STM JOURNALS

Research & Reviews: Journal of
Ecology

ISSN: 2278-2230
Volume 13, Issue 3, 2024
September–December
DOI (Journal): 10.37591/RRJoE

https://journals.stmjournals.com/rrjoe

Review RRJoE

Phytochemical and Nutritional Aspects of Wild Edible Plants from Shivalik Hills of Himachal Pradesh: A Review

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Abstract

The Shivalik Hills of Himachal Pradesh, a region known for its rich biodiversity, is home to a wide variety of wild edible plants (WEPs) that have long been integral to the diet and health practices of local tribal communities. These plants have been prized for generations not just for their culinary applications but also for their important nutritional and therapeutic qualities. The current study delves into the phytochemical and nutritional profiles of these WEPs, uncovering the presence of numerous bioactive substances that support their health benefits. Phytochemical analysis reveals that many WEPs from the Shivalik Hills contain substantial amounts of alkaloids, flavonoids, tannins, and phenols. These substances are well known for their strong antioxidant capabilities, which aid in scavenging damaging free radicals from the body and lowering oxidative stress and the hazards it entails, including aging and chronic illnesses. Moreover, the anti-inflammatory properties of these phytochemicals play a crucial role in managing and preventing inflammatory conditions, further highlighting their medicinal value. In addition to their phytochemical richness, these wild edible plants are also nutritionally dense. They are superior resources of essential nutrients, including vitamins (such as vitamins C and A), proteins, and dietary fibers. The high nutrient content of these plants makes them invaluable in addressing nutritional deficiencies, particularly in regions where conventional food sources may be limited or where malnutrition is a concern. The dietary fibers in these plants also promote digestive health, contributing to overall well-being.

Keywords: Edible plant, flavonoid, phenol, moisture, folk uses

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Received Date: August 14, 2024
Accepted Date: September 16, 2024
Published Date: September 30, 2024

Citation: Neha Thakur, Nitesh Kumar, Ruchika Devi, Sunita Saklani, Rohit Puri. Phytochemical and Nutritional Aspects of Wild Edible Plants from Shivalik Hills of Himachal Pradesh: A Review. Research & Reviews: Journal of Ecology. 2024; 13(3): 24–32p.

INTRODUCTION

In local diets, especially in rural and indigenous populations, wild edible plants are essential. These plants provide a diverse range of nutrients that may be lacking in cultivated crops, offering essential vitamins, minerals, and antioxidants. Often foraged from forests, fields, and other natural environments, wild edible plants can be a vital food source during times of scarcity, such as droughts or food shortages [1]. They also contribute to food security by diversifying the diet, reducing dependence on a limited range of crops, and preserving biodiversity. In traditional medicine, wild edible plants hold significant cultural and medicinal value. These plants also cure common illnesses, leveraging centuries-old knowledge passed down through generations [2]. The usage of plants in herbal remedies reflects a deep understanding of local

ecosystems and plant properties. This traditional knowledge not only supports the health of local populations but also fosters a connection to cultural heritage and the natural world, contributing to the conservation of these plants and the ecosystems they inhabit [3].

The Shivalik Hills, sometimes referred to as the Outer Himalayas, are the foothills of the Himalayas and are in northern India, Nepal, and Bhutan. This region is characterized by its diverse topography, including rugged hills, deep valleys, and riverbeds. The Shivalik Hills boast rich biodiversity, housing a wide array of flora and fauna, including dense forests of sal, teak, and bamboo, and a variety of medicinal plants [4]. The wildlife here is equally diverse, with species such as leopards, elephants, and numerous bird species thriving in the region. The Shivalik are also crucial for their role in protecting the plains from soil erosion and sustaining the livelihoods of local communities through resources like timber, fodder, and non-timber forest products [5].

