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A case study on usage patterns of wild edible plants in sacred groves of Kumaon Himalaya

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Abstract

There are a large number of sacred groves in Kumaon Himalaya where grows a huge variety of wild edible plants valued for medico-nutritional needs. Present research was carried out in four famous sacred groves of Kumaon. The purpose of the study is to document the wild edible plants found in the sacred groves along with the associated indigenous knowledge for different medicinal purposes. The research is based on extensive and frequent field surveys using semi-structured questionnaires, group discussions and personal interviews. The most utilized plant parts were fruits (90%) followed by bark (40%) and flowers (30%). The WEPs were used to treat various ailments like asthma, diarrhoea, jaundice, urinary disorders etc. *Myrica esculenta* is found to be the most important WEP with maximum number of phytochemicals (19%) followed by *Berberis asiatica* and *Pyrus pashia* with 14% and 13% respectively. It is concluded that wild edible fruits and berries are essential for supplying nourishment, to ensure food security and choice of living in the Himalayan region. Consequently, some of the species are being used on a large scale and are thought to be capable of offering alternative means of subsistence to the marginal groups of community residing in remote areas.

Keywords: Biodiversity, Nutrition, Sacred groves, Traditional knowledge, Wild edibles.

Introduction

Wild edible plants are thought to be a possible alternative and means of overcoming food insecurity on a global scale. There is an increasing trend of worldwide interest to investigate and gather plant germplasm that may become economically viable in near future (Rapoport et al., 1995). Listings of plants with ethnobotanical worth are significant for understanding and assessing the relationship between plant diversity and their environment (Bye, 1979). About 150 species of plants have ever been cultivated throughout the history of human civilisation

while nearly 3000 plant species have been used as sustenance. It is anticipated that a great variety of flora will still need to be studied for their potential uses. India is a home to 45,000 different plant varieties; 17,000 of which are flowering plants with 60% of them being endemic to various climatic zones and landscapes (Chatterjee, 1940).

Sacred groves are found all over the world, and different cultures have their own methods of recognising them and encoding different rules for their protection. Due to the region's diverse geographic, physiographic, topographical, climatic, and ecological zones, Himalayan regions are highly rich in biodiversity. The tribal people of the Himalayas use a variety of plant species for food (Gangwar and Ramakrishnan, 1989). Sacred groves are diverse virgin forests that have been long protected by the locals due to their cultural and religious beliefs that the deities reside there and guard the residents from various disasters. Every sacred grove has its own customs, myths and tales that serve as the foundation for the grove and play a vital part in encouraging the sustainable use and preservation of the local flora and animals as well. There are many sacred groves in India, particularly in the places where the indigenous communities reside. The area of sacred groves range from a few square meters to several hectares and situated in different altitudinal gradients and natural ecosystems which help in the conservation of biodiversity (Devi Khumbongmayum et al., 2005). In some of these sacred groves, a number of threatened plants and animals are still well preserved. Numerous medicinal plants that are lacking in the forests are abundant in sacred groves. Additionally, sacred groves are home to rare, endangered, threatened, and endemic species.

Any region or place that has diverse and dense forest region protected by the residents and indigenous populations and linked to their religious convictions, traditional values, and taboos can be selected as a sacred grove. Sacred groves can be chosen for the study based on a variety of criteria, including forest type, altitude range, area, god worship, taboos, management status, etc. The sacred groves can either be pure forests (with a single tree species) or mixed forests (with a variety of tree species), depending on their type. The traditional indigenous knowledge is passed from one generation to other (Bhushan and Kumar, 2013). The traditional knowledge collected from the local inhabitants may have practical implications for the discovery of new medicines to treat a particular ailment (Bharati and Kumar, 2014; Kumar and Shukla, 2014). In Uttarakhand, wild fruits are extremely important from culinary and health perspectives. The sacred groves of Uttarakhand cater a variety of wild edibles, such as Bedu (*Ficus palmata*), Timla (*Ficus auriculata*), Melu/Mehal (*Pyrus pashia*), Kaphal (*Myrica esculenta*), Dadim (*Punica granatum*), Karonda (*Carissa*

carandas), Ber (*Ziziphus mauritiana*), Wild Amla (*Emblica officinalis*), Apricot (*Prunus armeniaca*), Hinsar (*Rubus ellipticus*), Bhimal (*Grewia optiva*), Gular (*Ficus racemosa*), Bhilmora/Bhamora (*Berberis asiatica*) and many others. Wild fruits are a great source of vitamins and antioxidants. The aim of the present study is to document the wild edible plants found in the sacred groves along with their indigenous knowledge, medicinal, nutritional and phytochemical properties.

Materials and Methods

The Study Area

Uttarakhand is a western Himalayan state of India that lies between 28°53'24"-31°27'50" N latitudes to 77°34'27"-81°02'22" E longitudes. It is also known as the "Land of Gods" due to its huge coverage of holy places and temples. Uttarakhand is home to diverse flora and fauna, many of which are protected by sanctuaries, national parks, reserves and sacred groves. The present study was carried out at Banari Devi, Shyahi Devi, Jhakar Sem and Jageshwar which are most famous sacred groves of Kumaon region situated in Almora district (Figure 1).

