BIODIVERSITAS
Volume 26, Number 8, August 2025
Pages: 4023-4034

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d260831

Biocultural and nutritional significance of *Sauromatum diversifolium* in Central Himalayan communities, India

RAJPAL SINGH NEGI[1], V. K. PUROHIT[2], R. K. MAIKHURI[3,♥], VINOD NAUTIYAL[1], SUBHASH CHANDRA[1], LAKHPAT SINGH RAWAT[4], M. C. NAUTIYAL[2], SUDEEP CHANDRA[2], RAVINDRA SINGH[3]

[1]Department of History including Ancient Indian History, Culture and Archaeology, Hemvati Nandan Bahuguna Garhwal University (A Central University). Madhi Chauras, Srinagar, Naur, Uttarakhand 246174, India
[2]High Altitude Plant Physiology Research Centre, Hemvati Nandan Bahuguna Garhwal University (A Central University). Madhi Chauras, Srinagar, Naur, Uttarakhand 246174, India
[3]Department of Environmental Sciences, Hemvati Nandan Bahuguna Garhwal University (A Central University). Madhi Chauras, Srinagar, Naur, Uttarakhand 246174, India. Tel./fax.: +91-9410-392632, ♥email: rkmaikhuri89@gmail.com
[4]G. B. Pant National Institute of Himalayan Environment, Garhwal Regional Centre. Kosi-Katarmal, Almora, Uttarakhand 263643, India

Manuscript received: 9 April 2025. Revision accepted: 20 August 2025.

Abstract. *Negi RS, Purohit VK, Maikhuri RK, Nautiyal V, Chandra S, Rawat LS, Nautiyal MC, Chandra S, Singh R. 2025. Biocultural and nutritional significance of* Sauromatum diversifolium *in Central Himalayan Communities, India. Biodiversitas 26: 4023-4034.* *Sauromatum diversifolium*, locally known as Nagdoon, is one of the important underutilized wild edible plant species whose root tuber (corm) is locally used as a staple food and a traditional medicine among indigenous communities in the Central Himalaya, Uttarakhand, India. Despite its significant cultural and medicinal importance, *S. diversifolium* remains largely under-researched, highlighting the urgent need to revalidate its traditional uses and explore its nutraceutical potential. The present study aims to analyze the nutritional value of the tuber and document the Indigenous knowledge related to local food, healthcare practices, biocultural traditions, and the socio-religious values of *S. diversifolium* in the Uttarakhand, namely Rawain, Niti, Darma, and Byans valleys of the region. An ethnobotanical survey using Participatory Rural Approaches (PRA), inventories, interviews, and local discussions in five villages (277 households) of Rawain Valley, followed by the collection of *S. diversifolium* for phytochemical and nutraceutical analysis of its tubers. The results of the nutritional analysis revealed the high nutritional value of the tubers, with significant levels of vitamins (B2, C, E), proteins, carbohydrates, and minerals were analyzed to understand their nutritional potential. The results revealed that the boiled tubers of the plant are traditionally consumed as a healthy food and used for medicinal purposes to treat various diseases, as reported by 95% respondents. The chemical screening of the corm showed higher Vitamin C content (4.7 mg/g) than other vitamins. Additionally, the carbohydrate, potassium, and calcium contents were also found significantly higher (76.6, 850, and 213 mg/100 g, respectively). The species can be a potential source of high-value food and provide an additional source of income opportunities for indigenous/ traditional communities. The present study emphasizes the domestication, large-scale cultivation, value addition, and product development of the species to enhance livelihoods and income generation, ensuring the sustainability of socio-ecological systems and the biocultural conservation of the region.

Keywords: Conservation, Himalayan Araceae, Nagdoon, traditional food systems, wild tubers

INTRODUCTION

Access to nutritionally adequate food remains a major global challenge. Although agricultural productivity has improved, over one billion people remain undernourished, with 98% in developing countries (Rasul et al. 2019). Wild plant genetic resources are increasingly recognized as nature-based solutions for food and nutritional security, particularly amid climate change, ecosystem degradation, and socio-economic vulnerability (Ray et al. 2020). Indigenous food systems, shaped by local ecosystems, cultural norms, and seasonal availability, embody unique, time-tested knowledge that supports forest conservation and the development of foods, medicines, cosmetics, and other natural products. Such systems link cultural and biological diversity, forming a foundation for sustainable bioresource use, influenced by ethical and religious values (Aryal et al. 2018; Singh et al. 2020; Kapoor et al. 2022).

Wild plants have notable nutraceutical and phytochemical potential, offering micronutrients, antioxidants, and health-promoting compounds (Bohra et al. 2022; Aswani et al. 2024). Globally, wild resource income and trade are estimated at $119 billion annually. These bioresources are valued for economic benefits, cultural richness, and subsistence contributions to rural households (Maikhuri et al. 2004). They also serve as genetic reservoirs for crop improvement, with traits for biotic and abiotic resistance, nutritional quality, and adaptability (Bohra et al. 2022; Aswani et al. 2024).

For many indigenous and rural communities, wild bioresources are the backbone of food systems, shaped by religious and cultural practices that promote sustainable use and conservation. In India, approximately six million rural residents rely on forest bioresources for their livelihoods (Nautiyal et al. 2023). In the Indian Himalayan Region (IHR), rugged terrain and climate constraints restrict agriculture, making wild and underutilized plants, especially tuberous species, essential for diets, health, and cultural preservation (Maikhuri et al. 2004; Bhatt et al. 2017; Rawat et al. 2023).

Although the Himalayan flora's ethnobotanical significance is recognized, many culturally important species remain scientifically under-documented. Such plants, long integral to diets and medicinal practices, often lack nutritional and phytochemical profiling, limiting their potential for broader applications and risking the loss of traditional knowledge. The region faces challenges, including dwindling forests, low agricultural productivity, unemployment, and the need to ensure food and nutritional security. Efforts to develop wild edible trade systems have emerged (Negi et al. 2011a; Chauhan 2022), but knowledge erosion due to modernization threatens these resources (Negi et al. 2011a; Olesen et al. 2024). Phytochemical studies, local value addition, and product development could promote consumption, while value chain development could link bioresources to income generation.

Documenting and validating these resources are urgent as climate change and livelihood pressures push mountain communities toward resilient, nature-based solutions. This study addresses a gap in Himalayan ethnobotany by focusing on *Sauromatum diversifolium*, locally known as Nagdoon, of the Araceae family. Despite global interest in wild edibles, nutritional studies on individual species are scarce. For *S. diversifolium* (syn. *Typhonium diversifolium*), information on use is virtually absent in Himalayan literature. This tuberous plant grows in moist, shaded grasslands and forests at 2,000-3,000 m in Uttarakhand, Himachal Pradesh, Assam, Meghalaya, Arunachal Pradesh, and Sikkim, and in Central Himalayan valleys like Rawain, Niti, Darma, and Byans. Nagdoon holds significant cultural, dietary, and medicinal roles, yet its nutritional potential and socio-cultural importance remain unexplored.

The research tests two hypotheses: (i) the corm of *S. diversifolium* provides substantial nutritional benefits, making it a vital resource for food security and dietary diversity in the Central Himalaya; and (ii) local communities possess extensive indigenous knowledge about its uses in food systems, healthcare, and socio-religious practices. The objectives are: (i) to analyze the nutritional value of the plant's corm; and (ii) to document indigenous knowledge related to its role in local diets, nutrition, healthcare, and socio-religious traditions in the Central Himalayan Region of India.

MATERIALS AND METHODS

Study area

The study was conducted in the Rawain Valley of Uttarkashi District, Uttarakhand, in the Central Himalayan Region of India. The valley lies within an altitudinal range of 1,800 to 3,000 meters above sea level, featuring steep terrain and a mosaic of vegetation types. Dominant forest communities include *Pinus roxburghii* at lower elevations, giving way to mixed temperate forests comprising *Quercus leucotrichophora*, *Rhododendron arboreum*, and *Aesculus indica*. In higher, moist zones, *Cedrus deodara* and moist temperate deciduous forests dominate, providing a suitable habitat for various wild edibles, including *S. diversifolium*. Five villages, i.e., Jakhol (31°07'06"N, 78°15'02"E), Saoud (31°04'43"N, 78°12'41"E), Naitwar (31°03'57"N, 78°06'20"E), Dhatmeer (31°06'15"N, 78°19'03"E), and Sideri (31°05'04"N, 78°11'36"E) were selected for detailed ethnobotanical and phytochemical surveys (Figure 1 and Table 1).