The bioactive substances known as phytochemicals, which are abundant in WEPs, add to their nutritional and medicinal significance. These plants often contain high levels of antioxidants, flavonoids, tannins, and alkaloids, which have been shown to have various health benefits, including anti-inflammatory, antimicrobial, and anticancer properties [6]. For instance, plants like (*Rumex hastatus*) are known for their high levels of polyphenols, which help to reduce the risk of chronic diseases. Similarly, *Bombax ceiba* are packed with flavonoids and other phytochemicals that promote anti-inflammatory and antimicrobial effects, making them useful in traditional medicine for treating allergies and joint pain [7]. Nutritionally, wild edible plants are often superior to cultivated vegetables in terms of their micronutrient content [8]. They are excellent sources of vitamins in various leafy greens, which are essential for immune function and vision [9]. Wild plants also tend to be rich in essential minerals like iron, calcium, and magnesium. For example, Kashmal (*Berberis lycium*) is noted for its high levels of Vitamin C, which are rare in plant sources and are crucial for heart health [10]. The high fiber content in many wild plants supports digestive health, while their low calorie and fat content makes them beneficial for weight management [11]. Incorporating wild edible plants into diets can thus significantly enhance nutritional intake and support overall health [12]. The native communities of Himachal Pradesh have long relied on these herbs for their dietary needs and medicinal purposes. Therapeutic knowledge about the preparation and consumption of these herbs has been passed down through generations. These practices not only contribute to food security but also preserve the folk heritage and biodiversity of the region.

STUDY AREA

The Shivalik Hills, often referred to as the “Foothills of the Himalayas”, form an integral part of the outermost range of the mighty Himalayas. Extending across the northern regions of India, they pass through the states of Himachal Pradesh, Uttarakhand, and Punjab. The Shivalik Hills in Himachal Pradesh are characterized by their unique topography, diverse flora, and rich cultural heritage.

GEOGRAPHICAL AND ECOLOGICAL CHARACTERISTICS

The Shivalik Hills in Himachal Pradesh are located between the latitudes of approximately 29°22' to 31°28' N and longitudes of 75°47' to 79°04' E. The elevation of these hills ranges from 300 meters to about 1,500 meters above sea level. The terrain is a mix of rolling hills, deep valleys, and steep slopes, which contribute to the region's varied microclimates. The climate of the Shivalik Hills varies from subtropical to temperate, depending on altitude. Summers are generally warm, while winters can be cool to cold, with occasional frost in higher elevations. The region experiences moderate heavy rainfall during the monsoon season, contributing to its lush vegetation.

FLORA AND VEGETATION

The Shivalik Hills are rich in biodiversity, with a wide variety of plant species thriving in the region. The vegetation includes tropical and subtropical forests, with an abundance of shrubs, herbs, and trees.

The forests are predominantly composed of species like Khair (*Acacia catechu*), and Shisham (*Dalbergia sissoo*), along with various undergrowth plants. In addition to the well-known forest species, the Shivalik Hills are home to numerous WEPs that have been traditionally used by local communities for diet and therapeutic purposes, such as *Asparagus racemosus*, *Berberis lycium*, *Ficus palmata*, *Lathyrus aphaca* and *Cassia occidentalis*. These plants are often found in forested areas, open grasslands, and along the banks of rivers and streams that crisscross the region.

ETHNOBOTANICAL SIGNIFICANCE

The local communities residing in the Shivalik Hills, including various tribal and rural populations, have deep-rooted information on the edible and medicinal herbs found in the region. This traditional information has been passed down through generations and plays a crucial role in the daily lives of people, particularly in remote areas where access to modern healthcare and markets is limited. Wild edible plants from the Shivalik Hills are not only consumed as food but are also used in indigenous medicine to cure numerous disorders. These plants provide essential nutrients and phytochemicals that contribute to the overall health and well-being of the local population.

METHODOLOGY

Literature reviews (LR) in general are systematic and thorough, and they expand on the methods used when looking at the phytochemical and nutritional information available on the wild edible plants (WEPs) found in Himachal Pradesh's Shivalik Hills. First, an extensive literature survey is performed, and relevant and useful data is collected from scientific journals, books, ethnobotanical records, and local reports. Data collection includes looking for literature on specific bioactive constituents of plants, that is, alkaloids, flavonoids, tannins, and phenols and how they help provide antioxidants, anti-inflammatory, and other proactive roles to the body. Studies are highlighted, which are dedicated to the analysis of the macro and micro elements, vitamins, proteins, and dietary fibers of plants in different specimens of foods. Critical evaluation and synthesis of the compiled data are then performed to reveal trends, sub-trends, and potential areas for developing in the future. It was clear that efforts made to comply with ethics requirements paid off as the reliability of the information issued was ensured and in case of doubt, publication bias was checked by using cross-referencing techniques.

