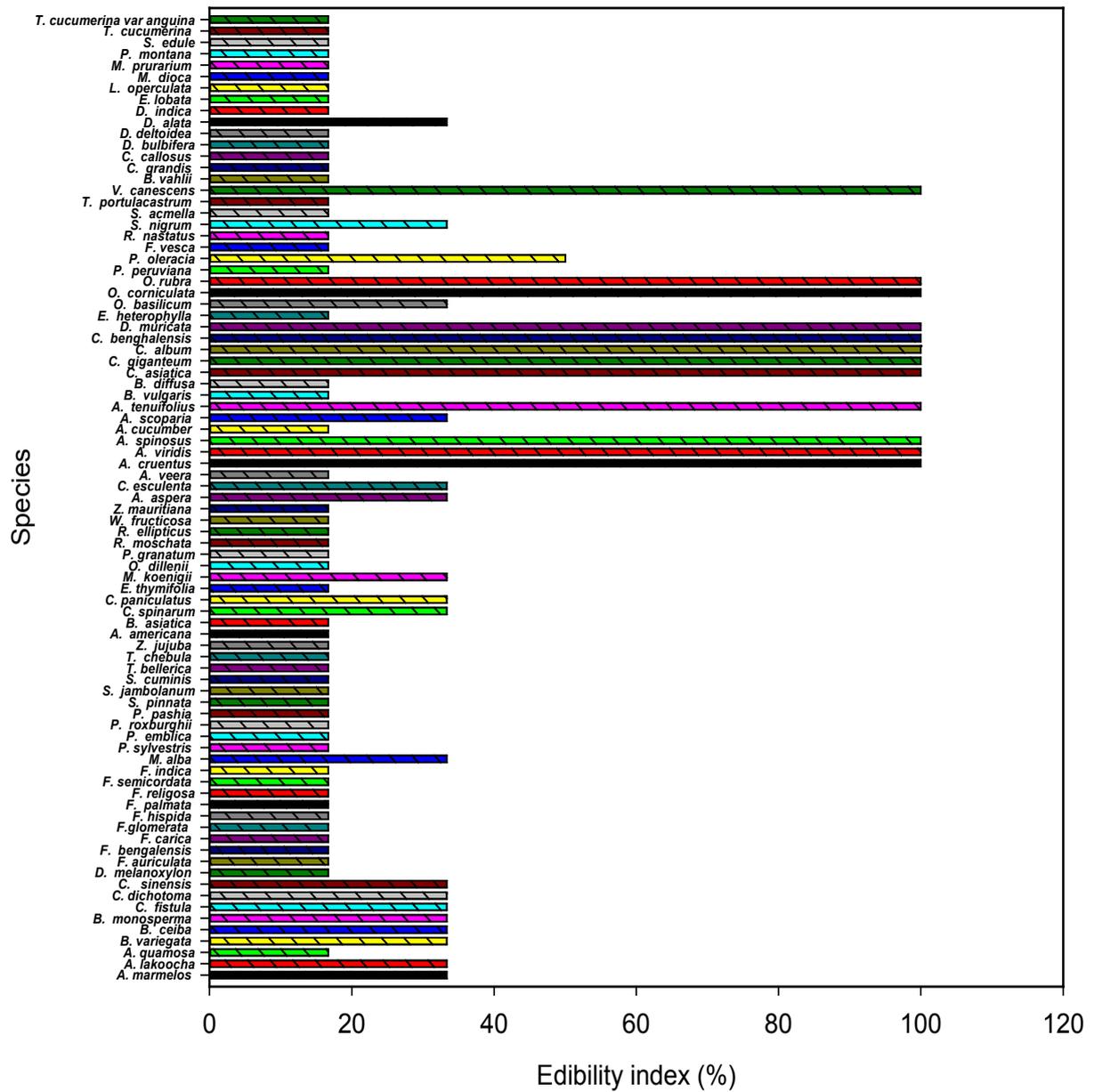


Figure 4. Edibility index (EI) of recorded plant species at research site.