These villages are inhabited by the 'Parvati' community, whose subsistence economy relies on agriculture, animal husbandry, and forest resources. Wild plant species are vital to their food and healthcare systems. *Sauromatum diversifolium*, known locally as Nagdoon, is commonly found in moist, shaded areas of forests and grasslands in this landscape and holds deep cultural significance in the region's traditional food, medicinal, and religious practices. This ecological diversity and cultural connection make this region highly important for studying the nutritional value and indigenous uses of the species.

Traditional culinary arts, biocultural food practices, and ethnomedicine aspects

A Participatory Rural Appraisal (PRA) approach, as outlined in studies by Sahoo et al. (2010), was used in our field study. The study was carried out from April 2022 to April 2024. A stratified sampling strategy was applied to ensure representative coverage of socio-economic groups and age categories. Approximately 50-55% of households were selected from each village using a random selection method, totaling 277 households. In addition to household surveys, three complementary ethnobotanical methods were used: key informant interviews (n: 100), focus group discussions (n: 185), and inventory-based field walks. Respondents for the key informant interviews and focus group discussion were not part of the 277 households interviewed. For key informant interviews, 20 knowledgeable men and women participated in each village (Table 2). Demographic diversity was ensured by including both male and female participants (M/F: approx. 60/40), with ages ranging from 20 to 75 years.

The PRA method is a crucial tool that facilitates the engagement of local communities, enables the identification of individuals with expertise in various fields, including traditional knowledge, communication, and cultural practices. This approach, which involved the audience, was instrumental in collecting data on biocultural knowledge, conventional culinary practices, and the use of plants in the local healthcare system were collected through frequent field visits. This includes the ingredients used in the preparation of traditional recipes, methods of preparation, cooking patterns, and the frequency of use of various dishes. Additionally, a variety of questionnaires were employed to capture indigenous knowledge about surviving culinary traditions, plant utilization patterns, and the specific seasons for harvesting herbs from their natural habitat. Three fundamental approaches were adopted for further insights following Phondani et al. (2010).

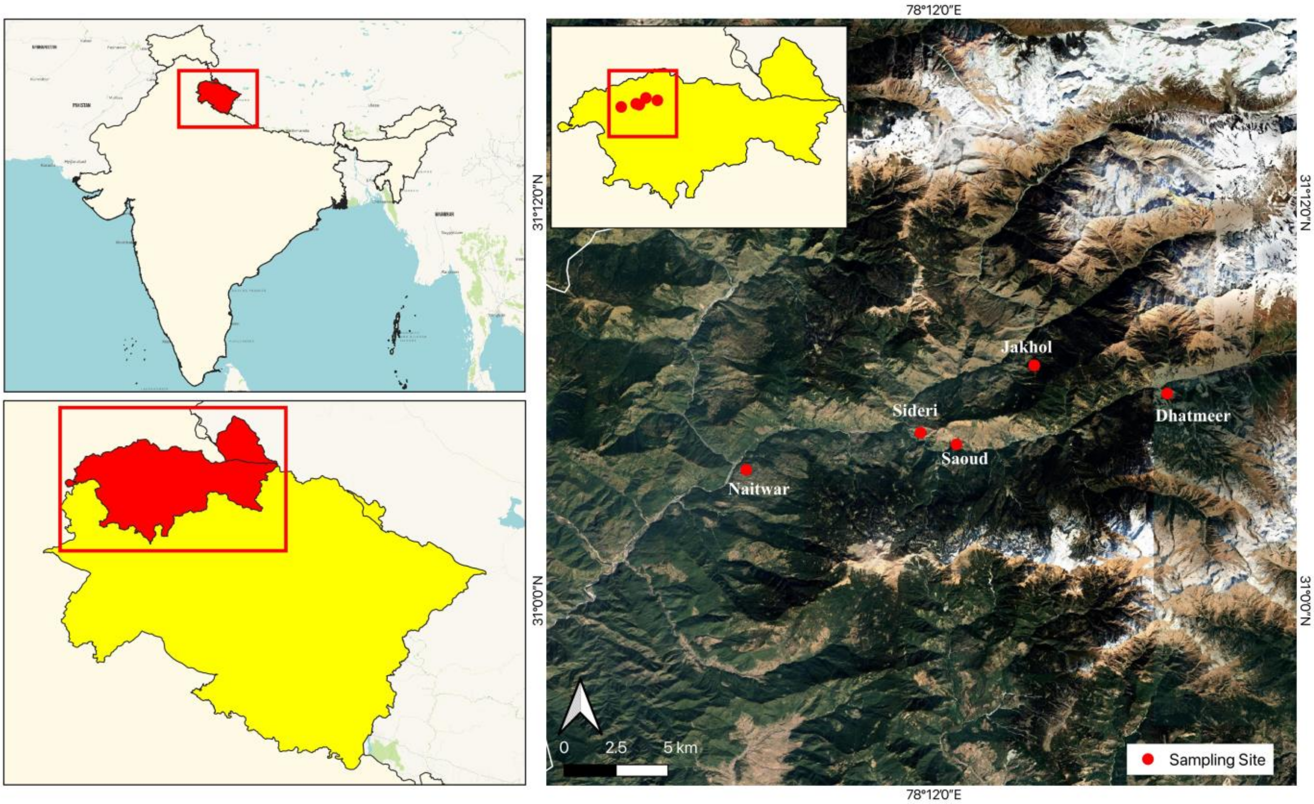

Figure 1. Google map showing the location of study villages in the State of Uttarakhand, India

Table 1. Demographic profile of the study villages in Uttarkashi, Uttarakhand, India

Particulars	Jakhol	Sideri	Souad	Dhatmeer	Naitwar
Number of households	204	86	95	101	54
Total human population	1,256	483	491	686	349
Average family size	6	5.6	5.1	6.8	6.5
Literacy rate (%)	45.84	20.15	63.70	56.24	62.30
Livestock population	5,010	1,433	927	5,719	927

Source: Block office Mori, Govt. of Uttarakhand, India

Table 2. Summary of Participatory Rural Appraisal (PRA) methods, respondent numbers, and demographic characteristics (gender, age range, primary role) across the five study villages in the Central Himalayan Region, India

Village	PRA method	No. of respondents	Gender (M/F)	Age range (Years)	Primary role
Jakhol	Household survey	98	56 / 42	25-70	Farmers, homemakers, pastoralists
	Key informant interviews	20	14 / 06	40-75	Herbal healers, elders, food practitioners
	Focus group discussions	38	22 / 16	20-65	Youth, women's group, community leaders
Sideri	Household survey	45	26 / 19	22-65	Farmers, homemakers
	Key informant interviews	20	13 / 07	38-70	Traditional healers, elders
	Focus group discussions	35	18 / 17	21-60	Women, youth, community elders
Saoud	Household survey	51	30 / 21	26-68	Farmers, livestock rearers
	Key informant interviews	20	15 / 05	42-73	Elders, food knowledge holders
	Focus group discussions	37	20 / 17	23-65	Youth, women, men
Dhatmeer	Household survey	53	32 / 21	27-66	Farmers, homemakers, pastoralists
	Key informant interviews	20	12 / 08	40-72	Herbalists, cultural leaders
	Focus group discussions	40	22 / 18	20-63	Gender-based and age-based discussion groups
Naitwar	Household survey	30	18 / 12	25-65	Farmers, pastoralists
	Key informant interviews	20	13 / 07	39-70	Herbal healers, elders, local experts
	Focus group discussions	35	17 / 18	21-64	Women, youth, men

Key informant interview-based approach

Elders and knowledgeable people of the villages were the key informants. We interviewed participants, particularly older individuals with expertise, including herbal healers, to gather knowledge about the use of various plants, particularly focusing on Nagdoon and other medicinal plants. We recorded plant names and visited forest locations, assisted by local informants and herbal healers, to identify specific plants.

An inventory-based approach

This approach included collecting plant specimens followed by interviews with informants to obtain information regarding their names and uses.