Banari Devi is a mixed forest situated at an altitudinal range of 1700-2000 m covering an area of 4 to 5 hectares. The dominant tree species of this sacred grove are *Pinus roxburghii*, *Quercus leucotrichophora*, *Rhododendron arboreum*, *Myrica esculenta*, *Alnus nepalensis*. The deity worshipped in the sacred grove is Maa Vindhyavasini (Banari Devi). Shyahi Devi is a mixed forest situated at an altitudinal range of 1900-2100 m covering an area of 5 to 6 hectares. The dominant tree species of this sacred grove are *Quercus leucotrichophora*, *Rhododendron arboreum*, *Myrica esculenta*, *Pinus roxburghii*, *Alnus nepalensis*. The deity worshipped in the sacred grove is Durga Maa (Katyayni Devi). Jhakar Sem is a mixed forest situated at an altitudinal range of 1800-2000 m covering an area of 1 to 2 hectares. *Cedrus deodara*, *Quercus leucotrichophora*, *Pinus roxburghii*, *Alnus nepalensis*, *Rhododendron arboreum*, *Myrica esculenta* are the dominant tree species of this sacred grove. The deity worshipped in the sacred grove is Shiva (Sem Devata). Jageshwar is a pure forest situated at an altitudinal range of 1700-1800 m covering an area of 3 to 4 hectares. *Cedrus deodara* is the dominant tree species of this sacred grove. The deity worshipped in the sacred grove is Shiva (Table 1).

Questionnaire based studies and perception of local inhabitants

An extensive field survey was conducted to document the floristic composition and people perception. The informed consent has been obtained from the participants during the present

study. Local inhabitants, villagers and Mandir Samiti members were interviewed from each research site; individuals of all age groups were involved in the perception of the study (Figure 2). The study was focused on the distribution of wild edibles present in these sacred groves, and to investigate the perception of locals towards medicinal and nutritive importance of these wild edibles. The major questionnaire included the wild edibles found in respective sacred groves, their medicinal and nutritive importance, taboos/restrictions followed by local communities and other benefits which the locals procure from these sacred groves. Information was collected from all sacred groves selected for the research work and concluded to find an overall result. In addition phenology of all the wild edible fruits was recorded.

Results and Discussion

Most of the wild edible fruits are significant source of antioxidants, which reduce the chance of ailments by boosting the immunity. People use wild edible fruits as a source of healthy nutrition and as a possible source of phytochemicals, vitamins and minerals. Majorly ten wild edible fruits i.e., *Myrica esculenta*, *Rhododendron arboreum*, *Berberis asiatica*, *Pyracantha crenulata*, *Pyrus pashia*, etc. were recorded from the study area (Figure 3). Similar work on wild edible fruits and their utilization was done in Himalayan region by Sharma et al., 2019a; Joshi and Chauhan, 2018b. Phenology of all recorded species was observed, detailing their growth phases throughout the year. Germination of seeds or active sprouting of buds was observed in March month in almost all recorded WEPs. During the months of April and May, majority of WEPs enter the vegetation phase, marked by rapid growth and development (Figure 4). Similarly seasonal phenology of various wild edible plants was recorded from Himalayan region (Kumar and Bhatt, 2020b; Singh et al., 2019).

Phytochemicals contains a diverse array of compounds including tannins, phenolic compounds, flavonoids, saponins, alkaloids, etc. known for their antimicrobial and therapeutic properties. *Myrica esculenta* contains tannins, flavonoids, alkaloids, phenols, terpenes, etc. and are rich in Na, K, Ca, Mg, Fe, Zn, Mn, Cu. *Berberis asiatica* commonly known as Indian barberry or kilmora contains flavonoids, saponins, tannins, berberine and many other phytochemicals. The plant consists of various mineral elements such as Li, Na, Mg, K, Ca, Cr, Mn, Fe, Ni, Zn, Mo, Ag and Pb. *Pyracantha crenulata* contains glycosides, alkaloids, tannins, saponins, phenols and resin. They are rich in Na, K, Ca, Zn, Cu, Mn and Fe important for maintaining health and preventing deficiencies. *Rhododendron arboreum* is

notable for its phenols, saponins, and steroids, contributing to its medicinal properties, including anti-inflammatory and antimicrobial effects. It contains a wide range of trace elements like Mn, Fe, Zn, and Cu, essential for maintaining metabolic processes (Table 2). Numerous studies on phytochemical analysis, mineral composition and medicinal properties of WEPs were done by Singh et al., 2018b; Kumar and Bhatt, 2020b; Sharma et al., 2019b; Joshi and Chauhan, 2018a. The significant diversity in phytochemicals and mineral content among these wild edibles emphasize their potential role in traditional medicine and modern pharmacology. The presence of various bioactive compounds and essential minerals underscores their importance in supporting health and treating various ailments.