### 3.2. Edibility Index

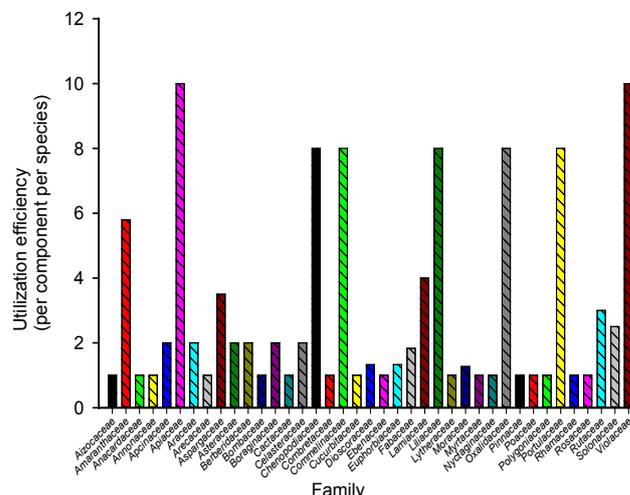
Edibility index (EI) is one of the important indices which may give authentic information of edible sense of each species. EI was calculated and represented on a percent base weighted score. It has been developed on a component-wise use of each plant species which categorized into several components like root, stem, shoot, leaf and flower etc. Therefore, whole plant components were scored on a scale of 10-100 percent (Table 2). Out of total 85 species, 2 species showed hundred percent, eighty percent by 11 species, 40 percent by 3 species and remaining other species (69) showed 10-30 percent, respectively (Figure 4).

**Table 2.** Component wise use scale applied for calculation of edibility index of plant species at Hamirpur district, Himachal Pradesh. Each component use is allocated to the percent use of whole plant.

S. No.	Component	Scale (%)
1.	Flower and flower bud	10.0
2.	Fruit	10.0
3.	Seed	10.0
4.	Leaf	10.0
5.	Stem and stem shoot (bark included)	10.0
6.	Root and tuber	10.0
7.	Resin	10.0
8.	Gum	10.0
9.	Whole Aerial Part (WAP)	80.0
10.	Whole Plant (WP)	100.0

### 3.3. Utilization Efficiency

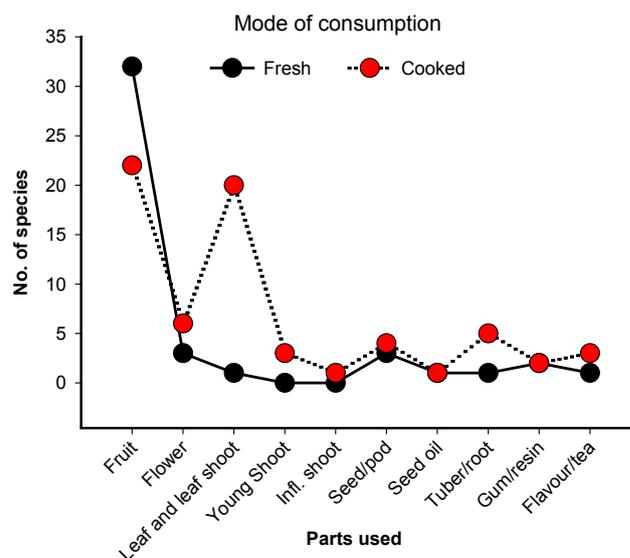
Another index i.e. utilization efficiency (UE) per species per component is constructed in this study. UE was calculated on the basis of plant parts used of all recorded edible species within a family divided by total number of species recorded of each family. Values estimated for maximum utilization efficiency will be not more than 10 and not less than 1 for each family; therefore, recorded values of UE across family will be ranged from one to ten. Highest utilization efficiency (10) was found in two families: (Apiaceae and Violaceae) which indicates hundred percent utilization of all components for edible purposes, after that, corresponding values for collected members of five families (Chenopodiaceae, Commelinaceae, Liliaceae, Oxalidaceae and Portulacaceae) have shown eight utilization efficiency which is significantly better than other remaining families (17) in which UE is only one which indicate at least one component is edible; while 14 families had more than one and less than four UE (Figure 5). Exceptionally, only one family (Amaranthaceae) had 5.8 UE score because the family members are herbaceous in nature and they had better utilization as leafy vegetable (Figure. 5).



**Figure 5.** Family-wise utilization efficiency of recorded plants. Values presented in the graph are calculated based on family-wise total no. of plant parts used divided by total number of plant species of each family.