RESULTS AND OBSERVATION

The current investigation discovered that the inhabitants of Himachal Pradesh's Shivalik Hills use 15 plant species from 13 families shown in Table 1. These naturally occurring edible plants serve various purposes, including being a source of food and nourishment, as well as medicine. The wild edible plants that are most used family Moraceae (3), followed by Liliaceae, Malvaceae, Brassicaceae, Berberidaceae, Elaeagnaceae, Polygonaceae, Rosaceae, Fabaceae, Moringaceae, and Caesalpiniaceae, 1 species each (Figure 2). Plant distribution based on habit revealed that tree species were notably more prevalent, followed by herbs and shrubs shown in Figure 3. Fruit is the plant part most widely used in this study, followed by leaf, pod, root tuber, seed, bud, and flower (Figure 1).

Table 1. Folk uses of WEPs with their phytochemical constituents and nutritional contents.

S.No.	Scientific Name	Local Name	Family	Habit	Parts Used	Phytochemical	Nutritional Contents	Folk Uses	Reference
1	*Asparagus racemosus* Willd.	Sansfai	Asparagaceae Liliaceae	Shrub	Bud	Asparagine, Quercitin, Rutin, Hyperoside flavonoids (flower and fruit)	Crude protein, crude fiber, carbohydrate	Buds are used to make a vegetable called “Bhale” and used to cure digestive problems.	[13–14]

2	*Berberis lycium* Royle	Kashmal	Berberidaceae	Shrub	Fruit	Balauchistanamine, Chinamine, Saponins, Berbamine, Sindamine, Berberine	Carbohydrates and Dietary fibre	Ripen fruits are eaten to cure diabetes. 2 g powder of fruit is boiled with water to make a decoction to cure typhoid fever.	[3–4, 16]
3	*Bombax ceiba* L.	Seemul	Malvaceae (Bombacaceae)	Tree	Fruit	Shamimicin, Lupeol, Quercetin, Hentriacontane, Quercetin, Rutin, Anthocyanin	Crude fiber, crude protein, carbohydrate	Fruit is cooked as a vegetable and cure leucorrhoea, and gonorrhoea as well as used to regulate menstrual abnormalities in women.	[17–18]
4	*Cassia occidentalis* L.	Badi Eluan	Caesalpiniaceae (Fabaceae)	Herb	Seed	Saponin, tannin, phenol, alkaloid, steroid, and terpenoid	Crude fiber, Crude lipid, Crude protein and carbohydrate	Seeds are used to make pickles.	[3, 19–20]
5	*Dioscorea oppositifolia* L.	Dregal	Dioscoreaceae	Climber	Root tuber	Glycosides, phenol, flavonoid, Saponin	Moisture, Crude Protein, and Fat	Root tubers are used to make vegetables.	[3, 21]
6	*Elaeagnus umbellata* Thunb.	Ghaiyin	Elaeagnaceae	Shrub	Fruit	Isopropyl alcohol, Methyl ester, Bis-dichloromethyl ether	Moisture, Ash, Protein, Fibre	Ripen fruits are edible. Fruits are utilized to cure diarrhea and infections.	[22–23]
7	*Ficus palmata* Forssk.	Dhuda, Fegra, Khasra, Daghla	Moraceae	Tree	Fruit	The unripe acid, Stigmasterol, Taraxasterol, Phytol, Hydroquinone	Moisture, protein, ash, carbohydrate, fiber, fat	Fruit is edible to cure diabetes. The unripe fruit is cooked as a food and used to cure gastric problems and constipation.	[24–25]
8	*Ficus auriculata* Lour.	Trayamble	Moraceae	Tree	Fruit	Phenol, Flavonoid	Protein, Carbohydrate, Fiber, Fat	Ripen fruit is edible and useful for reducing diabetes. Unripen fruit is used as a vegetable.	[26–27]