The wild edibles found in the sacred groves are also available on the local market of Kumaun region; however they too are transported to other regions of the country. Not all the wild edibles are marketed as some fruits have the longevity of a very short duration such as *Rubus ellipticus*, *Pyracantha crenulata*, *Ficus auriculata*, *Rhododendron arboreum*, *Berberis asiatica*, *Prunus domestica*, *Prunus persica* etc. as also observed by Negi et al., 2019. Some of the wild edibles are available as a by-product in the local markets and transported to other regions e.g. juice and squash of *Rhododendron arboreum*. Anjeer made from *Ficus auriculata* is an important source of dietary and economy of locals. However, some wild edibles are consumed as vegetable such as *Ficus auriculata*. *Berberis asiatica* is effective in treating diabetes, jaundice, and skin problems. *Pyracantha crenulata* is used against hypertension, skin tanning and the tea prepared from its leaves is beneficial for human body. *Rhododendron arboreum* is beneficial for heart, liver, and diabetes and the flower juice aids menstrual health. The commercial product of Burash is sold in the form of squash. *Ficus auriculata* is good for skin health, boosts immunity, clears constipation and aids weight loss. It is available in the form of Anjeer in market with the cost of Rs. 1100 per kg (Table 3). Similar observations on various wild edibles were done by Joshi and Chauhan, 2018a; Singh et al., 2018a; Negi et al., 2019b; Sharma et al., 2019; Kumar and Bhatt, 2020b; Sharma et al., 2020. These plants are valuable for their wide range of medicinal and nutritional benefits, making them important resources for traditional medicine and potential commercial exploitation.

The wild edible plants are considered as healthy dietary supplements. Phytochemicals are naturally occurring compounds in plants. The main phytochemical compounds found in wild edible fruit plants are flavonoids, tannins, phenols, terpenes, glycosides, saponins and many others. Wild fruits contain a variety of phytochemicals that impart numerous health benefits

and are also used to treat various ailments such as diarrhoea, bacterial, fungal, and viral infections, inflammation, diabetes, asthma, eczema, heart diseases and cancer. Tannins are versatile compounds with applications in treating tonsillitis, pharyngitis, hemorrhoids, and skin eruptions. They are also effective against diarrhoea and intestinal bleeding and serve as an antidote for certain poisons. These properties are evident in plants such as *Myrica esculenta*, *Rhododendron arboreum*, *Berberis asiatica* and among others. Vitamins, found in *Prunus persica*, are essential for cell function, growth, development, and overall health. Organic acids, also present in *Prunus persica*, improve gut health and enhance growth performance (Table 4). It is similar with the studies made by Singh et al., 2018c; Negi et al., 2019a; Sharma et al., 2019c. These wild edible fruits have significant medicinal and nutritional value and are rich in phytochemical content. These plants offer a diverse array of health benefits, supporting their traditional use and potential for future therapeutic applications.

As per the published work, 22 phytochemicals are found in the wild edible fruits mentioned in Table 4. Of which phenolic compounds are dominant followed by tannins and flavonoids. *Myrica esculenta* contains maximum number of phytochemicals (19%) followed by *Berberis asiatica* with 14%, *Pyrus pashia* (13%) and *Pyracantha crenulata* with 10% (Figure 5). Comparative study of phytochemicals on various wild edible plants was done in Himalayan region (Sharma et al., 2019d; Kumar and Bhatt, 2020a). The rural economy of the villagers can be increased as the price of wild edible plants has increased over the years. The production and marketing of these wild edible fruits enhance the economy of the family. Its taste and juicy flavour adds to the flavour. In addition, the nutritive values found in it are good for health and can be used to treat various body problems such as respiratory, gastrointestinal conditions, fever, jaundice, and eye problems. Various plant parts were utilised for ethno-botanical purposes, including leaves, roots, bark, fruits, and flowers, others. The most utilized plant parts were fruits (90%) followed by bark (40%), flowers and leaves (30%), roots and seeds 20% (Figure 6). Similarly numerous ethno-botanical studies of WEPs were recorded by Singh et al., 2018d; Joshi and Chauhan, 2019. There are several promising wild fruit species in the areas, on which a virtuous study needs to be done so that their full nutritional and economic potentials can be realised in a sustainable way.

Conclusion

It is concluded that wild edible plants are one of the most crucial floral components for supplying nourishment and sources of income. Hence, utilising the potential of wild edible plants to support local livelihoods requires a special emphasis. Wild edible fruits and berries are utilised as dietary supplements and as a secondary source of income due to the production of many products with value additions. In order to ensure food security and choices for a living in the Himalayan region, it is crucial to understand the role of wild edible fruits and berries. It has been observed that the sacred groves are home to a wide variety of wild edibles that are popular for their delicious and juicy taste coupled with their medicinal and nutritive properties. Consequently, some of the species are being used on a large scale and are therefore thought to be capable of offering alternative means of subsistence to the marginal groups of the state particularly residing in the remote areas. Understanding of diversity, its distribution, availability, traditional use practises and nutritional properties, cultivation practises, demand, supply and marketing, and conservation and management of high-value plant species is now essential for the sustainable development of wild edibles.