### 3.4. Mode of Consumption

Consumption of wild plants for the food purposes are perhaps storehouse of traditional knowledge acquired by local people. It was observed in this study that consumption mode of various plant parts were used as mainly as fresh or cooked form. Maximum numbers of wild plants as fruits are generally eaten raw when they ripe and usually unripe fruits, seeds, flowers and leaves are cooked as vegetables (Figure 6). Across component-wise use, highest number of edible species was used as fruits eaten as raw as well as cooked followed by other components. However, leaf and leaf-shoot were used as cooked for vegetable, which was the most applicable consumption mode after fruits. Although, other components such as tubers, young stem-shoots, seeds/pods etc. are minimally used.



**Figure 6.** Component-wise consumption mode of edible plant species

In case of certain edible plants, conventional and non-conventional processing is essential to make it palatable. For example, shoots of Bamboo, Agave and Thor shoots (*Euphorbia royleana*) are peeled off or outer hard part is removed, cut into small pieces, then boiled in water to remove its bitterness, then fried and cooked. However, some plants can be directly consumed without processing. Underground parts or tuber require washing, slicing and boiling for particular time to discard the acrid content of the tuber. Leaves of Jangli Kachalu (*Colocasia esculenta*) are steamed before cooking into vegetable. Flower buds of Kachnaar (*Vauhinia variegata*) is boiled in water, squeezed off and then cooked into vegetable.

## 4. Discussion

### 4.1. Edible Plant Diversity and Its Edibility

Wild edible plants are the alternative source of food which plays an important role to meet the nutritional requirements of the local people in remote or rural areas of India as well as in the other developing countries of the world. The documentation of traditional knowledge on utilization by the local people of wild plants and its nutritive values is one of the main objectives of this study as the most of traditional information of these plants is still poorly documented. At global level, particularly developing countries, large number of population do not have sufficient food for their daily need. Moreover, the food they consume is deficient of nutrients [24]. The present study indicates the potential of underutilized plants as the source of non-conventional food which can be good source of potential food supplements and cheaper alternative food across the hilly regions [3]. In addition, many of these plants are rich in minerals and vitamins and may act as potential nutraceutical supplements. Consumption of these fruits, vegetables is known to lower the risk of several life style diseases such as cardiovascular disease, cancer, diabetes, stroke etc. ([18], [3]).

Himalayan region is the main storehouse of wild edible plants as it is evident through the studies ([25], [16]). In present study, 85 edible plant species were explored from selected sites. On the basis of plant parts used; out of 85 species, maximum plant species are utilized as fruit (45 species) followed by leaf (13 species), whole aerial part (WAP, 12 species), flower/ inflorescence (9 species), seeds (6 species), tuber (6 Species), stem-shoot (3 species), whole plant (WP, 2 species) and 2 species as gum and one species as resin (Figure. 7). In conformity with this, Sharma et al.[20], reported 25 wild edible plants used as fruit, 22 as leaf and 13 used as root from Mandi district, Himachal Pradesh confirms that edible wild plants have substantial access to search food for future prospect.

Some plants have shown substantial edible quality that might be a good hope for searching new quality-wise edible plants particularly rich with nutritive values. Literature survey indicates that study concerning exploration and documentation of wild edible plants in India is certainly not a

new task, it is perhaps linked with scale of pre-historic developmental period. However, the research conducted on such plants is not comprehensive and integrative e.g. Sehgal and Sood, [26] reported nutritional components of only one wild edible fruit (*Ziziphus jujuba* Mill.) and moreover some studies have been reported on medicinal, traditional and ethno botanical aspects but not focused on diversity and status of underutilized edible plants in the same region. Kumar and Choyal [27] recorded 16 plants traditionally used for curing snake bites by the Local rural people and ethno botanical notes of 26 plant species[28]; 91 plant species used for curing different ailments by Sharma et al.,[20] and Devi et al.,[29], recorded 20 plants from Fabaceae and Solanaceae families for ethno-medicinal purposes.