An interactive and focus group discussion-based approach

This method involved arranging interactive meetings with village elders and individuals knowledgeable about traditional practices to discuss and uncover various uses of Nagdoon and other medicinal plants. In focus groups, each comprising a small group of people, usually of the same age, who were knowledgeable in a specific area, were assembled. The village leaders assisted the researchers in gathering groups of men, women, and adolescents, with 35 to 40 individuals in each group, capable of providing accurate information. In total, across all villages, there were 185 participants in focus groups.

The research strictly "adhered to ethical guidelines; before beginning", the study's purpose was explained to village leaders and community members. Prior informed consent was obtained from all participants, including those involved in household surveys, key informant interviews, and focus groups. Participation was voluntary, and "it was clearly communicated that their traditional knowledge would be used for academic purposes". All personal information was kept confidential to protect participants' privacy.

Chemical analysis

The nutritional analysis of *S. diversifolium* was undertaken to scientifically validate its traditional use as a food source and assess its potential contribution to dietary and nutritional security in the Central Himalayan Region. Fresh corm samples of *S. diversifolium* (Accession identified and submitted to HNB Garhwal University Herbarium, ID-GUH7214) were collected from wild populations in shaded forest and grassland areas across the five study villages during the peak harvesting season (August to September). After cleaning to remove soil and impurities, samples were washed in distilled water and sliced into uniform pieces. The sliced material was shade-dried for 10-12 days and then oven-dried at 50°C to constant weight. Dried samples were ground into a fine powder using a stainless-steel grinder and stored in air-tight containers at 4°C until laboratory analysis. Powdered samples were analyzed for vitamin and mineral content following standard spectrophotometric and atomic absorption procedures with slight modifications, as summarized in Table 3.

Table 3. Summary of protocols, reagents, and instrumentation used for vitamin and mineral assays of *Sauromatum diversifolium* corms

Analyte	Key reagents and chemicals	Sample preparation and conditions	Instrument / Detection wavelength	Reference
Vitamin C	4% Oxalic acid, Bromine water, 2% 2,4-dinitrophenylhydrazine (DNPH), Thiourea, 80% H_2SO_4	0.5 g sample homogenized in 50 mL oxalic acid (4%), filtrate reacted with reagents, and incubated at 37°C for 2 hours	UV-Vis Spectrophotometer, 540 nm	Bisht et al. (2023)
Vitamin E	Absolute ethanol, Petroleum ether, 2,2-dipyridyl, Ferric chloride ($FeCl_3$), Concentrated HCl	Extracted with ethanol and petroleum ether; reacted with 2,2-dipyridyl and $FeCl_3$; absorbance measured after 30 min	UV-Vis Spectrophotometer, 520 nm	Oguazu et al. (2021)
Vitamin B_4	50% Ethanol, 5% Potassium permanganate ($KMnO_4$), 30% Hydrogen peroxide (H_2O_2), 40% Sodium sulfate (Na_2SO_4)	10 g sample extracted in 100 mL ethanol (50%), oxidized with $KMnO_4$ and H_2O_2, diluted and reacted with 20 mL Na_2SO_4 (40%), incubated in a water bath	UV-Vis Spectrophotometer, 440 nm	Bisht et al. (2023)
Phosphorus (P)	Diacid mixture (HNO_3:$HClO_4$, 3:1), Ammonium Molybdate-Vanadate, KH_2PO_4 standard	1 g powdered sample digested with diacid mixture, filtered, and volume adjusted to 100 mL. 10 mL aliquot mixed with 10 mL Ammonium Molybdate-Vanadate; final volume 50 mL	UV-Vis Spectrophotometer (2701, Systronics), 430 nm	AOAC (2005), Standard Methods
Potassium (K)	Standard potassium chloride (KCl) solution	Sample ashed and mineralized; analyzed using flame photometry or AAS	Flame photometer	AOAC (2005)
Calcium (Ca)	Lanthanum chloride solution ($LaCl_3$) as an ionization suppressant	Wet digestion followed by analysis using AAS with lanthanum to prevent phosphate interference	AAS, 422.7 nm (Varian AA 28-0Z)	AOAC (2005)
Manganese (Mn)	Nitric acid, Perchloric acid	Sample digested with nitric-perchloric acid mixture; direct AAS measurement	AAS, 279.5 nm (Varian AA 28-0Z)	AOAC (2005)

RESULTS AND DISCUSSION

Biocultural milieu and traditional food practices associated with *Sauromatum diversifolium*

The practices of collecting wild bioresources, ensuring their sustained availability, and using them to prepare a variety of traditional cuisines have evolved over the years of experimentation. Nagdoon is the only plant in the entire Himalayan region for which a festival is organized by the twenty-two villages of Rawain Valley, Uttarakhand, due to its socio-cultural, culinary, spiritual, and religious values. Nagdoon's cultural relevance is further reinforced by its ecological availability and the traditional resource-use ethics of the local people. The availability of *S. diversifolium* aligns closely with the seasonal cycles of the region, with harvests timed according to annual calendars based on ethno-biological events characteristic of the forest. Such practices are guided by locally embedded ethical codes for gathering wild food resources, emphasizing frugality and a restrained use that guarantees resource sustainability. This interlinking of availability, seasonal knowledge, and ethical harvesting reflects a finely balanced socio-ecological system in which cultural and biological rhythms reinforce one another. During the festival, the entire area resonates with the laughter and folk songs while the women from all the villages, dressed in traditional attire, leave for the forest in the morning with their baskets and spades to collect Nagdoon corm (Figure 3).

The wild corm of the species is washed thoroughly after collecting from the forest to eliminate its bitterness. Two traditional dishes, i.e., *Ghaan* and *Lol*, are generally prepared from the plant species. *Ghaan* is prepared by cooking the cleaned corm in hot water for 15 to 20 minutes, then processing it into a paste to form a dough. Small balls are then shaped from this dough. These are eaten with *ghee* (clarified butter from cow or buffalo milk) and honey, and are swallowed rather than chewed due to their slight bitterness. *Lol*, a *kheer* or pudding, is cooked in milk until golden, then mixed with salt, wheat flour, and fresh whey. After an additional 15-20 minutes of cooking, it is also served with *ghee* and honey. Sometimes, it is mixed with barley or millet flour and sun-dried for later use. The nutritional significance of *S. diversifolium* was established through a developed comparative framework that correlates its traditional culinary uses with key nutrient profiles. The ethnobotanical importance of commonly prepared dishes and their corresponding nutritional contributions is shown in Table 4.

These practices show how traditional communities' food systems hold valuable knowledge from long-standing norms and ways of living within local ecosystems. The aspects of nature and culture that define a food system, contributing to the overall health of individuals and communities, include physical health and are deeply linked to emotional, mental, and spiritual well-being, healing, immune system strengthening, and disease prevention. Therefore, there is a need to develop and promote traditional dishes and recipes based on this knowledge to support food, nutrition, and livelihood security. Cultural diversity extends beyond appearance, folklore, song, storytelling, and dance. Considering the ongoing sustainability of wild foods, their social, economic, and environmental foundations should be studied and promoted within the framework of food security and nutrition for future generations. Dishes made from wild bioresources, especially of Nagdoon, are highly nutritious, a fact that needs broader awareness to benefit the health of future generations. Indigenous culture and its productive systems heavily rely on spirituality and traditional belief systems. Bio-cultural diversity is as vital as biological diversity, as both are crucial for preserving the richness of life. In such systems, cultural pluralism enhances human creativity and fosters various forms of collective coexistence. In the case of Nagdoon, its use as food and medicine demonstrates how one plant can hold ecological and cultural importance, illustrating the interconnectedness of nature, tradition, and health.

There is almost very limited literature available on the existing ethnobotanical uses of *S. diversifolium* among different communities, and this is the first comprehensive study on the local uses of the species. However, the Araceae family includes several ethnobotanically significant species in India, long utilized by tribal and rural communities for food, medicine, and cultural practices. *Colocasia esculenta* (Taro), cultivated and consumed in regions like Odisha, Jharkhand, and the North-East, provides iron-rich corms and leaves that are eaten after cooking to neutralize oxalates and are also used traditionally to treat diarrhea and anemia (Sundriyal and Sundriyal 2001; Bora and Kumar 2003).