Abbreviations

E-East

kg- Kilogram

m- Meter

N- North

WEPS- Wild edible plants

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Conflict of Interest

There is no conflict of interest.

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Ethical approval and Consent to participants

NA

Availability of data and materials

All the data generated or analysed during the study are included in the published article.

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Figures and Tables

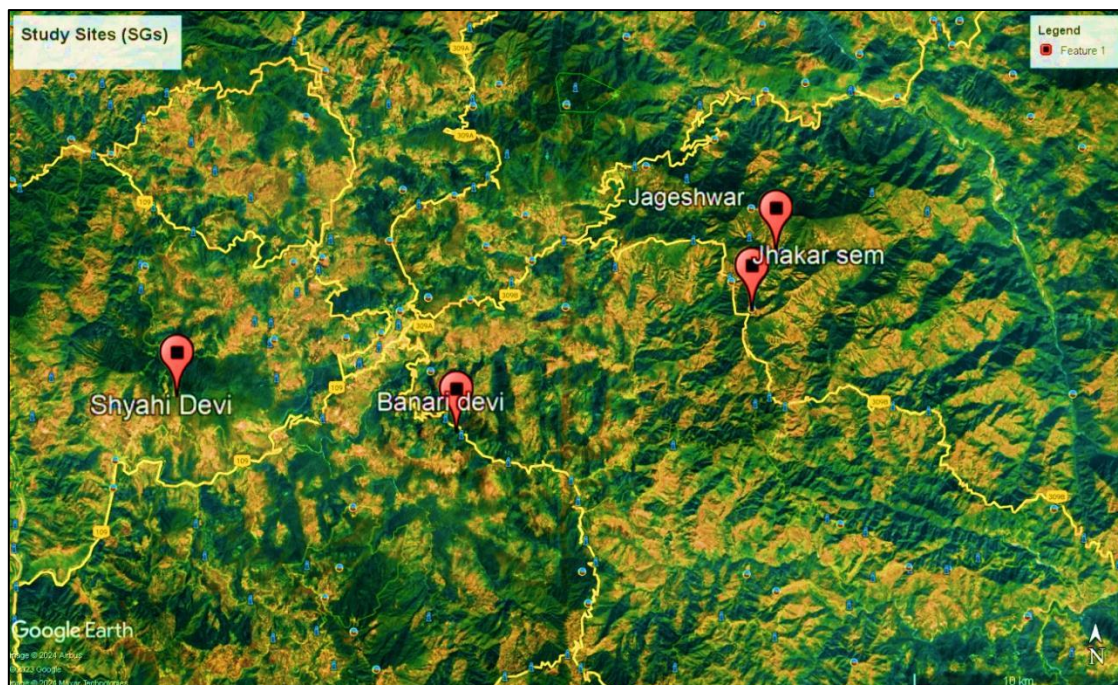
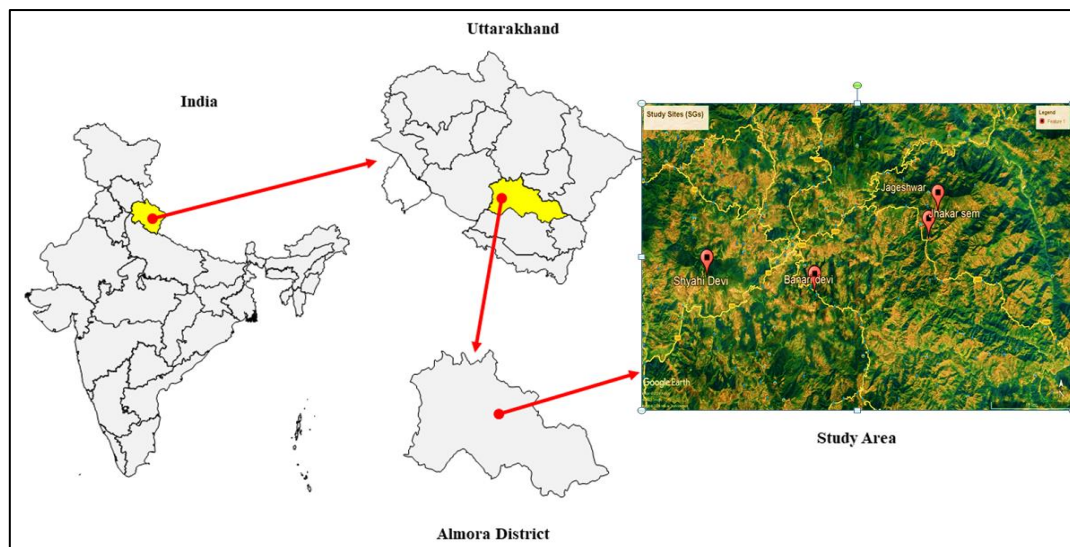


Figure 1. Map showing the location of the research sites in the Almora district of Uttarakhand



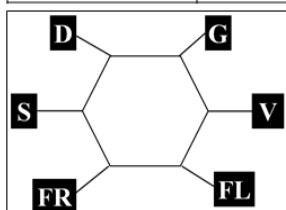
Figure 2. Methodology followed during perception in the study area



Figure 3. Wild edible fruits recorded from the study area.