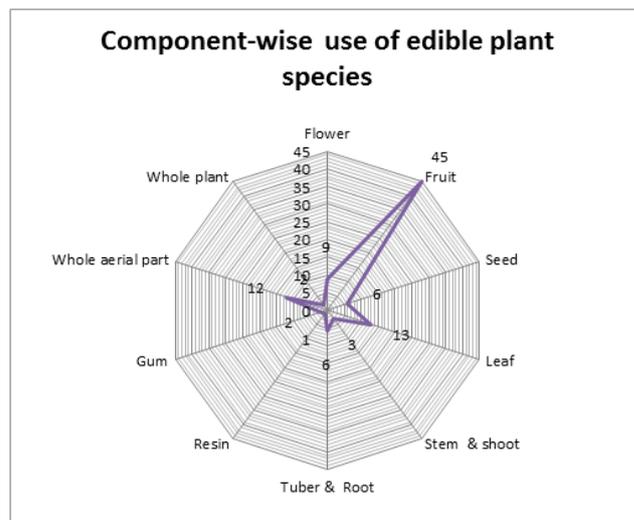


Figure 7. Component-wise use of edible plant species

Species documented in present study are of various life forms, of which, majority of species are trees followed by herbs, creepers and shrubs. Family-wise distribution of the recorded plants revealed 39 families; of which, highest number of species belong to family Moraceae (11) followed by Cucurbitaceae (8) Fabaceae (6), Amaranthaceae and Rosaceae (5), Many families (14 in total) had 2 to 4 species and remaining other 20 families have minimum no. of one species. In conformity with this, 9 species of Moraceae family were reported by Sharma and Mishra [22], (study was conducted at Bilaspur district in Himachal Pradesh).

It is widely accepted that traditional knowledge is very valuable resource which may provide useful leads for scientific research [21]. Most of wild edible or underutilized plants traditionally consumed either as raw fruits, cooked leafy and tuber vegetables having nutritive rich elements diets which can compensate dietary deficiency of nutrients and vitamins necessary for human [30]. In the present study, it was observed that consumption mode of various plant parts were used as mainly cooked or as fresh; of which, maximum numbers of wild plants as fruits are generally eaten raw when they ripe and also unripe fruits, seeds, flowers and leaves are used as cooked in form of vegetables (described in Figure 6). Across component-wise usage, highest number of species

(45) was used as fruits followed by other components like leaf (13), whole aerial part (12), flower (9), seed (6), tuber and root (6), gum & resin (4) stem & shoot (3), and whole plant (2), respectively (Figure. 7). In this study, however, consumption of leaf and leaf shoot as cooked vegetable was major mode of consumption after fruits. Sharma et al. [20], who conducted a study on wild edible plants in Mandi district, Himachal Pradesh, also reported that maximum species (25 spp.) were used as fruits followed by leaves (22 spp.) and roots (13 spp.). Based on general perceptions of the local people, fruits are indeed rich source of protein and energy; therefore it can be used to combat malnutrition [31]. However, after fruits and leaf, other parts like tubers, young shoots and inflorescence shoots etc. are less consumed e.g. *Dioscorea bulbifera*, *D. deltoidea*, and *Pueraria montana* used as tuber, and *Euphorbia royleana*, *Bambusa vulgaris* and *Agave amaricana* as young stem and young inflorescence whereas, *Achyranthes aspera*, *Amaranthus cruentus*, *Bauhinia vahlii*, *Pinus roxburghii*, *Celastrus paniculatus* as seed and *Butea monosperma*, *Cordia dichotoma*, *Cordia sinensis* and *Berberis asiatica* are used as gum & resin. In addition to this, young pods of *Cassia fistula* is used to prepare pickle and Murabba (a preparation of sweet jelly) and young shoots of *Euphorbia royleana* are being used to prepare vegetable by local people; this is perhaps a new kind of use not reported in literature. It is noted that some plants are commonly available throughout the region, therefore, use and applications of following species for food purposes are more harnessed by local people, such as: *Aegle marmelos*, *Bauhinia variegata*, *Cordia dichotoma*, *Ficus carica*, *Ficus palmata*, *Phyllanthus emblica*, *Pyrus pashia*, *Syzygium cuminii*, *Berberis asiatica*, *Punica granatum*, *Morus alba*, *Murraya koenigii*, *Colocasia esculenta*, *Amaranthus viridis*, *Amorphophallus paeoniifolius*, *Centella asiatica*, *Chenopodium album*, *Digera muricata*, *Ocimum basilicum*, *Viola serpens*, *Celastrus paniculatus*, *Dioscorea deltoidea*, *Momordica dioica* etc. Due to several reasons, the use of some plants is day by day declining; however, more specifically it was observed that local people are changing traditional living

style and adopting modern lifestyle rapidly, therefore, exploration regarding edibility and nutrient components of the wild plants is an urgent need of the hour. Furthermore, which can be a basis to solve the problem malnutrition especially in developing countries where malnutrition and food security are main issues [32]. Moreover, conservation and harnessing of those useful wild species can be taken for future prospects.