Table 4. Cultural relevance and associated nutritional benefits of *Sauromatum diversifolium* dishes

Traditional dish	Cultural role/Festival use	Method of preparation	Key nutritional content
Ghaan	Rawain: Consumed during rituals/festivals for immunity Byans: Eaten with butter tea; staple during lean months Darma: Also given to the sick/elderly for strength Niti: Served during family gatherings/festive days	Corm boiled, mashed into dough, formed into balls, eaten with ghee/honey	High in carbohydrates (76.6±6.6 g), Vitamin C (470±44 mg), potassium (850±132 mg), energy (350±34 kcal)
Lol	Rawain: Used during transhumance migration for satiety Byans: Winter food for energy; eaten during livestock migration Darma: Portable food for herders Niti: Dried into cakes for long-distance travel	Corm milk-pudded, cooked with wheat/barley flour, sometimes sun-dried for storage	Protein (7.1±1.3 g), Vitamin E (84±14 mg), calcium (213±9 mg), moderate lipid (1.9±0.2 g)

Amorphophallus paeoniifolius (Elephant Foot Yam) is widely used in southern India both as a nutritious tuber and in Ayurvedic preparations for piles, dyspepsia, and abdominal pain (Panda 2003; Rout and Panda 2018). *Alocasia macrorrhizos* and *A. indica* are employed in ethnomedicine to treat rheumatism, wounds, and skin infections, though the raw plant parts contain irritating calcium oxalate crystals requiring detoxification (Jain 1991). *Typhonium trilobatum*, known for its application in bronchitis, boils, and abscesses, is used in Bengal and Assam regions with caution due to its toxicity (Chopra and Nayar 1956; Hossain 2016). In the Himalayan states of Uttarakhand and Himachal Pradesh, *Arisaema* species are employed by tribal healers against snake bites, skin diseases, cuts, and burns etc. (Kumar 2017). *Sauromatum diversifolium,* commonly called Nagdoon, much like other Araceae plants such as *C. esculenta* (Taro) and *A. paeoniifolius* (Elephant foot yam) in South Asia, needs careful preparation to remove its unpleasant taste before consumption (Dhakal et al. 2020; Aditika et al. 2022). Nagdoon holds a unique and special place in the Rawain Valley, as is evident from the ethnobotanical survey conducted in the present study, and therefore can be added to the long list of traditionally utilized species of the Araceae family. The fusion of ritual, specialized cuisine, and community celebration also makes Nagdoon culturally valued and very special, as it is a key part of the community's identity and local traditions.

Indigenous knowledge and the traditional health care system

The local communities inhabited in Rawain, Darma. Byans and Niti Valleys possess a wealth of ethnobiological knowledge, reflecting their close connection to the natural environment (Negi et al. 2011b). Apart from the food and nutritional potential of the Nagdoon, the local communities primarily depend on this plant for medicinal purposes, such as curing stomach ailments and stomach worms, preventing arthritis, reducing intestinal inflammation and vomiting, etc. (Figure 2). The methods for using Nagdoon plants vary according to the presence of different compounds in the various parts of the plants and the nature of the disease being treated (Phondani et al. 2010). In most cases, a decoction of leaves, soft petioles, and corms is applied to the body to treat illnesses. These decoctions are usually prepared using a mortar and pestle to crush the plant parts. However, some decoctions are made by boiling plant parts in water, decanting the liquid, and then drinking it after it cools.

To determine the appropriate course of treatment, traditional herbal healers conduct a careful diagnosis and then prescribe herbal remedies. The dose of medicine varies depending on the patient's age, physical health, and underlying conditions. Preserving this traditional wisdom is important, as such knowledge systems have historically contributed to the development of pharmacological treatments for previously untreatable diseases (Da-Yong et al. 2019; Moreira et al. 2023).

Factors such as strong cultural faith, limited access to modern healthcare, and economic constraints in remote areas contribute to continued reliance on herbal medicine (Phondani et al. 2010). Nagdoon plant is also deeply associated with the transhumance communities who migrate during the winter and summer seasons with their flock of animals to higher and lower regions of the Himalaya. The corm is consumed during travel to higher altitudes where conventional food (wheat/rice/millets/pulses and vegetables) is scarce (Negi et al. 2011a). Anecdotal reports suggest that a small quantity of corm powder (5-8 g) mixed with honey is traditionally believed to suppress appetite for an entire day (Negi et al. 2011b). While these observations suggest potential bioactivity of the species, controlled pharmacological studies are needed to validate these claims. Therefore, caution is advised when interpreting these effects, and further empirical research is necessary to validate the medicinal properties and bioactive compounds of this species. Despite the biocultural and socio-economic significance of the species among the local people of the region, the domestication of this plant has not yet started. However, it is exciting to highlight that a team of scientists began a small field trial on the domestication of the species to explore its possibility for large-scale cultivation in the region. The team also initiated ex-situ experiments to examine the optimum environmental conditions required for the cultivation of the species (Figure 3). This attempt has motivated the villagers to domesticate, cultivate, and conserve the species, and it is also exploring opportunities to link the species with livelihood interventions and income generation.

Nutritional contents in the corm of *Sauromatum diversifolium*

The common denominator of underutilized plant species is a dearth of attention in research and conservation. However, the nutritional, economic, and biocultural potential of these wild species is not fully understood. Indigenous knowledge system proves that food and health care are strongly interrelated with local communities' socio-cultural, spiritual, and religious belief systems. Thus, indigenous communities have used many wild edibles as food and medicine for generations. A huge body of literature reveals that wild resources such as wild edible fruits and plants have outstanding healing and nutritional value and properties (Bhatt et al. 2017; Maikhuri et al. 2017, et al. 2021; Negi et al. 2018a, b) and therefore, can be promoted as a potential source of nutraceuticals for health improvement among rural populations. Edible parts of a few wild edibles have been investigated for various vitamins such as vitamin B-complex, tocopherols, β-carotene (precursor of retinol), and carotenoids (Bhatt et al. 2017; Kannan et al. 2025).

The chemical screening of Nagdoon indicated that the corms of the plant contain vitamins, manganese, and essential micronutrients (Table 5). The results of the vitamin analysis reveal vitamin B2 (0.1 mg/100g), vitamin C (470 mg/100g), and vitamin E (84 mg/100g) in the corms of the plant. Vitamin C is highly useful in curing oxidative damage in the body and is also applicable to treat many ailments. Similar to *S. diversifolium*, a few other species within the genus *Sauromatum*, such as *S. venosum* (Jadhao et al. 2024), *S. trilobatum* (Shahriar et al. 2015; Dina et al. 2022), *S. guttatum* (Said et al. 2019), and *S. Flagelliforme* (Maha et al. 2023), were reported to exhibit phytochemically potent medicinal properties. Despite being the second-largest genus in the Araceae family, comprising 82 species (Manudev and Nampy 2022), so far, only a very limited number of *Sauromatum* species have been explored for their phytochemical constituents. Among the various wild edible fruits found in the Himalaya, *Phyllanthus emblica*, *Viburnum mullaha*, and *Hippophae salicifolia* are the richest sources of vitamin C (Negi et al. 2011a; Maikhuri et al. 2012; Bhatt et al. 2017; Cheema et al. 2017). The value of vitamin C content in many wild edible fruits is equivalent to some of the cultivated vegetables (Gupta and Prakash 2008). For example, vitamin C content in *Hippophae rhamnoides* ranged between 100-300 mg/100 g, much higher than in cultivated fruits (Wang et al. 2022; Vdovina et al. 2025).