Name of the wild edible species	Phenology Diagram	Name of the wild edible species	Phenology Diagram
<i>Myrica esculenta</i>		<i>Pyracantha crenulata</i>	
<i>Rhododendron arboreum</i>		<i>Rubus ellipticus</i>	
<i>Berberis asiatica</i>		<i>Ficus auriculata</i>	

Name of the wild edible species	Phenology Diagram	Name of the wild edible species	Phenology Diagram
<i>Pyrus pashia</i>		<i>Prunus persica</i>	
<i>Prunus domestica</i>		<i>Prunus armeniaca</i>	



*G = Germination of seeds or active sprouting of buds, V =Vegetative phase, FL = Flowering phase, FR = Fruiting phase, S = Seed maturation, D = Death of the plant in annual and that of aerial parts in perennials (Leaf-abscission in trees), Jan = January, Feb =February, Mar = March, Apr = April, Jun =June, Jul = July, Aug = August, Sep = September, Oct = October, Nov = November, Dec = December

Figure 4. Phenology of WEPs recorded throughout the year

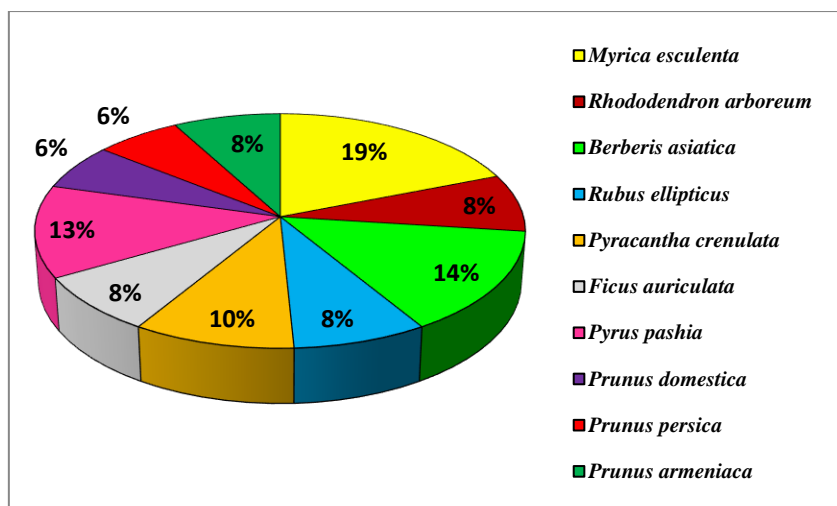


Figure 5. Per cent distribution of phytochemicals in various wild edible plants

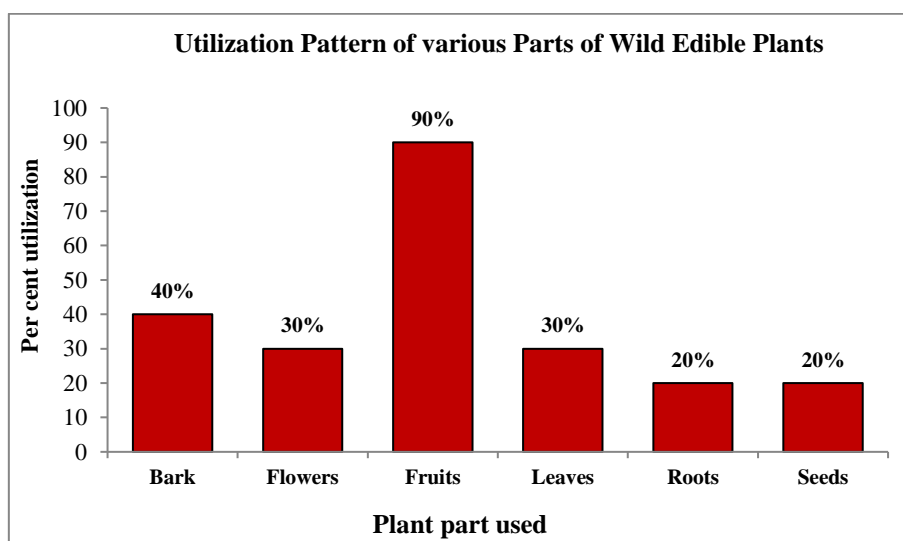


Figure 6. Utilization pattern of wild edibles

Table 1: Description of research sites located in district Almora

S. No.	Name of Sacred Grove	Latitude Longitude Alt. (m)	God/ Deity worshipped	Dominant Tree Species	Wild Edible Species	
					Shrubs	Trees
1.	Banari Devi	29°33'39.3"N 79°41'41.4"E 2081	Banari Devi (Vindhya vasini)	<i>Pinus roxburghii</i> , <i>Quercus leucotrichophora</i> , <i>Rhododendron arboreum</i> , <i>Myrica esculenta</i> , <i>Alnus nepalensis</i>	<i>Berberis asiatica</i> , <i>Rubus ellipticus</i> , <i>Pyracantha crenulata</i>	<i>Rhododendron arboreum</i> , <i>Myrica esculenta</i> , <i>Pyrus pashia</i>
2.	Jageshwar	29°38'15"N 79°51'6" E 1801	Shiva	<i>Cedrus deodara</i> , <i>Rhododendron arboreum</i> , <i>Pinus roxburghii</i>	<i>Berberis asiatica</i> , <i>Rubus ellipticus</i> , <i>Pyracantha crenulata</i>	<i>Rhododendron arboreum</i> , <i>Myrica esculenta</i>
3.	Jhakar Sem	29°36'47.2" N 79°50'23.4"E 2014	Sem Devata (Shiva)	<i>Cedrus deodara</i> , <i>Quercus leucotrichophora</i> , <i>Pinus roxburghii</i> , <i>Alnus nepalensis</i> , <i>Rhododendron arboreum</i> , <i>Myrica</i>	<i>Berberis asiatica</i> , <i>Pyracantha crenulata</i>	<i>Rhododendron arboreum</i> , <i>Myrica esculenta</i>

				<i>esculenta</i>		
4.	Shyahi Devi	29°34'34"N 79°33'27.4"E 2192	Durga maa/ Katyayni devi	<i>Quercus leucotrichophora</i> , <i>Rhododendron arboreum</i> , <i>Myrica esculenta</i> , <i>roxburgii</i> , <i>nepalensis</i>	<i>Berberis asiatica</i> , <i>Rubus ellipticus</i> , <i>Pyracantha crenulata</i>	<i>Rhododendron arboreum</i> , <i>Myrica esculenta</i>