9	*Fragaria indica* Andrews	Jangli strawberry Lal Akhe	Rosaceae	Herb	Fruit	Euscaphic acid, Arjunic acid, Rosamultin, Tomentic acid	Protein, water-soluble sugar	Fresh fruit is edible. Fruit is utilized to enhance immunity.	[28–29]
10	*Lathyrus aphaca* L.	Mattar-phali	Fabaceae	Herb	Seed	Alkaloid, Flavonoid, Terpene, Phenol, Tannin	Fat, Protein, Ash and Carbohydrate	Seeds are eaten as a food.	[30]
11	*Morus alba* L.	Toot	Moraceae	Tree	Fruit	Rutin, Isoquercitrin, Astragalin	Protein, Lipid, Crude fiber, Ash, Carbohydrate	Ripe fruit is edible and to cure diabetes.	[31–32]
12	*Moringa oleifera* Geartn.	Swanjan	Moringaceae	Tree	Pod	Tannin, saponin, phenol, and alkaloid	Ash, Protein, Moisture, and Fat	Pods are used to make vegetables.	[3, 33–34, 37]
13	*Opuntia dillenii* (Ker Gawl.) Haw.	Nagphani, dandathor	Cactaceae	Shrub	Fruit	Alkaloid, phenol, flavonoid, terpenoid, saponin, and steroid	Fatty acids, and Vitamin E	Ripen fruits are edible. Baked fruit is used as a remedy for treating whooping cough.	[38–40]
14	*Phoenix sylvestris* Roxb.	Khajoor	Arecaceae	Tree	Fruit	Catechine, p-coumaric acid, Caffeic acid, quercetin	Crude protein, crude lipid, crude fibre and ash	Ripe fruits are eaten.	[3, 41, 42]
15	*Rumex hastatus* D. Don	Malora	Polygonaceae	Herb	Leaf	Nepodin, Hastatuside A, Hastatuside B, Rumexoside, and Orientaloside	Moisture, ash, crude fat, and crude protein	Leaves are used to make “saag”.	[35, 3, 36]

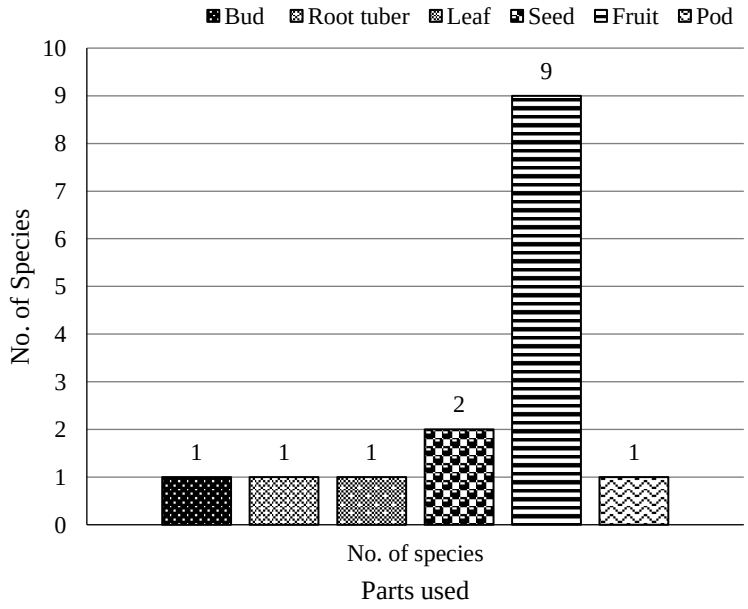

Figure 1. Different parts used in WEPs.