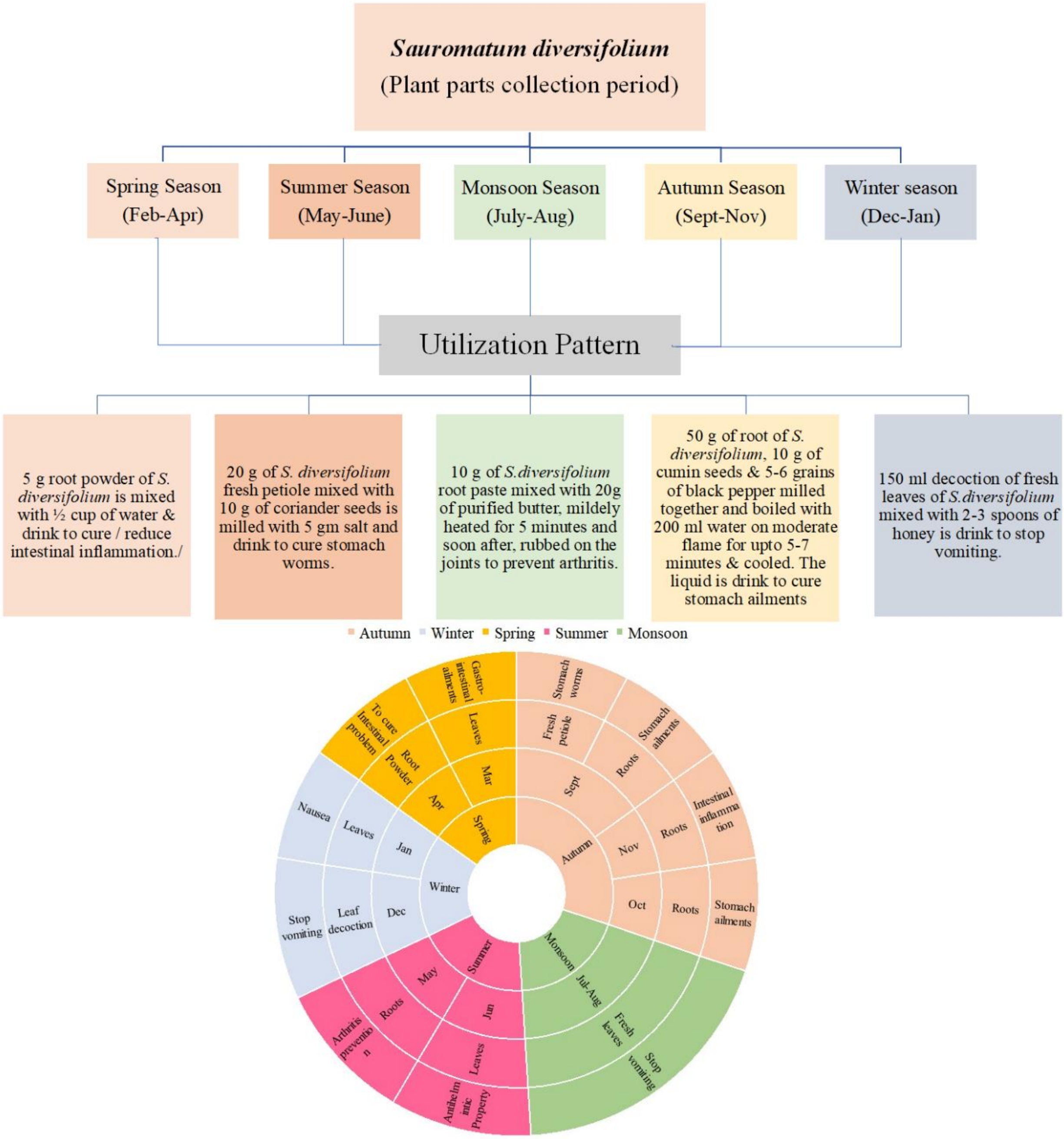

Figure 2. Seasonal collection, preparation, and medicinal use of *Sauromatum diversifolium* (Nagdoon) in traditional healthcare. The top panel illustrates seasonal collection of plant parts, the middle panel describes traditional formulations and their therapeutic applications, and the circular calendar diagram summarizes seasonal use of specific plant parts for treating various ailments. Different colors indicate corresponding seasons

Figure 3. Different stages of *Sauromatum diversifolium* (Nagdoon) collection from Lodistha, Kotgaon (2400 m asl), Mori, Uttarakashi in India. A: Mature plant in the wild, B: Flower, C-E: Collection of mature plants from wild, F-G: Mature corm of the plant, H-I: Processing corm for different traditional recipes, J-K: Collection for *ex-situ* conservation experiments, L: In vitro propagation experiments

The corm of Nagdoon is a good source of minerals like phosphorus (47.5 mg/100g), potassium (850.1 mg/100g), calcium (213 mg/100g), and manganese (1.2 mg/100g); these minerals are obligatory for the growth of bones and muscles of human beings. Even the quantity of these minerals is found to be higher in the Nagdoon as compared to other common edible tubers such as *Dioscorea deltoidea*, *Amorphophallus companulatus*, and *C. esculenta* (Wills et al. 1983; Subhash et al. 2012; Basu et al. 2014). However, the quantity of few minerals such as copper, iron and manganese is found higher in *D. deltoidea*.

Besides, on a dry-weight basis, the corms of the plant provide 350 kcal per 100 g and are considered a good source of energy. The micro and macro mineral analysis established that Nagdoon corms can be a potential source of nutraceuticals (Table 5). Moreover, the recipes made of the corm of this plant are quite rich in protein, carbohydrates, and other essential nutrients.

Table 5. Comparative analysis of nutraceutical contents (mean±SD) in bulbs of *Sauromatum diversifolium* in Central Himalayan communities, India and others

Parameter	Nutraceuticals	Quantity				F value
		Sauromatum diversifolium	***Dioscorea deltoidea***	***Amorphophalus companulatus***	***Colocasia esculenta***	
Vitamin (mg/100g)	Vitamin C	470.0±44.14^{a}	87.39±11.44^{b}	76.65±10.50^{b}	14.30±2.21^{c}	236.09***
	Vitamin B2	0.10±0.01^{a}	0.03±0.01^{b}	0.03±0.00^{b}	0.03±0.00^{b}	30.59**
	Vitamin E	84.00±14.76^{a}	0.35±0.05^{b}	900±15.54^{c}	2.38±0.38^{b}	448.32***
Mineral (mg/100g)	Phosphorous	47.50±3.08^{a}	0.43±0.02^{b}	0.45±0.07^{b}	0.58±0.07^{b}	694.27***
	Potassium	850.10±132.35^{a}	0.80±0.20^{b}	1208±5.66^{c}	300.00±55.05^{d}	125.43***
	Calcium	213.30±9.05^{a}	0.78±0.13^{b}	19.52±2.66^{c}	44.00±6.56^{d}	897.82***
	Magnesium	85.00±3.78^{a}	0.92±0.21^{b}	81.98±6.54^{a}	31.00±4.58^{c}	190.97***
	Copper	0.30±0.03^{a}	2.14±0.13^{b}	0.33±0.09^{b}	0.17±0.01^{a}	465.66***
	Iron	13.10±1.35^{a}	32.25±1.07^{b}	1.79±0.57^{c}	1.71±0.29^{c}	798.68***
	Zinc	3.10±0.28^{a}	1.24±0.05^{b}	2.06±0.48^{c}	1.10±0.18^{b}	79.76**
	Manganese	1.20±0.23^{a}	3.92±2.19^{b}	0.39±0.25^{a}	0.38±0.01^{a}	6.92*
Nutritional Contents (%/wt)	Carbohydrate	76.60±6.60^{a}	27.51±0.10^{b}	25.54±6.52^{b}	26.80±3.70^{b}	98.43**
	Protein	7.10±1.26^{a}	2.13±0.08^{b}	9.81±2.50^{c}	1.20±0.62^{b}	57.99**
	Lipid	1.90±0.16^{a}	0.60±0.12^{b}	1.41±0.30^{c}	0.30±0.10^{b}	62.47**
	Total Ash	3.00±0.61^{a}	3.34±0.15^{a}	4.83±0.54^{b}	1.00±0.20^{c}	53.92**
	Moisture	9.50±0.57^{a}	58.92±0.10^{b}	66.08±1.98^{b}	66.80±7.08^{b}	53.32**
	Crude fibre	1.90±0.35^{a}	7.50±0.14^{b}	5.70±1.20^{c}	4.30±1.30^{d}	33.19**
Kcals/100g	Energy value	350.00±34.22^{a}	118.00±11.13^{b}	335.00±40.92^{a}	509.00±38.43^{c}	69.65**

Note: *Sauromatum diversifolium* (present study), *Dioscorea* species (Shajeela et al. 2011; Subhash et al. 2012; Chandrasekara and Kumar 2016; Senthilkumar 2019), *Amorphophalus companulatus* (Basu et al. 2014), and *Colocasia esculenta* (Wills et al. 1983; Hedges and Lister 2006; Kothiyal et al. 2012; Shah et al. 2022). One-way ANOVA followed by Duncan's Multiple Range Test (DMRT) was used to compare mean values among species. Similar superscript letters within a row indicate non-significant differences ($p>0.05$). *$p<0.05$, **$p<0.01$, ***$p<0.001$