Table 2: List of phytochemicals and minerals found in some selected wild edible fruits

S. No.	Botanical Name of the plants	Common/Vernacular Name	Family	Phytochemicals	Mineral elements	References
1	<i>Myrica esculenta</i> Buch. Ham. ex D. Don	Box berry/ Kaphal	Myricaceae	Tannins, Phenolic compounds, Terpenes, Alkaloids, Diarylheptanoids, Steroids, Triterpenoids, Myricetrin.	Flavonoids, Flavonols, Glycosides, Ionones, Saponins, Myricetin.	Na, K, Ca, Mg, Fe, Zn, Mn, Cu Kabra and Baghel, 2018; Kabra <i>et al.</i> , 2019
2	<i>Rhododendron arboreum</i> Sm.	<i>Rhododendron</i> / Burash	Ericaceae	Phenols, Steroids, Xanthoprotein,	Saponins, Tannin, Coumarin.	Mn, Fe, Zn, Cu, Na, Cr, Co, Cd, Mo, Ni, Pb, As Madhvi <i>et al.</i> , 2019; Sharma <i>et al.</i> , 2022
3	<i>Berberis asiatica</i> DC.	Indian barberry/ Kilmora	Berberidaceae	Flavonoids, Steroids, Glycosides, Triterpenoids, Tannins, Berberine.	Saponins, Coumarins, Polyphenols.	Li, Na, Mg, K, Ca, Cr, Mn, Fe, Ni, Zn, Mo, Ag, Pb Chander <i>et al.</i> , 2017
4	<i>Rubus ellipticus</i> Sm.	Himalayan raspberry/ Hisalu	Rosaceae	Glycosides, Phenols, Resin, Tannins.	Flavonoids, Saponins.	Na, Ca, Mg, K, Fe, Zn Sharma <i>et al.</i> , 2019
5	<i>Pyracantha crenulata</i> Roxb. ex D. Don M. Roem	Himalayan firethorn/ Ghingharu	Rosaceae	Glycosides, Tannins, Phenols, Resin.	Alkaloids, Saponins.	Na, K, Ca, Li, Zn, Cu, Mn, Fe, Co Bacchetti <i>et al.</i> , 2023
6	<i>Ficus auriculata</i> Lour.	Roxburgh fig/ Timila	Moraceae	Glycosides, Phenols, Resin, Flavonoids, Tannins.		K, Ca, Mg, P Bacchetti <i>et al.</i> , 2023
7	<i>Pyrus pashia</i> Buch. Ham. ex D. Don	Wild Himalayan Pear/ Mehal	Rosaceae	Alkaloids, Saponins, Flavonoids, Tannins, Amino acids.	Glycosides, Steroids, Phenols.	P, K, Ca, Mg, Fe, N Siddiquiet <i>et al.</i> , 2015; Bacchetti <i>et al.</i> , 2023
8	<i>Prunus domestica</i> L.	Plum/ Plum	Rosaceae	Polyphenols, Tannins, Anthocyanins.	Flavonoids.	Mn K, Cu, Fe, Mg, Ca, Zn Mehta <i>et al.</i> , 2014; Shukla, 2021
9	<i>Prunus persica</i> L.	Peach/ Aru	Rosaceae	Carotenoids, Phenolic Volatiles, Organic acids.	Vitamins, Compounds.	Ca, P, Fe, Mg, Na, K, Zn Kant <i>et al.</i> , 2018
10	<i>Prunus armeniaca</i> L.	Apricot/ Khumani	Rosaceae	Phenols, Flavonoids, Antioxidants.	Glycosides, Carotenoids.	Ca, Fe, Mg, P, K, Na, Zn, Cu, Mn, Se Alajil <i>et al.</i> , 2021