#### 4.2. Role of Edible Plant Species on Human Health Issues

In general, those wild plant species have been reported across tropics or any habitat from the globe having certain amount of medicinal sense. Since wild edible plants have played an important role in human life since time immemorial particularly in the rural and tribal communities, who depends upon wild food resources to get food and remedies of ailments. Therefore, it is again pressure on tribal communities who are residing in remote, mountainous and adjacent to the forest areas where no proper facilities of transportation and any kind of health care system is available. Hence, local and tribal communities are bound to search wild flora for food and medicinal purposes.

However, main objective of our present study was to explore edibility assessment of the underutilized wild flora because information concerned to this is substantially lacking while a significant number of documents are found in literature on ethno medicinal and ethno-botanical purposes, therefore, we found medicinal uses of almost all recorded species in the literature. Details are given in the Table 3. Many of the edible wild plants that are included in local food baskets have both therapeutic (medicinal) and dietary functions. In addition, several wild edible plant species having rich macro and micronutrients qualities with antimicrobial and antioxidant properties, which are essential to check diseases and for better health. From a nutritional viewpoint, it is important to pay attention to this group of traditional foods for several reasons. Their direct nutritional contribution is often significant but neglected and not well understood.

**Table 3.** Potential role of wild edible plants on Human health related problems and source of minerals enrichment. Present information of recorded wild edible plants assembled from literature is given in this table.

Sr. no	Plant Species	Diseases	Source
1	<i>Aegle marmelos</i>	Abdominal pain, Constipation, Asthma and Sexual debility, Dysentery, Vitamin C.	([34], [35], ([36], [37])).
2	<i>Achyranthes aspera</i>	Pneumonia, Weakness, Fever, Cough and Cardiac tonic, Hydrophobia, Diuretic and Abortion	([34], [38], [35], [39]).
3	<i>Aloe vera</i>	Jaundice, Stomach problems and Burning sensation	[39].
4	<i>Amaranthus spinosus</i>	Boils, Snake bite, Toothache, Piles and Iron , Zinc rich	([38], [40]).
5	<i>Amaranthus viridis</i>	Constipation, Piles, Bronchial problems, Eye vision, Cooling, Laxative, Leucorrhoea, Snake bite, Antipyretic, Leprosy, Burning sensation and Iron, Zinc rich	[40]
6	<i>Artemisia scoparia</i>	Burns	[38]
7	<i>Bauhinia variegata</i>	Abdominal tumor and rich in Potassium and Calcium	([37], [40])
8	<i>Berberis asiatica</i>	Blood purifier, Cooling, Laxative, Diaphoretic, Stomach, Diarrhoea, Piles, Eye infection, Fever, Ulcer, Skin diseases, Rheumatism, enlargement of spleen, Cholera and Dyspepsia	[39]
9	<i>Boerhavia diffusa</i>	Eye swelling and watering of eyes, Jaundice, Night blindness, Eczema, Rheumatism and Abortifacient	([34], [35], [38])
10	<i>Bombax ceiba</i>	Skin diseases, Pimples, Leucorrhoea, Menstrual disorder, Urinary problems and Tonic	([35],[36],[37])
11	<i>Butea monosperma</i>	Cuts, Wounds, Swelling, Bone fracture, Leucorrhoea and Bleeding at the birth of child	([34],[35],[37])
12	<i>Carissa spinarum</i>	Constipation, Indigestion and Appetizer	[41]
13	<i>Cassia fistula</i>	Paralysis, Rheumatism, Jaundice, Wound, Eczema, Headache and Acidity	([37], [42]).
14	<i>Celastrus paniculatus</i>	Rheumatism Increase memory and Headache	([35], [36]).
15	<i>Centella asiatica</i>	Increases memory, Fever and Cardiac problem	([36], [42]).
16	<i>Chenopodium album</i>	Stomach pain Swollen gum and Zinc rich	([36], [38], [40]).
17	<i>Coccinia grandis</i>	Cough, cold, Diabetes and Throat infection	([36], [37]).
18	<i>Colocasia esculenta</i>	Atrophy, Cough and Bronchial disorder	[37]
19	<i>Commelina benghalensis</i>	Leprosy and epistaxis , Epilepsy, Stomach disorder, Eye sore, Treating sterility Throat sore and Calcium rich	([37], [40]).
20	<i>Cordia sinensis</i>	Mouth ulcer and Indigestion	([35], [37]).
21	<i>Cordia dichotoma</i>	Mouth ulcer and Indigestion	([35], [37]).
22	<i>Digera muricata</i>	Boils	[34]
23	<i>Dioscorea bulbifera</i>	Intestinal Worms, Abdominal Pain, Boils, Bone fracture, Piles, Dysentery Calcium and Potassium rich	([35], [37], [40]).
24	<i>Dioscorea deltoidea</i>	Dysentery Piles, Calcium and Potassium rich	([43], [40]).
25	<i>Diospyros melanoxylon</i>	Urinary and Heart diseases and Antidysentric	[37]
26	<i>Duchesnea indica</i>	Cuts, Eye diseases, Swelling and Ulcer	[43]
27	<i>Euphorbia thymifolia</i>	Skin diseases, Bone fracture and Eye problems	[43]
28	<i>Ficus auriculata</i>	Cause infertility	[37]
29	<i>Ficus benghalensis</i>	Piles, Boils and blisters, Spermatorrhoea, Snake bite and Sexual potentiality	([38], [37]).
30	<i>Ficus carica</i>	Boils, Eruption, Skin disease, Gastric problems, Cancer, Wart, Inflammation and Calcium rich	([37], [40]).
31	<i>Ficus glomerata</i>	Diarrhoea, Bleeding piles and Acidity	[44]
32	<i>Ficus hispida</i>	Leucoderma	[37]
33	<i>Ficus palmata</i>	Constipation, Lung , Bladder diseases; Calcium rich	([40], [45]).
34	<i>Ficus religiosa</i>	Ulcers, Asthma, Fistula of annus, Prevent conception, Skin diseases and Abortifacient	([38], [36]).
35	<i>Flacourtia indica</i>	Antidote	[37]
36	<i>Fragaria vesca</i>	Menstrual problems, Laxative and Purgative	[41]
37	<i>Luffa operculata</i>	Jaundice	[37]
38	<i>Momordica dioica</i>	Blood purifier, Diabetes and Eye infection	[37]