Globally, wild edible foods supplement a large share of carbohydrates, micronutrients, and vitamins (Cao et al. 2020; Ray et al. 2020). For example, a study by Bayang et al. (2021) reported that in the far North regions of Cameroon, 23 wild edible species rich in lutein, lycopene, vitamin C, and β-carotene, like bioactive nutrients, are consumed, which protect local communities from various diseases. In another study, Powell et al. (2013) revealed that 31% of vitamin A and 19% of iron in the diet of local communities of the East Usambara Mountains of Tanzania were obtained from wild food sources. The food and medicinal uses of wild edibles and their contribution to the local diet were also reported from various regions of the Indian Himalaya in previous studies (Negi et al. 2018a; Thakur et al. 2020; Samkaria and Kumari 2025). Fruits of *Zanthoxylum armatum*, *P. emblica*, *Terminalia chebula*, *Aegle marmelos*, *H. salicifolia*, *Berberis asiatica*, and flowers of *R. arboreum* are important species used in food and the traditional system of healthcare (Negi et al. 2011a; Aryal et al. 2018; Singh et al. 2022). Generally, consuming fruits and green leafy vegetables of wild origin provides a nutrient-rich diet that lowers the risk of chronic diseases and maintains good health.

Despite the immense nutritional value and cultural significance of wild edibles, they are increasingly at risk. The viability of underutilized wild edibles like *S. diversifolium* is threatened by a combination of cultural, environmental, and socio-economic pressures, which also endanger the intergenerational transfer of knowledge associated with them. Younger generations are becoming increasingly disconnected from traditional ecological knowledge due to evolving socio-economic priorities, reduced practical experience in the field, and a perception of wild foods as inferior (Olesen et al. 2024). Climate change worsens this issue by altering species distributions and phenology, reducing the reliability of traditional harvesting practices (Powell et al. 2023). Additionally, policy frameworks often overlook wild edibles, providing minimal support for their conservation, domestication, or integration into food systems. Market forces also discourage their cultivation, as formal agricultural markets tend to favor high-yield crops and often exclude underutilized species from support programs, value chains, or food safety regulations. Biological challenges further hinder cultivation efforts; many wild species grow slowly, have inconsistent fruiting patterns, or require specific ecological conditions that are difficult to replicate. These combined challenges (the erosion of knowledge, environmental shifts, institutional neglect, and cultivation hurdles) collectively form a significant obstacle to conserving and domesticating nutritionally valuable wild edibles like *S. diversifolium*. Conservation policies often struggle to prioritize both biological and cultural aspects, and few initiatives successfully integrate these dimensions. For indigenous and traditional food systems, health goes beyond the absence of disease; it encompasses harmony and balance within the environment and community. This holistic view emphasizes the need for conservation strategies that address both cultural and ecological sustainability, ensuring the preservation of biocultural resources like *S. diversifolium* in both their physical form and cultural importance.

The present study demonstrates that the corms of Nagdoon, a wild plant with high cultural value in the Central Himalayas, are a rich source of proteins, carbohydrates, vitamins (B_2, C and E) and essential minerals (P, K, Ca, Mn etc.), and also possess significant antioxidant potential and therapeutic effects. Based on these findings, a strategic roadmap is essential to translate this potential into tangible and sustainable outcomes. The immediate scientific priority is to develop appropriate propagation techniques and conduct comprehensive ecological assessments of *S. diversifolium*, including its distribution, resource availability, phenology, and sustainable harvesting methods. This foundational research will enable its conservation and pave the way for promoting its cultivation, which can directly enhance local livelihoods and nutritional security in remote Himalayan regions. Furthermore, its rich composition makes it an ideal candidate for developing high-value products like energy bars and health supplements by conducting proper pharmacological research and understanding contraindications. Ultimately, the successful integration of Nagdoon and other native plants into regional bioresource management policy-making is also vital. Such an approach, which addresses both cultural and biological diversity, is fundamental to conserving the ecological balance while strengthening the health and livelihoods of populations across the Indian Himalayan region.

The Central Himalayan Region is considered a veritable treasure trove of bioresources. The region also contributes a large number of crop plants and wild relatives of several crop and domesticated animals. With a whole range of traditional/tribal/ethnic communities, the human dimension of bioresource utilization and management is enormous, indeed. For centuries, the under-utilized crop varieties have played a vital role in the subsistence economy of the traditional communities living in the Himalaya. However, there is strong evidence that the life support systems on which our economies depend are being overloaded. Unless a shift is made towards sustainable development, we might face severe or irreversible damage to our environment and bioresources. Besides the profound ethical and aesthetic implications, it is clear that the loss of bioresources has serious economic and social costs. The genes, species, ecosystems, and human traditional knowledge that are being lost represent a living library of options available for preventing and/ or adapting to local and global change.

The present study demonstrates that the corms of Nagdoon, a wild plant with high cultural value in the Central Himalayas, are a rich source of proteins, carbohydrates, vitamins (B_2, C, and E), and essential minerals (P, K, Ca, Mn etc.), and also possess significant antioxidant potential and therapeutic effects. Apart from the nutritional potential, the local communities rely on these resources for social, cultural, and religious functions. The socio-cultural belief systems have often played a significant role in controlling over-exploitation, leading to the conservation of this plant. The cultural practices and regulations indicate the conservation and management ethics. Through the application of traditional knowledge and customs, unique and important under-utilized bioresources of the region have often been protected and maintained by indigenous/traditional communities. Based on these findings, a strategic roadmap is essential to translate this potential into tangible and sustainable outcomes. The immediate scientific priority is to develop appropriate propagation techniques and conduct comprehensive ecological assessments of *S. diversifolium*, including its distribution, resource availability, phenology, and sustainable harvesting methods. This foundational research will enable its conservation and pave the way for promoting its cultivation, which can directly enhance local livelihoods and nutritional security in remote Himalayan regions. Furthermore, its rich food and nutritional composition make it an ideal candidate for developing high-value products like energy bars and health supplements by conducting proper pharmacological research and understanding contraindications. Ultimately, the successful integration of Nagdoon and other native plants into regional bioresource management policy-making is also vital. Such an approach, which addresses both cultural and biological diversity, is fundamental to conserving the ecological balance while strengthening the health and livelihoods of populations across the region. Therefore, linking cultural diversity with bioresources as the basis for sustainable development, leading towards a bio-economy and sustainable livelihood, is to be seen as the way out to ensure the well-being of the marginalized and neglected sections of humans including those who often are referred to as indigenous, tribal, ethnic or traditional communities inhabited in the Central Himalayan Region.

ACKNOWLEDGEMENTS

The authors thank Prof. Annapurna Nautiyal (Former Vice Chancellor) of HNB Garhwal University, India, for her encouragement and support. We also extend our sincere thanks to Dr. Suman Chandra and Dr. John Adams of the School of Pharmacy, the University of Mississippi, USA, for their thorough review of the manuscript, addressing both technical and linguistic aspects. Finally, we deeply appreciate the generous cooperation and support provided by the local community in the study area throughout this research. This manuscript is dedicated to the memory of the late Dr. Lakhpat Singh Rawat, in recognition of his valuable contributions and lasting inspiration.

REFERENCES

Aditika, Kapoor B, Singh S, Kumar P. 2022. Taro (*Colocasia esculenta*): Zero wastage orphan food crop for food and nutritional security. South Afr J Bot 145: 157-169. DOI: 10.1016/j.sajb.2021.08.014.

AOAC. 2005. Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists, Washington DC, Method 935.14 and 992.24.

Aryal KP, Poudel S, Chaudhary RP, Chettri N, Chaudhary P, Ning W, Kotru R. 2018. Diversity and use of wild and non-cultivated edible plants in the Western Himalaya. J Ethnobiol Ethnomed 14 (1): 1-18. DOI: 10.1186/s13002-018-0211-1.

Aswani MA, Khyade M, Kasote DM, Jagtap SD, Vyavahare S, Kunchiraman BN, Mantri N, Nawaz MA, Lee JHJ, Ranjekar P. 2024. Wild edible plants from western peninsular and Deccan Plateau regions of India: valued nutritional and functional foods. Discov Plants 1 (1): 62. DOI: 10.1007/s44372-024-00060-9.