Table 3: List of major wild edible fruits found in and around sacred groves

S. No.	Wild edibles	Medicinal value*	Nutritional value	Commercial Part/Product	Price (Rs) / kg	References
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1	<i>Berberis asiatica</i>	Effective in diabetes, jaundice, skin problems.	Minerals such as lithium, sodium, calcium, iron, zinc, silver, etc. are found. Phytochemicals, secondary compounds are present.	Fruits	1000	Sati <i>et al.</i> , 2018
2	<i>Rubus ellipticus</i>	Used for antioxidant, anti-tumour and wound healing properties	Contains minerals like calcium, magnesium, potassium and carbohydrates. Phytochemicals are present. Good source of malic and citric acid.	Jam and chutney	600-800	Saklani <i>et al.</i> , 2012
3	<i>Pyracantha crenulata</i>	Used to cure hypertension, skin tanning and the tea prepared from its leaves is good for health.	Macro and microelements include sodium, calcium, copper, iron, cobalt, etc. Carbohydrates, sugars, tannins and phenols.	Fruits	450	Saklani and Chandra, 2014
4	<i>Rhododendron arboreum</i>	Beneficial for heart, liver and diabetes. Juice prepared from its flowers is beneficial for health and helpful for females during mensuration.	Contains minerals, phenols, saponins, tannins, coumarins. Minerals as zinc, iron, copper, sodium, cobalt are abundant in flowers.	Squash	500-1000	Sharma <i>et al.</i> , 2022
5	<i>Myrica esculenta</i>	Used to treat cough, asthma, fever, stomach problems and ear ache. Fruits are good for constipation.	Good source of flavonoids, terpenes, tannins and phenols. Phytochemical such as myricetin is present.	Fruits	100-200	Gusain and Khanduri, 2016; Srivastava <i>et al.</i> , 2016
6	<i>Pyrus pashia</i>	Useful in constipation, minimize thirst, eye problems.	Contain flavonoids, steroids and tannins. Minerals as phosphorus, potassium, calcium, magnesium and iron are present.	Fruits	2500	Prakash <i>et al.</i> , 2021
7	<i>Ficus auriculata</i>	Good for skin health, boosts immunity, clear constipation, help in weight loss.	Minerals such as calcium, potassium, phosphorus, etc. are present. Plant contains glycosides, flavonoids, phenols and tannins.	Fruits in form of Anjeer	1100	Khatun <i>et al.</i> , 2016
8	<i>Prunus domestica</i>	Used against skin problems and to treat stomach issues like constipation.	Vitamins A, B6, C, D, E, and K are found in abundance. Minerals consists of manganese (Mn), potassium (K), copper (Cu), iron (Fe), magnesium (Mg), calcium (Ca), and zinc (Zn).	Fruits	60-80	Ozzengin <i>et al.</i> , 2023

9	<i>Prunus persica</i>	Used to treat bronchitis and whooping cough. Use to aid in the healing of wounds.	Fruits of the plant contain carbohydrates, protein, and vitamin C. Minerals found are calcium (Ca), phosphorus (P), iron (Fe), magnesium (Mg), sodium (Na), potassium (K) and zinc (Zn).	Fruits	40-50	Baldi <i>et al.</i> , 2010
10	<i>Prunus armeniaca</i>	Used to treat Skin conditions and ear inflammation. Asthma, cough, constipation and fever are all treated with a decoction.	Plant contains Phenols, Flavonoids and Carotenoids. Minerals such as calcium (Ca), iron (Fe), magnesium (Mg), phosphorus (P), potassium (K), sodium (Na), zinc (Zn), copper (Cu), manganese (Mn), selenium (Se) are present.	Fruits	70-100	Alajil <i>et al.</i> , 2021

*Survey based indigenous knowledge

Table 4: Medicinal applications of phytochemicals present in wild edible fruit plants under study