39	<i>Morus alba</i>	Sore throat, Dyspepsia, Anthelmintic, Purgative and Vermifuge	[41]
40	<i>Mucuna prurarium</i>	Mental and renal disorder, Snake bite, Diuretic, Constipation, Purgative and Aphrodisiac	([43], [44]).
41	<i>Murraya koenigii</i>	Dysentery, Diarrhoea, Malarial fever, Tonic, lactation and Anthelmintic	[41]
42	<i>Ocimum basilicum</i>	Increases potency in men	[37]
43	<i>Oxalis corniculata</i>	Skin diseases, Toothache, Piles, Anemia and Calcium rich	([42], [44], [40]).
44	<i>Oxalis rubra</i>	Dysentery, Fever, Insect bite, skin disease and Stomach problem	[43]
45	<i>Phoenix sylvestris</i>	Heartburn, Loss of consciousness and vertigo	[37]
46	<i>Phyllanthus emblica</i>	Constipation, Dysentery, Leucorrhoea, Stop bleeding, Hypertension and Vitamin C rich	([34], [38], [40]).
47	<i>Physalis peruviana</i>	Earache, Spleen disorder, Gastric and Stomachache	([36], [44]).
48	<i>Pinus roxburghii</i>	Cuts, Wounds, Antibacterial and Cracks on feet	[45]
49	<i>Portulaca oleracea</i>	Cardiac stimulant, Skin burning, Sores, Cough, Burn, Earache, Febrifuge, Diuretic	[40]
50	<i>Pueraria montana</i>	Abdominal pain, antiemetic, Asthma, Body ache, Cholera and Diarrhoea	[37]
51	<i>Punica granatum</i>	Cough, Cold, Cardiac tonic, Bleeding nose, Brain affection, Dysentery, Diarrhoea, Worms and Source of Vitamin C	[39]
52	<i>Pyrus pashia</i>	Swelling and Cuts	[43]
53	<i>Rosa moschata</i>	Eye troubles, Joint pain, Diarrhoea, Ophthalmia and Wounds	([39], [43]).
54	<i>Rubus ellipticus</i>	Laxative	[39]
55	<i>Rumex hastatus</i>	Stomachic, Astringent, Carminative, Dysentery, Jaundice and Calcium rich	([40], [41]).
56	<i>Solanum nigrum</i>	Liver Complaints, Blood purifier, Antidote, Boils, Antiemetic, Diarrhoea, Eye infection and Hydrophobia	([37],[40])
57	<i>Spilanthes acmella</i>	Mouth and throat affection, Tongue paralysis and Stammering in Children	[39]
58	<i>Syzygium cuminii</i>	Diabetes, Anti dysentery, Headache, Increase appetite, Blisters in mouth, Cancerous sore, Carminative, Diuretic	([37], [44]).
59	<i>Terminalia bellirica</i>	Asthma, Cold & Cough, Leprosy, Liver complaint, Stomach problems, Piles, Liver, Fever. Rheumatism and Purgative	([37], [44]).
60	<i>Terminalia chebula</i>	Body heat	[42]
61	<i>Trichosanthes cucumerina</i> var. <i>cucumerina</i>	Bronchial problems and Heart diseases	[37]
62	<i>Viola canescens</i>	Cough, cold, Asthma, Bronchial, Eye problems and Asthma	([39], [43]).
63	<i>Woodfordia fruticosa</i>	Diarrhoea, Asthma, Boils, Rheumatism, Tonic in weakness in pregnancy, Fever, Night blindness, Cough, Dysentery and Cholera	([37], [43], [44]).
64	<i>Ziziphus mauritiana</i>	Fever, Blood purifier, Diarrhoea and Digestive disorder	[37]