Basu S, Das M, Sen A, Choudhury Rr, Datta G. 2014. Analysis of complete nutritional profile of *Amorphophallus campanulatus* tuber cultivated in Howrah district of West Bengal, India. Asian J Pharm Clin Res 7 (3): 26-29. DOI: 10.1016/S1995-7645(14)60285-6.

Bayang JP, Laya A, Kolla MC, Koubala BB. 2021. Variation of physical properties, nutritional value and bioactive nutrients in dry and fresh wild edible fruits of twenty-three species from Far North region of Cameroon. J Agric Food Res 4: 100146. DOI: 10.1016/j.jafr.2021.100146.

Bhatt ID, Rawat S, Badhani A, Rawal RS. 2016. Nutraceutical potential of selected wild edible fruits of the Indian Himalayan region. Food Chem 215: 84-91. DOI: 10.1016/j.foodchem.2016.07.143.

Bisht A, Bahukhandi A, Singh B, Kewlani P, Pande V, Rawat S, Bhatt ID. 2023. Morphological, nutritional, chemical and antioxidant potential of *Mahonia jaunsarensis* Ahrendt fruit: A narrow endemic wild edible species of Western Himalaya. Intl J Fruit Sci 23 (1): 70-86. DOI: 10.1080/15538362.2023.2205533.

Bohra A, Kilian B, Sivasankar S, Caccamo M, Mba C, McCouch SR, Varshney RK. 2022. Reap the crop wild relatives for breeding future crops. Trends Biotechnol 40 (4): 412-431. DOI: 10.1016/j.tibtech.2021.08.009.

Bora PJ, Kumar Y. 2003. Floristic diversity of Assam: Study of ethnobotany. Indian J Tradi Knowl 2 (1): 27-39.

Cao Y, Li R, Zhou S, Song L, Quan R, Hu H. 2020. Ethnobotanical study on wild edible plants used by three trans-boundary ethnic groups in Jiangcheng County, Pu'er, Southwest China. J Ethnobiol Ethnomed 16 (1): 66. DOI: 10.1186/s13002-020-00420-1.

Chandrasekara A, Kumar TJ. 2016. Roots and tuber crops as functional foods: A review on phytochemical constituents and their potential health benefits. Intl J Food Sci 2016 (3): 3631647. DOI: 10.1155/2016/3631647.

Chauhan PP. 2022. Ethnobotanical studies of wild edible plants used by ethnic people in Pabbar Valley, District Shimla, Himachal Pradesh. Worldwide Intl J Multidiscip Res 8 (4): 5-10.

Cheema J, Yadav K, Sharma N, Saini I, Aggarwal A. 2017. Nutritional quality characteristics of different wild and underutilized fruits of Terai region, Uttarakhand (India). Intl J Fruit Sci 17 (1): 72-81. DOI: 10.1080/15538362.2016.1160271.

Chopra RN, Nayar SL. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.

Da-Yong L, Wu HY, Shen Y. 2019. Medical treatments for incurable diseases, palliative therapy. Hos Pal Med Intl J 3 (5): 175-176. DOI: 10.15406/hpmij.2019.03.00174.

Dhakal L, Aryal B, Joshi G, Pant D. 2020. Nutritional potential of selected species of *Arisaema* Mart. from Nepal. Biodiversitas 21 (12): 5703-5709. DOI: 10.13057/biodiv/d211229.

Dina SS, Das S, Addow AM, Kawser M. 2022. Phytochemical screening and in vitro antibacterial activity of *Typhonium trilobatum* methanolic extract. J Dhaka Intl Univ 12 (1): 47-56. DOI: 10.62673/DIUJLHRV12N2A5.

Gupta S, Prakash J. 2008. Studies on Indian green leafy vegetables for their antioxidant activity. Plant Foods Hum Nutr 64 (1): 39-45. DOI: 10.1007/s11130-008-0096-6.

Hedges LJ, Lister CE. 2006. Health Attributes of Roots and Tubers. New Zealand Institute for Crop and Food Research Limited, New Zealand.

Hossain MB. 2016. Potential Analgesic and Cytotoxic Activities of the Plant *Typhonium trilobatum*. [Dissertation]. BRAC University, Bangladesh.

Jadhao AS, Shaikh FT, Sirsat DR, Bathe PN, Agrawal NK. 2024. Phytochemical screening of *Sauromatum venosum* (Ait.) Schott (Araceae). In: Farah S, Azharuddin QS (eds). Multi-Disciplinary Research. Lambert Academic Publishing, United Kingdom.

Jain SK. 1991. Dictionary of Indian Folk Medicine and Ethnobotany: A Reference Manual of Man-Plant Relationships, Ethnic Groups and Ethnobotanists in India. Deep Publications, Delhi.

Kannan G, Paul BM, Thangaraj P. 2025. Wild edible fruits from the Western Ghats: A rich source of bioactive compounds with health-promoting effects: A review. In: Thangaraj P (eds). Pomotherapeutic Insights on Wild Edible Fruits. Springer, Singapore. DOI: 10.1007/978-981-96-0543-9.

Kapoor R, Sabharwal M, Ghosh-Jerath S. 2022. Indigenous foods of India: A comprehensive narrative review of nutritive values, antinutrient content and mineral bioavailability of traditional foods consumed by Indigenous communities of India. Front Sustain Food Syst 6: 696228. DOI: 10.3389/fsufs.2022.696228.

Kothiyal SC, Saklani S, Singh J. 2012. Phytochemical screening of Garhwal Himalaya wild edible tuber *Colocasia esculenta*. Intl Res J Pharm 3 (3): 181-186.

Kumar A. 2017. Ethno-botanical diversity and conservation status of medicinal flora at high terrains of Garhwal (Uttarakhand) Himalaya, India: A case study in context to multifarious tourism growth and peri-urban encroachments. Intl J Agric Biol Eng 11: 320-325.

Maha LH, Fidrianny I, Satrialdi, Suciati T. 2023. An updated review of *Typhonium flagelliforme*: Phytochemical compound, pharmacological activities and the use of vitexin and isovitexin as flavonoid compound in cosmetics development. Pharmacia 70 (3): 673-680. DOI: 10.3897/pharmacia.70.e106092.

Maikhuri RK, Dhyani D, Tyagi Y, Singh D, Negi VS, Rawat LS. 2012. Determination of nutritional and energy value of *Viburnum mullaha* Buch.-Ham. Ex D. Don (Indian cranberry). Ecol Food Nutr 51 (3): 218-226. DOI: 10.1080/03670244.2012.635566.

Maikhuri RK, Negi VS, Rawat LS, Pharswan DS. 2017. Bioprospecting of medicinal plants in Nanda Devi Biosphere Reserve: Linking conservation with livelihood. Curr Sci 112 (3): 571-577. DOI: 10.18520/cs/v113/i04/571-577.

Maikhuri RK, Parshwan DS, Kewlani P, Negi VS, Rawat S, Rawat LS. 2021. Nutritional composition of seed kernel and oil of wild edible plant species from Western Himalaya, India. Intl J Fruit Sci 21: 609-618. DOI: 10.1080/15538362.2021.1907009.

Maikhuri RK, Rao KS, Saxena KG. 2004. Bioprospecting of wild edibles for rural development in the Central Himalayan mountains of India. Mt Res Dev 24 (2): 110-113. DOI: 10.1659/0276-4741(2004)024[0110:BOWEFR]2.0.CO;2.

Manudev KM, Nampy S. 2022. Taxonomic identity of *Typhonium roxburghii* var. *longispathum* (Araceae) and notes on the extended distribution of *T. bulbiferum*. Rheeda 32 (1): 55-58. DOI: 10.22244/rheedea.2021.32.01.05.

Moreira J, Machado M, Dias-Teixeira M, Ferraz R, Delerue-Matos C, Grosso C. 2023. The neuroprotective effect of traditional Chinese medicinal plants-A critical review. Acta Pharm Sin B 13 (8): 3208-3237. DOI: 10.1016/j.apsb.2023.06.009.

Nautiyal AP, Nautiyal S, Chari S. 2023. One Himalaya One Policy, India's G20 Presidency and Sustainable development in the Himalaya: Opportunities, Strategies and Policy Recommendation. Shiva Offset Press, Dehradun, India.