S. No.	Name of Phytochemicals	Applications	WEPs* containing respective Phytochemicals
1	Tannins	Tannins are used to treat tonsillitis, pharyngitis, hemorrhoids, and skin eruptions, it is administered internally to check diarrhoea and intestinal bleeding and as an antidote for metallic, alkaloidal and glycosidic poisons.	1, 2, 3, 4, 5, 6, 7, 8
2	Phenolic compounds	Phenolic phytochemicals are used to treat bacterial, protozoal, fungal, and viral infections coupled with inflammation, diabetes, and cancer ailments.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
3	Flavonoids	Flavonoids anticancer, antioxidant, anti-inflammatory, and antiviral properties. They help to reduce oxidative stress in the body.	1, 3, 4, 6, 7, 8, 10
4	Terpenes	Terpene is used to enhance skin penetration, prevent inflammatory diseases. They show a range of pharmacological activities, such as anti-viral, anti-bacterial, anti-malarial, anti-inflammatory, hypoglycemic activities, and anti-cancer activities.	1
5	Alkaloids	Alkaloids show anti-inflammatory, anticancer, analgesic, local anesthetic and pain relief properties along with neuropharmacologic, antimicrobial and antifungal, activities.	1, 5, 7
6	Glycosides	Glycosides have great therapeutic potential, including antifungal, anticancer and antiplatelet activities.	1, 4, 5, 6, 7, 10
7	Diarylheptanoids	Diarylheptanoids exhibit antiproliferative, cytotoxic, antiemetic, anti-inflammatory and antiviral activities.	1
8	Ionones	Ionones exhibit anti-inflammatory, cancer-preventing, antibacterial, antifungal, and antileishmanial activities.	1
9	Steroids	Steroids reduce redness and swelling (inflammation). This can help with inflammatory conditions of asthma and eczema.	1, 2, 3, 7
10	Saponins	Saponins, affect the immune system in ways that help to protect the human body against cancers, and also lower cholesterol levels. Saponins decrease blood lipids, lower cancer risks, and lower blood glucose response. It exhibits Expectorant, anti-inflammatory effects, diuretics, and urinary tract disinfectants.	1, 2, 3, 5, 7

11	Triterpenoids	Triterpenoids exhibit various biological activities, such as antibacterial, antiviral, antitumor, antiosteoclastic differentiation activity, anti-HIV-1, hepatoprotection, antioxidation, antihypertension, cholesterol reduction, and antiaggregation functions.	1, 3
12	Myricetin	Myricetin acts by antioxidant, antiinflammatory, anticarcinogen, and antiviral activities and induces apoptosis in several cancer cell lines. Myricetin also inhibited thioredoxinreductase activity in A549 lung cancer cells.	1
13	Coumarin	Coumarins have antithrombotic, anti-inflammatory, and vasodilatory activities. Coumarins also have antiviral effects. It is used in the treatment of oedema.	2, 3
14	Glycosides	Glycosides have great therapeutic potential, including antifungal, anticancer, antiplatelet activities. They are used for treating heart failure and irregular heartbeats.	3
15	Berberine	Berberine is used for diabetes, high levels of cholesterol or other fats in the blood, and high blood pressure. It is also used for burns, canker sores and liver disease.	3
16	Resin	Resins are mainly used in the treatment of inflammatory conditions, as well as in some cancerous diseases, wound healing and for its antimicrobial activity.	4, 5, 6
17	Amino acids	Amino acids are used for sleep disorders, depression, ADHD, phenylketonuria, narcolepsy, and chronic fatigue syndrome. Amino acids can also be used as a source of energy in the body.	7
18	Anthocyanins	Anthocyanins prevent inflammation and protect against type 2 diabetes, cancer, and heart disease. Also benefit memory and overall brain health.	8
19	Carotenoids	Carotenoids help to maintain a normal visual function, in the prevention of cataracts and in the prevention of acute and chronic coronary syndromes and stroke.	9, 10
20	Vitamins	Vitamins are needed for normal cell function, growth, and development. Helps to fight infection, wound healing, making our bones strong and regulating hormones.	9
21	Organic acids	Organic acids reduce gastric pH, prevent the growth of pathogens, act as an energy source, increase apparent total tract digestibility, improve gut health and enhance growth performance and productivity.	9
22	Antioxidants	Antioxidants protect cells from the damage caused by unstable molecules known as free radicals which may lead to cancer. They reduce oxidative stress, support disease prevention, support eye health, aid in brain function, contribute to mental health improvements, reduce inflammation and support healthy aging processes.	10
*WEP _s = Wild Edible Plants; 1 = <i>Myrica esculenta</i> , 2 = <i>Rhododendron arboreum</i> , 3 = <i>Berberis asiatica</i> , 4 = <i>Rubus ellipticus</i> , 5 = <i>Pyracantha crenulata</i> , 6 = <i>Ficus auriculata</i> , 7 = <i>Pyrus pashia</i> , 8 = <i>Prunus domestica</i> , 9 = <i>Prunus persica</i> , 10= <i>Prunus armeniaca</i>			