Due to insufficient scientific evidences on about health benefits of regular consumption of small quantities of medicinal foods, many of important medicinal plant species from wild regions are still waiting for proper diagnosis and investigation. According to Abbasi et al. [40], the traditional plant medicines may be the contribution of small quantities of trace minerals and vitamins. Further, they expressed that wild plants are found in uncultivated land, such as forests, which have not been depleted of minerals, and also act as alternative source of micro-nutrients for cultivated crops [46]. Many studies revealed that consumption of wild edible plants might be an important mediator for curing different disease and may be fed as food supplements to chalk out and fill the gap of deficient food in mineral and micro-nutrients([34], [35], [36], [40]). Wild edible plants could prove clinically useful for improving the health and disease outcomes among the food insecure. Documentation of these plant species, traditional uses, nutritive and

medicinal properties, ecological status could benefit the health of human and animals in the societies. The current research suggests that wild edible plants should be considered in studies examining health concerns in food insecure populations.

## 5. Conclusions

The existing observations indicate that the local people of Hamirpur district of Himachal Pradesh, India who are particularly living in remote and high altitude areas mainly rely upon the plant resources adjacent to their surroundings to meet their day-to-day requirements. But today new generation is continuously forgetting the use of local recourses as food and depends upon staple food plants only. To replace the existing burden on staple crops to meet the need of whole population, there is an urgent need to explore

other alternative food plants having rich potential and excellent source of energy. For this, nutritional prospects of the plants need to be worked out which can help to overcome the nutritional deficiencies especially in remote areas.

In conclusion, in this study, we found that maximum numbers of wild edible plants are used as fruit and leaf followed by other components. Generally, fruits are eaten as raw when they ripe and usually unripe fruits, seeds, flowers and leaves are cooked as vegetables. Majority of edible plants do not require processing whereas some plants need to be processed. Therefore, there is also a need to find out the traditional method of food processing and status of nutrients after processing in addition to documentation and exploration of wild plants for better edibility, investigation for their role in maintaining aesthetic ecosystem and environment for local people. The Food and Agricultural organization (FAO) already recognizes that 'nutrition and biodiversity converge to a common path leading to food security and sustainable development 'can play as a key role in global nutrition security' [5].

## Competing Interests

Authors declare that they have no competing interests

## Authors' Contributions

ANS designed experimental establishment, RCB performed field study and drafted manuscript, CN helped in preparation and finalized manuscript. All authors have equal role in preparation and finalizing the manuscript.

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