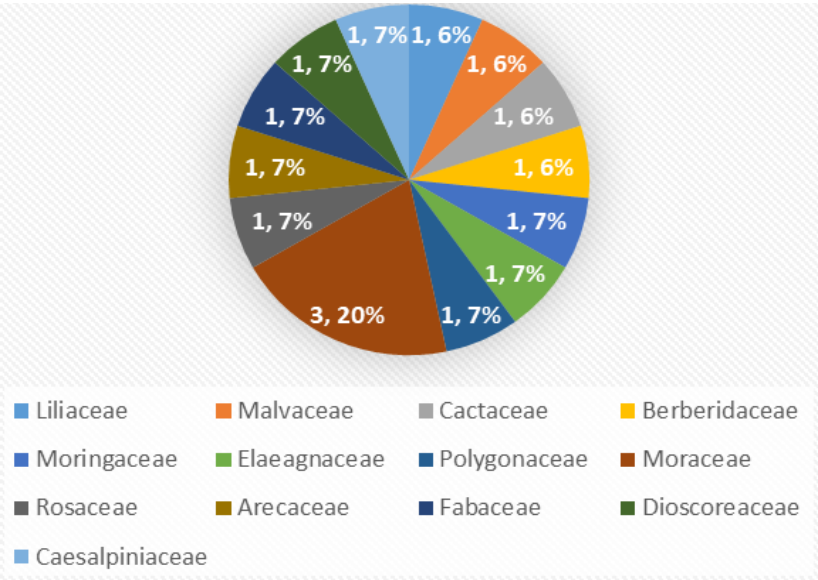

Figure 2. Families of WEPs.

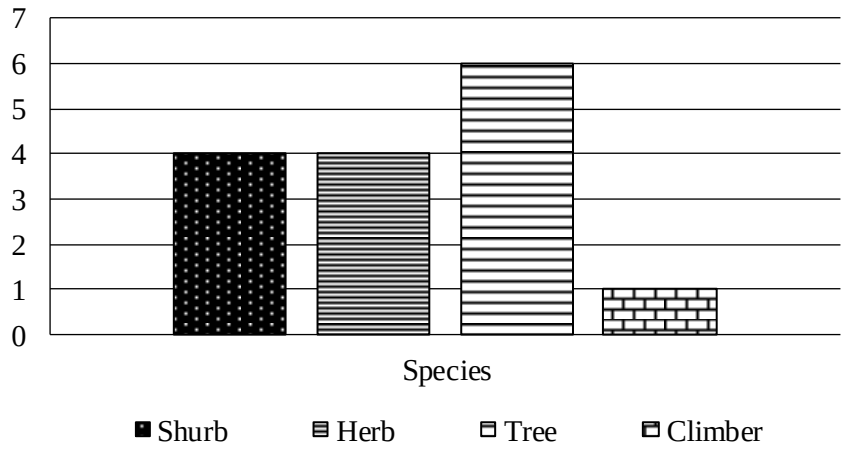

Figure 3. Habits of WEPs.

DISCUSSION

The phytochemical and nutritional aspects of herbs from the Shivalik Hills of Himachal Pradesh have garnered attention in recent research due to their potential health benefits and role in food security. These plants, often consumed by indigenous communities, are found to be rich sources of essential nutrients and bioactive compounds, making them valuable both nutritionally and medicinally [43]. Wild edible plants from this region are packed with vital nutrients, proteins, carbohydrates, and dietary fiber. For instance, studies have shown that certain wild fruits and leafy vegetables from the Shivalik Hills contain higher levels of nutrients compared to commonly cultivated crops [44]. The high dietary fiber content contributes to digestive health, while the presence of essential amino acids in some plants adds to their protein quality. These nutritional attributes make these wild edibles an important dietary supplement, especially in rural and undernourished populations.

Phytochemicals, the bioactive compounds found in these plants, play a crucial role in their medicinal properties. Research indicates that these plants contain significant amounts of flavonoids, tannins, phenolics, alkaloids, and saponins, which exhibit strong antioxidants, anti-inflammatory, and antimicrobial activities. The traditional knowledge of using these herbs for food and medicine passed

down through generations, is a critical aspect of ethnobotany in the Shivalik Hills. The use of these plants is not only a reflection of the rich biodiversity of the region but also of the deep cultural ties that the local communities have with their environment. The continued practice of harvesting and using these plants sustainably is essential for preserving both the biodiversity and the cultural heritage of the region [45].

CONCLUSION

The plants from the Shivalik Hills of Himachal Pradesh offer significant phytochemical and nutritional benefits, highlighting their potential as valuable food sources and medicinal resources. These plants are rich in essential nutrients, such as vitamins, minerals, and dietary fibers, which contribute to overall health and well-being. Additionally, the presence of biologically active compounds provides an antioxidant, and anti-inflammatory, which could play a crucial role in disease prevention and organization. The study of these plants underscores the importance of conserving biodiversity and encouraging the sustainable usage of traditional knowledge to improve nutrition and well-being outcomes, especially in rural and tribal communities. Further research and documentation of these plants can help preserve and utilize them for future generations.

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