Negi VS, Kewlani P, Pathak R, Bhatt D, Bhatt ID, Rawal RS, Sundriyal RC, Nandi SK. 2018a. Criteria and indicators for promoting cultivation and conservation of medicinal and aromatic plants in Western Himalaya, India. Ecol Indic 93: 434-446. DOI: 10.1016/j.ecolind.2018.03.032.

Negi VS, Maikhuri RK, Rawat LS. 2011a. Non-timber forest products (NTFPs): A viable option for biodiversity conservation and livelihood enhancement in Central Himalaya. Biodivers Conserv 20: 545-559. DOI: 10.1007/s10531-010-9966-y.

Negi VS, Maikhuri RK, Vashishtha DP. 2011b. Traditional healthcare practices among the villages of Rawain valley, Uttarkashi, Uttarakhand, India. Indian J Tradit Knowl 10 (3): 533-537.

Negi VS, Pathak R, Sekar KC, Rawal RS, Bhatt ID, Nandi SK, Dhyani PP. 2018b. Traditional knowledge and biodiversity conservation: A case study from Byans Valley in Kailash Sacred Landscape. India J Environ Plan Manag 61 (10): 1722-1743. DOI: 10.1080/09640568.2017.1371006.

Oguazu CE, Adimora KH, Anajekwu BA, Dike CC, Ikimi CG. 2021. Evaluation of the vitamins and possible nutrient composition of local and improved species of guava flesh (*Psidium guajava*). Intl J Biochem Res Rev 30 (7): 6-14. DOI: 10.9734/ijbcrr/2021/v30i730277.

Olesen RS, Powell B, Kilawe CJ, Rasmussen LV. 2024. Food environment change on wild food consumption in rural Tanzania. Food Secur 16: 1203-1221. DOI: 10.1007/s12571-024-01469-6.

Panda H. 2003. Herbal Foods and Its Medicinal Values. NIIR Project Consultancy Services, Delhi.

Phondani PC, Maikhuri RK, Rawat LS, Farooquee NA, Kala CP, Vishvakarma SR, Saxena KG. 2010. Ethnobotanical uses of plants among the Bhotiya tribal communities of Niti Valley in Central Himalaya, India. Ethnobot Res Appl 8: 233-244. DOI: 10.17348/era.8.0.233-244.

Powell B, Bhatt ID, Mucioki M, Rana S, Rawat S, Kerr RB. 2023. The need to include wild foods in climate change adaptation strategies.

Curr Opin Environ Sustain 63: 101302. DOI: 10.1016/j.cosust.2023.101302.

Powell B, Mandu P, Kuhnlein HV, Johns T. 2013. Wild foods from farm and forest in the East Usambara Mountains, Tanzania. Ecol Food Nutr 52: 451-478. DOI: 10.1080/03670244.2013.768122.

Rasul G, Saboor A, Tiwari PC, Hussain A, Ghosh N, Chettri GB. 2019. Food and nutrition security in the Hindu Kush Himalaya: Unique challenges and niche opportunities. In: Wester P, Mishra A, Mukherji A, Shrestha A (eds). The Hindu Kush Himalaya Assessment. Springer, Cham. DOI: 10.1007/978-3-319-92288-1_9.

Rawat S, Acharya P, Bhutia PO, Pandey A, Kumar D, Joshi R, Bhatt ID. 2023. Changes in nutritional, physicochemical, phytochemical composition and antioxidant potential of *Mahonia nepalensis* fruits during ripening. Intl J Food Prop 26 (1): 1062-1078. DOI: 10.1080/10942912.2023.2200480.

Ray A, Ray R, Sreevidya EA. 2020. How many wild edible plants do we eat-Their diversity, use, and implications for sustainable food system: An exploratory analysis in India. Front Sustain Food Syst 4: 56. DOI: 10.3389/fsufs.2020.00056.

Rout PG, Panda T. 2018. Ethnobotanical Survey of Medicinal Plants Used for the Treatment of Diarrhoea and Dysentery by the Tribals of Similipal Forest, Mayurbhanj, Odisha, India. SSRN, United States.

Sahoo UK, Lalremruata J, Lalramnghinglova H, Lalremruati JH, Lalliankhuma C. 2010. Livelihood generation through non-timber forest products by rural poor in and around Dampa Tiger Reserve in Mizoram. J Non-Timber For Prod 17 (2): 147-161. DOI: 10.54207/bsmps2000-2010-4UV335.

Said A, Wahid F, Bashir K, Rasheed HM, Khan T, Hussain Z, Siraj S. 2019. *Sauromatum guttatum* extract promotes wound healing and tissue regeneration in a burn mouse model via up-regulation of growth factors. Pharm Biol 57 (1): 736-743. DOI: 10.1080/13880209.2019.1676266.

Samkaria S, Kumari P. 2025. Wild edible flowers of Indian Himalayan region, their traditional uses and potential health benefits: A way forward for food and nutritional security. Plant Foods Hum Nutr 80 (1): 60. DOI: 10.1007/s11130-025-01302-1.

Senthilkumar M. 2019. Evaluation of nutritional and anti-nutritional components of wild yams (*Dioscorea* spp.). Intl J Biol Res 4 (3): 62-67.

Shah YA, Saeed F, Afzaal M, Waris N, Ahmad S, Shoukat N, Ateeq H. 2022. Industrial applications of taro (*Colocasia esculenta*) as a novel food ingredient: A review. J Food Proc Preserv 46 (11): e16951. DOI: 10.1111/jfpp.16951.

Shahriar M, Tithi NA, Akhter R, Kamal S, Narjish SN, Bhuiyan MA. 2015. Phytochemical and pharmacological investigation of the crude extract of *Typhonium trilobatum* (L.) Schott. World J Pharm Res 4 (2): 167-188.

Shajeela PS, Mohan VR, Jesudas LL, Soris PT. 2011. Nutritional and antinutritional evaluation of wild yam (*Dioscorea* spp.). Trop Subtrop Agroecosyst 14 (2): 723-730.

Singh RK, Kumar A, Singh A, Singhal P. 2020. Evidence that cultural food practices of Adi women in Arunachal Pradesh, India, improve social-ecological resilience: Insights for sustainable development. Ecol Proc 9: 29. DOI: 10.1186/s13717-020-00232-x.

Singh S, Chatterjee S. 2022. Value chain analysis of *Rhododendron arboreum* squash 'buransh' as a Non-Timber Forest Product (NTFP) in Western Himalayas: Case study of Chamoli district, Uttarakhand in India. Trees For People 7: 100200. DOI: 10.1016/j.tfp.2022.100200.

Subhash C, Saklani S, Dimari M. 2012. Evaluation of Garhwal Himalaya wild edible tuber *Dioscorea deltoidea*. Intl Res J Pharm 3: 152-156.

Sundriyal M, Sundriyal RC. 2001. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. Econ Bot 58 (2): 286-299. DOI: 10.1663/0013-0001(2004)058[0286:WEPOTS]2.0.CO;2.

Thakur A, Singh S, Puri S. 2020. Exploration of wild edible plants used as food by Gaddis-a tribal community of the Western Himalaya. Sci World J 2020: 6280153. DOI: 10.1155/2020/6280153.

Vdovina T, Lagus O, Vinokurov A, Aimenova Z, Sumbembayev A. 2025. Assessment of biochemical composition of fruits of *Hippophae rhamnoides* (Elaeagnaceae juss.), *Viburnum opulus* (Viburnaceae raf.) and *Lonicera caerulea* subsp. altaica (Caprifoliaceae juss.). Metabolites 15 (4): 256. DOI: 10.3390/metabo15040256.

Wang Z, Zhao F, Wei P, Chai X, Hou G, Meng Q. 2022. Phytochemistry, health benefits, and food applications of Sea buckthorn (*Hippophae rhamnoides* L.): A comprehensive review. Front Nutr 9: 1036295. DOI: 10.3389/fnut.2022.1036295.

Wills RB, Lim JS, Greenfield H, Bayliss-Smith T. 1983. Nutrient composition of taro (*Colocasia esculenta*) cultivars from the Papua New Guinea Highlands. J Sci Food Agric 34 (10): 1137-1142. DOI: 10.1002/jsfa.2740341015.